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# Nursing satisfaction in county hospitals at the closing of health system reform round

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## Abstract

Nurses are key actors in the healthcare sector and their satisfaction is essential for patient care delivery. Assessing their professional satisfaction at the closing of a national health system reform round is therefore vital. This cross-sectional study estimated the relative importance of professional satisfaction components, evaluated the overall level of job satisfaction among nurses, and examined how the components of their perceived satisfaction vary with demographic variables. A total of 276 registered nurses from three (3) county hospitals across Jiangsu Province in China were surveyed using the Index of Work Satisfaction scale. Multiple regression models represented as structural equation models were used to estimate the effects of demographic variables on each dimension of job satisfaction. Nurses appeared to be more satisfied with their pay and professional status but dissatisfied with their task requirements and interactions. Statistically significant correlations were also found between nurses' age and years of experience and some job satisfaction components. At the end of this health system reform round, the overall level of satisfaction among nurses is still low, showing a slim contribution to the new transformations. The findings and recommendations may provide clues to help nursing managers implement informed strategies and address critical issues to increase nurses' satisfaction.

**Index Terms-** County hospitals, Health System, Index of Work Satisfaction, Multiple Regression, Registered Nurses.

## I. INTRODUCTION

Job satisfaction expresses how happy a worker is, content with, or enjoys his or her job (Jun & Jo, 2016). It has also been defined as the degree of positive affect towards a job or its components or as a pleasurable and positive emotional state resulting from the affection and the appreciation that someone has about his or her job experience (Nehrir, Ebadi, Tofighi, Karimi, & Honarvar, 2010; Zangaro & Soeken, 2007). P. L. Stamps (1997) understood it as the degree to which workers appreciate their jobs and have a positive or negative attitude towards them. Nursing satisfaction has been discussed a lot in the literature, but as long as the nursing profession exists, taking an interest in their well-being remains important (Chien & Yick, 2016). Focus on nursing satisfaction traces its way long back in the '40s when Nahm, conducted the first significant study on job

satisfaction among nurses at the University of Minnesota (Andriotti et al., 2017). Subsequent researches have shown that many different factors drive nurses' job satisfaction and the common ones include workload, leadership, and support (Lundmark, Nordin, Yepes-Baldó, Romeo, & Westerberg, 2020), environmental and demographic characteristics (K. Liu et al., 2012; Tao, Guo, Liu, & Li, 2018), communication or interaction, autonomy (Itzhaki, Ea, Ehrenfeld, & Fitzpatrick, 2013), promotion, educational training and improvement, internal policies, insurance and safety, schedule flexibility, salary and fringe (George & Zakkariya, 2015; Linh, Jin, Kiong, & Fah, 2016; L.-F. Zhang et al., 2014). The role that nurses play in any given society is no longer to be demonstrated, as they provide services and help patients with their health issues around the clock (Thorne, 2020; Tourangeau, Patterson, Saari, Thomson, & Cranley, 2017). They must then be in a perfect state of mind, without worries and anxieties to avoid costly or irreversible mistakes (Riklikien, Krušinskait, Gatautis, & Bagdonait, 2015). It has been demonstrated that nurses' commitment, service quality, and retention are related to their job satisfaction, for when they are satisfied, they have that inner drive which prompts them to perform well and achieve personal and collective goals (Ijadi Maghsoodi, Abouhamzeh, Khalilzadeh, & Zavadskas, 2018; Y. Wang, Chang, Fu, & Wang, 2012; A. Zhang, Tao, Ellenbecker, & Liu, 2013). Contrariwise, nurses whose needs are not met at the workplace tend to be low productive and could experience some level of work stress and burnout that can impoverish their health, cause them to make a poor clinical judgment, endanger their lives, and those of the patients under their care (H. Wang et al., 2020). Likewise, nursing professional dissatisfaction is generally associated with a high turnover rate leading to workers shortage in medical organizations (Riklikien et al., 2015; Yıldız, Ayhan, & Erdoğan, 2009; Yun, Jie, & Anli, 2010).

However, many studies have focused on examining the extrinsic (environmental, physical, and social) factors that can influence job satisfaction (Hayes, Douglas, & Bonner, 2015; L.-F. Zhang et al., 2014). Still, it has been argued that workers can experience different levels of job satisfaction while having the same job and working in the same environment (Spector, 2006). Some authors have attributed that difference to intrinsic factors such as personal characteristics (Curtis, 2008). Besides education, age, and years of experience have been generally associated with job satisfaction. Results from some studies on the relationship between age, years of experience, and nurses' job

satisfaction showed a proportional relationship (Curtis, 2008; Eberhardt, Pooyan, & Moser, 2012; Hayes et al., 2015; Hu & Liu, 2004; Qu & Wang, 2015; Ramoo, Abdullah, & Piaw, 2013), while others showed a disproportional (Agho, 1993; Baggs & Ryan, 1990) or no (Oermann, 1995) correlation between nurses' job satisfaction, age, and years of experience.

In the context of China, the health system has been repeatedly criticized for its imperfections and inequalities (La Forgia & Yip, 2017; Yun et al., 2010; T. Zhang, Xu, Ren, Sun, & Liu, 2017). Nurses who constitute the largest hospital workforce complained of being marginalized for the benefit of doctors. For hospitals (which are more than 60% self-funded), physicians have been considered as a source of gain through a shot up of consultations, treatments, and medications prices (La Forgia & Yip, 2017; Milcent, 2016). With the high rate of nursing shortage due to the increasing turnover Chinese hospitals are facing now, hospital managers tend to recruit more contract-based nurses. It has been reported that contract-based nurses already represent more than 54% of nurses in Chinese hospitals (Shang et al., 2014). For instance, 59% of the participants in this study had a contract-based employment status. Moreover, they don't enjoy the same benefits (permanent contract, fixed income, health insurance, housing, and retiring allowances) as formally employed nurses and their pay and job-related benefits can vary between employers (Shang et al., 2014; Yun et al., 2010). This is a considerable threat to their retention since Chinese nurses are more and more highly educated by holding a bachelor's degree or above, which is an asset for better work positions. In our cohort, for example, 75% of nurses are university graduates. On the other side, patients also complained of the fact that healthcare services were not easily accessible and affordable (Meng, Mills, Wang, & Han, 2019; Milcent, 2016; Yau et al., 2012; Yun et al., 2010). It was therefore necessary to find a balance between those who provide health care and those who receive care. To remedy this, the Chinese central government instructed reforms to the health system. After the first one (1996-2007) had failed, especially with the outbreak of severe acute respiratory syndrome (SARS) in 2003 which still exposed its limits, a second-round was launched in 2009. The primary purpose of this second reform round was to make the healthcare services equitable and more accessible to all and to provide people with better financial health protection by 2020 (Meng et al., 2019). The reform also advocates the old market-centered care system to be progressively replaced by a patient-centered care system, where more efforts are orientated towards providing high-quality care services (A. Zhang et al., 2013). Indeed, finding a balance between patient satisfaction and that of the medical care providers is not easy, because while the emphasis is on one, the other will feel neglected. With the rapid economic growth and development of the Chinese society, nurses in their daily professional life have to cope with a competitive and hostile environment and requirements of performances and adaptability that are increasingly tough, and above all, they must provide quality service (Guo et al., 2016). This only confirms that the nursing profession is one of the most stressful works (Chan, Lai, Ko, & Boey, 2000). Likewise, as reported by many studies, nurses' job dissatisfaction is exacerbated by their work stress (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Ellenbecker, Porell, Samia, Byleckie, & Milburn, 2008; Kalkidan, Moges

Wubie, & Cheru Tesema, 2018; Ma, Samuels, & Alexander, 2003; Tourangeau et al., 2017; Vander Elst et al., 2016; Yun et al., 2010). With all this in view, one wonders how Chinese nurses manage to appreciate their job, or are there still some aspects of their job that they would like to see improved, to work under better conditions that allow them to flourish and produce the expected results?

Although some studies have been devoted to nurses' job satisfaction in China (Chien & Yick, 2016; Hu & Liu, 2004; Tao et al., 2018; A. Zhang et al., 2013), few focused on how it varies with biographic variables such as age and year of experience. This especially with the rampant number of contract-based nurses in Chinese hospitals, who do not enjoy the same privilege as formally employed nurses. Additionally, the search for understanding the dimensions involved in the satisfaction or dissatisfaction experienced by Chinese nurses remains an ongoing area of interest for nursing managers and healthcare policymakers, because of their contribution to the stability of the health system. This study then intended to estimate the overall level of job satisfaction among Chinese nurses and determine the job components for which they are more satisfied or dissatisfied at the end of the reformation period, as a consequence of significant transformations in their workplace. Moreover, the effects of their age and clinical experience on the elements of their perceived job satisfaction were investigated. The findings of this research may provide clues to help nursing managers and policymakers implement informed strategies and address critical issues to increase nurses' satisfaction and guarantee their retention

## II. MATERIALS AND METHODS

### 2.1. Study design

A descriptive and cross-sectional study was carried across Jiangsu province, using questionnaires to collect data. The province was divided into three main zones (northern, middle, and southern) and a purposive sampling approach was used to select three second-level hospitals, such as one in each zone. Second-level hospitals are hospitals found in small cities at the county or district level with medium size (100-500 beds), which offer comprehensive medical and healthcare services (A. Zhang et al., 2013).

### 2.2. Data collection and participants

A two-part questionnaire form was designed and sent to the selected hospitals between June-August 2019. The survey package also contained a cover letter stating the purpose of the study and assuring participants that it was voluntary and anonymous. The questionnaires were translated from English to Chinese to avoid communicational issues. Prior to the actual data collection, a pilot study was conducted in one county hospital on a sample of 10 nurses, to refine and clarify the instrument and ensure that there was no ambiguity in the questions and for the Chinese health system context. With the help of the nurses' administrators of the targeted hospitals, 300 volunteer nurses were recruited for the study. Registered nurses (RNs) who had been working for at least one full year were eligible to willfully participate in the survey. After completion of the survey

questionnaire, nurses were supposed to seal their responses in a self-address return envelop provided in the survey package, and deposit it in the nursing office mailbox. A total of 276 responses were received from registered nurses who consented to respond and mail the questionnaire, for a response rate of 92%.

### 2.3. Instruments

The survey questionnaire included a self-designed socio-demographic information questionnaire and the Index of Work Satisfaction (IWS) questionnaire. The collection of the socio-demographic information was essential to identify social and personal factors that may influence or be related to nurses' job satisfaction. The socio-demographic information consisted of gender, age, educational level, wards, clinical experience, and employment status.

The Index of Work Satisfaction (IWS) questionnaire is one of the few models providing a comprehensive framework to assess nursing job satisfaction. This model has been widely cited and used in nursing research (Ahmad, Oranye, & Danilov, 2016; Hayes et al., 2015; Itzhaki et al., 2013; Oermann, 1995). It was developed by L. Stamps & Piedmont (1986), based on a critical review of occupational theories in the social sciences and a series of interviews with nurses. They intended to develop a valid and reliable scale to get a quantitative estimation of the extent to which nurses appreciate their job (P. L. Stamps, 1997). The IWS is a two-part measurement tool that assesses job satisfaction based on six components. Part A of the IWS questionnaire is a paired-comparison technique which consists in calculating the impact that each component has on the overall satisfaction of the nurses surveyed. This part is made of fifteen pairings of the six components, and participants are asked to choose one component from each pair that influences the most their level of satisfaction. Part B estimates the satisfaction level for each component as well as the overall level of satisfaction. It consists of randomly ordered 44 items with positively and negatively worded statements distributed among the six component: payment (six items), autonomy (eight items), task requirements (six items), organizational policies (seven items), professional status (seven items) and interactions (ten items), subdivided into two subscales: nurse-nurse interaction (five items) and nurse-physician interaction (five items).

Responses were scored on a seven-point Likert scale, going from "strongly agree" (7) to "strongly disagree" (1) for the negatively worded statements and from "strongly disagree" (1) to "strongly agree" (7) for the positively worded statements (the wording style was considered only during the analysis).

### 2.4. Validity and reliability

The IWS questionnaire content validity and construct validity have been established through factor analysis. The Cronbach's alpha of the original scale ranged from 0.82 to 0.91, with the reliability of the overall score being 0.81 (P. L. Stamps, 1997). Multiple studies have reported that the IWS scale is valid and reliable, the Cronbach's alpha of its subscales ranging from 0.50 to 0.92 (Ahmad et al., 2016; Hayes et al., 2015; Itzhaki et al., 2013). For instance, in their study titled "Meta-analysis of the reliability and validity of Part B of the Index of Work Satisfaction across studies," the authors concluded that the IWS was reliable and valid in different settings, including community

and acute care hospitals, universities, and multisite studies (Zangaro & Soeken, 2005). In the present study, the total scale Cronbach's coefficient alpha was 0.864, indicating a valid degree of reliability and internal consistency.

### 2.5. Data analysis

Descriptive statistical estimators were computed to examine the sample characteristics using the Statistical Package for Social Sciences (SPSS v22). The scoring procedures described in the workbook for the Index of Work Satisfaction questionnaire were applied to evaluate the perceived importance of job satisfaction components. Onyx (version 1.0-1010) was used to perform multiple regression modeling as structural equation models and estimate fitness indicators (Oertzen, Brandmaier, & Tsang, 2015). Confidence intervals and P-values for estimating the parameters were subsequently estimated using the Laavan package (version 0.6-5) in R software (version 3.6.2). The level of significance was set to  $P < 0.05$ .

### 2.6 Ethical Statements

The Ethical Review Committee of the University approved the conduction of this study. An introductory text on the questionnaire informed the nurses about the study's purposes and clearly stated the participation conditions, the willingness, the anonymity, and other ethical aspects of the study. The Index of Work Satisfaction (IWS) questionnaire and the scoring manual originally developed by Paula Stamp were purchased from the Market Research Street, Inc., the full-service agency in charge. Consent was obtained to use the copyrighted Index of Work Satisfaction and to adapt it to the needs of the study.

## III. RESULTS

### 3.1 Demographic characteristics of registered nurses

The demographic characteristics of the respondents are summarized in Table 1. The participants were nearly all female (97.82%). The age range of RNs was 23 to 49 (mean age 33.43 years). Their clinical experience ranged from one to twenty years (mean 10.25 years and a standard deviation of 5.57 years). Regarding education, 75.00% graduated from university, and 25.00% had a professional diploma. The majority of participants work in the internal medicine ward (30.00%) and the surgical department (28.00%). As for the employment status, 59% of the nurses are contract employed, while 41% are formally employed.

### 3.2 Perceived importance of job satisfaction components among RNs

Figure 1 presents the results from part A of the questionnaire and shows the perceived level of importance of job satisfaction components by RNs. The component of job satisfaction ranked as the most important by the nurses was pay (weight = 3.525), followed by professional status (weight = 3.330) and task requirements (weight = 3.113). Autonomy obtained a score of 2.953, interactions a score of 2.871, and organizational policies a score of 2.809.

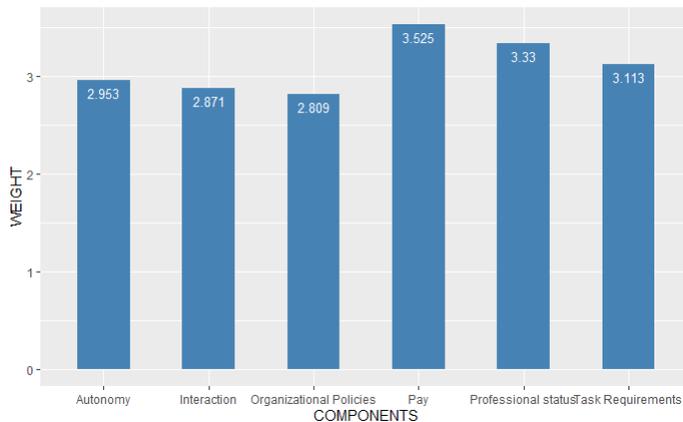
participation were also greater than the associated latent variables correlations (see Table 2).

**Table 1. Validity and reliability of the scales**

Variables	Category	Total (N= 276)	Proportion (%)
Gender	Male	6	2.18
	Female	270	97.82
Age	23-25	40	14.50
	26-35	142	51.50
	36-45	72	26.10
	46-49	22	7.90
Clinical experience	1-5	69	25.00
	6-10	80	29.00
	11-20	127	46.00
Educational level	Professional diploma	69	25.00
	University education	207	75.00
Ward	Intensive care unit	23	8.41
	Medical ward	83	30.00
	Obstetrics and Gynecology ward	31	11.31
	Operation room	16	5.79
	Outpatient department (OPD)	24	8.69
	Pediatrics	11	4.13
	Surgical ward	78	28.00
	Other	10	3.67
	Employment status	Contract employed	163
Formally employed		113	41.00

**Table 3. Levels of job satisfaction components and overall IWS**

Component	Weighting Coefficient (Part A)	Component Scale Score (Part B)	Component Mean Score (Part B)	Adjusted Scores
Pay	3.525	20.420	3.440	12.126
Autonomy	2.953	26.790	3.350	9.893
Task Requirements	3.113	18.340	2.290	7.129
Organizational Policies	2.809	27.640	3.460	10.770
Professional status	3.330	26.940	3.370	11.222
Interaction	2.871	34.570	3.460	9.934
Nurse-Nurse	-	18.500	3.700	-
Nurse-Physician	-	16.070	3.200	-
<b>Total Scale Score: 154.700 (range: 44-308)</b>	<b>Mean Scale Score: 3.228 (range: 1-7)</b>		<b>Overall IWS: 10.179 (range: 0.9-37.1)</b>	



**Figure 1. Relative importance of job satisfaction components among RNs**

**3.3 Levels of job satisfaction components and overall job satisfaction**

The IWS components scores for part B are shown in Table 2. Chinese nurses in county hospitals were most satisfied with their pay (score = 12.126) and their professional status (score = 11.222). They were the least satisfied with their task requirements (score = 7.129) and their interactions (score = 9.934). The organization policies component obtained a score of 10.770, while the autonomy component yielded a score of 9.893. Overall, the Index of Work Satisfaction for all the participant nurses is low (IWS score = 10.179), falling in the first quartile.

**3.4 Relationship between demographic characteristics and job satisfaction components**

The above results are useful for understanding what dimensions of their satisfaction the RNs value most, and the overall satisfaction level of nurses in our cohort. However, they do not tell us how demographic variables such as age and the number of years of clinical experience affect job satisfaction components. To this end, further multiple regression analyses modeled as SEM were performed to evaluate the effect of age and years of clinical experience on the perception of job satisfaction components. We experimented with six different models, and their path analysis results are shown in Figure 2. All the models produced acceptable fit to the sample data as shown by numerous goodness-of-fit statistics, and the hypotheses were examined based on standard coefficients and p-values. Fitness indicators and estimates of regression coefficients are given in Table 3.

There were statistically significant positive relationships between age and years of experience and the perception of job satisfaction for some components, including organizational policies ( $\beta = 0.18, p = 0.041$  for age,  $\beta = 0.23, p = 0.001$  for experience), task requirements ( $\beta = 0.28, p = 0.043$  for age), and interactions ( $\beta = 0.47, p = 0.04$  for age,  $\beta = 0.39, p = 0.007$  for experience). Little but statistically significant reverse relationships were found between age and years of experience and the job satisfaction components pay ( $\beta = -0.08, p = 0.035$  for age,  $\beta = -0.12, p = 0.048$  for experience), and professional status ( $\beta = -0.16, p = 0.015$  for age,  $\beta = -0.09, p = 0.025$  for experience). No statistically significant relationships were found for a few paths, as can be seen in Table 3.

The  $R^2$  obtained for the six models show that 49.6% of the variance in the perceived satisfaction with pay, 46.7% of the

variance in the perceived satisfaction with autonomy, 45.2% of the variance in the perceived satisfaction with task requirements, 58.8% of the variance in the perceived satisfaction with organizational policies, 51% of the variance in the perceived the satisfaction with professional status, and 46.7% of the variance in

perceived satisfaction with interactions, can be explained by the two demographic variables (age and years of experience)..

Model fit: ( $X^2 = 518.983$ ; df

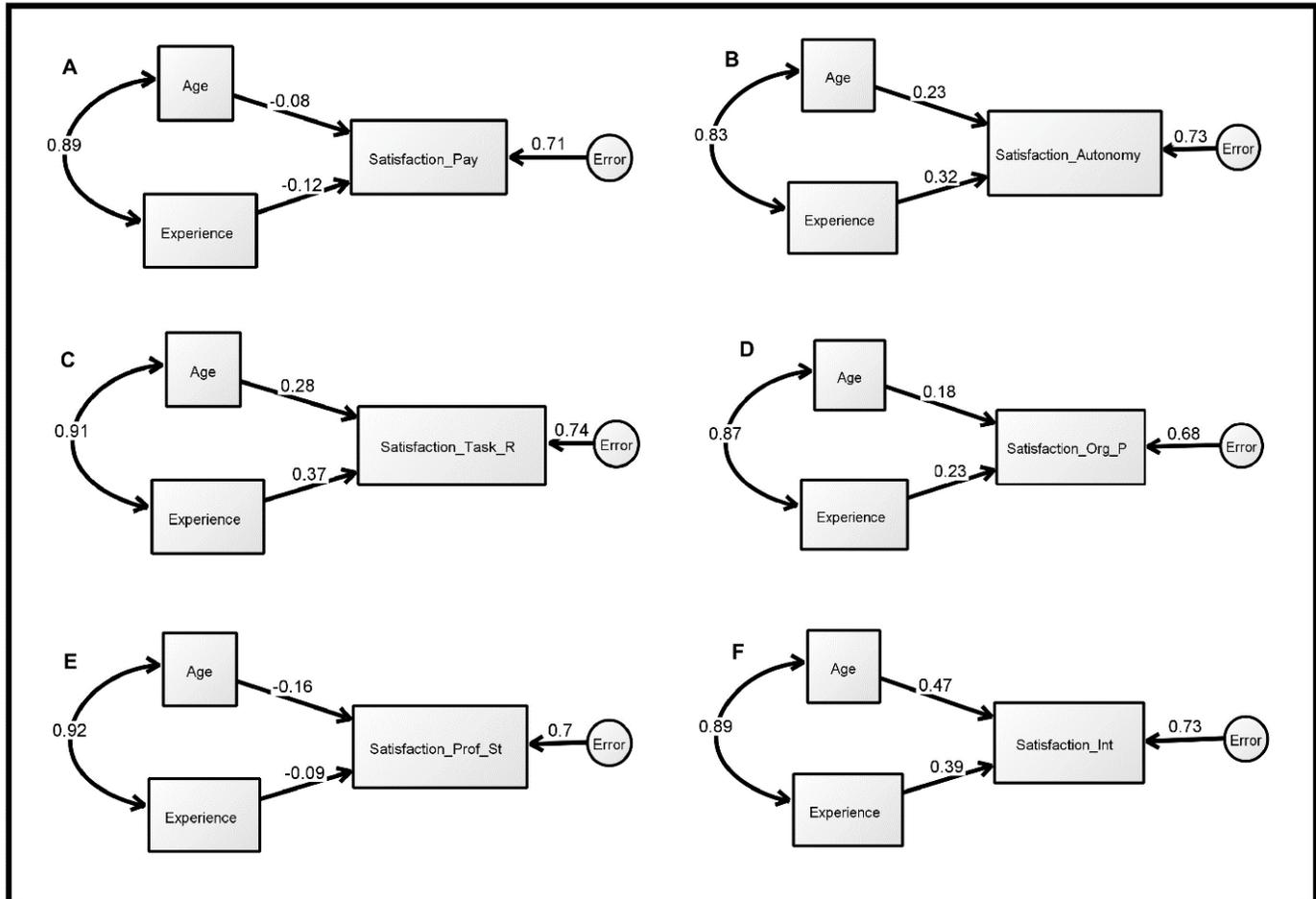


Figure 2: Multiple regression models for evaluating the effects of demographic variables on job satisfaction components

#### IV. DISCUSSION

In this paper, the perceived importance of job satisfaction components was assessed as well as the overall level of job satisfaction among Chinese nurses. Moreover, the variations of the levels of job satisfaction components with the age and clinical experience of the nurses were also investigated. At the closing year of this round of the health system reform in China, the results show that the nurses perceived the new policies brought by the reform as the least contributing factor to their general satisfaction. Besides, the overall level of job satisfaction was found to be low (IWS = 10.2 points).

Several studies aiming at evaluating the professional satisfaction of nurses in various provinces of China and

conducted before or at the beginning of the current round of health system reform have also reported a low level of nursing satisfaction. For example, Lu, While, & Louise Barriball (2007) surveyed 512 nurses in Beijing (before the ongoing reform round) and reported that 79.2% of nurses were dissatisfied with their jobs with low salaries being the leading cause. In the early beginning of the current reform, similar results were found by Ning, Zhong, Libo, & Qiuji (2009) in Harbin, where 650 nurses from six hospitals were surveyed, and the main reasons for their dissatisfaction were a heavy workload and insufficient compensations. An investigation of 2,250 nurses from 19 general hospitals in Shanghai revealed that the majority of the nurses were dissatisfied with their jobs for several reasons including the absence of extra rewards and fringe benefits, the lack of annual leave right, and low salaries (C. Liu et al., 2012).

**Table 3: Fitness indicators and estimates of regression coefficients**

Model	SRMR	CFI	SRV	R <sup>2</sup>	Path name	β	95% CI	P-value
A	0.001	1.00	0.50	0.4959	-	-	-	-
					Age → Pay†	-0.08	[-0.14, -0.06]	0.035*
					Experience → Pay†	-0.12	[-0.16, -0.07]	0.048*
B	0.001	0.99	0.53	0.4671	-	-	-	-
					Age → Autonomy†	0.23	[0.17, 0.29]	0.059
					Experience → Autonomy†	0.32	[0.21, 0.34]	0.065
C	0.001	0.98	0.54	0.4524	-	-	-	-
					Age → Task requirements†	0.28	[0.17, 0.29]	0.063
					Experience → Task requirements†	0.37	[0.29, 0.40]	0.043*
D	0.002	0.99	0.46	0.5376	-	-	-	-
					Age → Policies†	0.18	[0.10, 0.21]	0.041*
					Experience → Policies†	0.23	[0.18, 0.26]	0.001*
E	0.000	0.99	0.49	0.51	-	-	-	-
					Age → Professional Status†	-0.16	[-0.21, -0.03]	0.015*
					Experience → Professional Status†	-0.09	[-0.17, -0.07]	0.025*
F	0.000	0.98	0.53	0.4671	-	-	-	-
					Age → Interactions	0.47	[0.41, 0.50]	0.040*
					Experience → Interactions	0.39	[0.31, 0.42]	0.007*

SRMR: Standardized Root Mean Square Residual, CFI: Comparative Fit Index, SRV: Standardized residual covariance, R2: Coefficient of determination, β: Standardized coefficients, †: Observed level of satisfaction concerning a given component; for example, pay † denotes the observed level of satisfaction concerning the component pay.

In a study conducted among 524 Chinese nurses working in five first-class tertiary hospitals in Tianjin, Yang, Liu, Chen, & Pan (2013) reported a mean level of job satisfaction of 2.51, using the Minnesota Satisfaction Questionnaire (MSQ). While the MSQ and the IWS questionnaire used in this study operate on different scales, the overall level of job satisfaction in these two studies falls in the first quartile. A more recent study conducted on a sample of 11,337 nurses from 92 hospitals across mainland China by Wu et al. (2018) showed a little improvement in the nurses' level of satisfaction mainly influenced by a more conducive working environment. While nurses in the current study did not perceive the changes brought by the reform in organizational policies as very important for their satisfaction, more experienced and older nurses were found increasingly more satisfied with this component, suggesting that the new policies were somewhat effective in this respect.

Nurses in Jiangsu Province perceived pay and professional status as more important to their job satisfaction and were more satisfied with these two components. These results seem a little surprising since, in most of the above comparison

studies, nurses were more dissatisfied with their pay compared to nurses surveyed in this study who seem to appreciate their salary. A possible explanation for this could be the fact that about 46% of participants have been working for more than 10 years and some of them could own a managerial position with more advantages, bonuses, and fringes benefits. Although the nurses were most satisfied with these components, however, their satisfaction with these components was found decreasing with age and professional experience. This finding disagrees with some studies early mentioned in this paper, where younger and less experienced nurses were found less satisfied compared to their older colleagues. A study by Curtis (2008) on the impact of biographical variables on job satisfaction among nurses in Dublin, Ireland, showed that nurses under 35 years old were less satisfied than nurses over the age of 36. Other studies among Chinese (Hu & Liu, 2004), Australian (Hayes et al., 2015), and Malaysian nurses (Ramoo et al., 2013) revealed that job satisfaction and nurses' intention to leave had a significant association with age and work experience influencing that relationship; younger nurses and those with shorter work

experience had lower satisfaction. Similar results were reported by Qu & Wang (2015) in their study of a sample of Chinese nurses, in which those under the age of 30 and those with less than five years of clinical experience had a lower level of satisfaction associated with burnout. But this finding corroborates with those of Baggs & Ryan (1990) and Agho (1993) who also found that job satisfaction was higher for younger nurses and those with less experience and lower for the older and the more experienced ones. A plausible explanation of this finding is that with growing age and experience, nurses might have lost their initial motivation when they saw their expectations not being met and their personal goals as related to their profession not being achieved.

The dissatisfaction of older nurses with their professional status could be explained by the fact that our experimental data sample is composed of 59% of contract-based nurses and 46% having worked for more than ten years. The preceding round of national reform has brought some changes to nursing employment in China. Formally employed nurses enjoy a position with state-guaranteed lifetime employment, opportunities for career development, and other benefits, while there is a more significant number of contract-based nurses, with limited opportunities and, job security, low wages, and benefits. Contract employed nurses tend to be more dissatisfied with their professional status and salary, compared to state-employed nurses who have more advantages (Hu & Liu, 2004; Shang et al., 2014).

In this study, the first area of nurses' dissatisfaction was with their task requirements. However, it is some glimmer of hope here as their satisfaction with this component slightly increased with experience. Given the context of nursing shortage in China due to the high rate of turnover in recent years, nurses are assigned different, multiple responsibilities, making their workload heavier and more complex (Yau et al., 2012). The absence of a clear description of their role and tasks may result in some confusion as to what they are expected to do at any given moment or situation, which in turn may increase their level of stress.

The second component for which nurses were dissatisfied is interactions. Interactions among nurses have been shown as one of the most critical determinants of professional quality of life and job satisfaction (Bagheri et al., 2018). Conflict at the workplace has also been identified as an essential source of job dissatisfaction among nurses (Itzhaki et al., 2013; Masood & Afsar, 2017). As a profession, nursing is associated with diverse and conflicting demands from unit managers, supervisors, physicians, the executive staff, and even patients and their families (Alshehry et al., 2019). However, when assessing their success and their achievement in the work setting, Chinese nurses highly value their interpersonal relationships with physicians (Chien & Yick, 2016).

The third area of less satisfaction among nurses, which is close to the previously discussed, is autonomy. The lack of autonomy of nurses has already been reported in China, in comparison with Western countries. Li & Lambert (2008) found in their investigation that Chinese nurses think they lack autonomy compared to nurses in Western countries. In China, nurses rely more on physicians for directions in their practices. Some nurses have complained of being verbally abused and not

respected by patients and their relatives, and sometimes by physicians (Li & Lambert, 2008; Yau et al., 2012). With the overall improvement of the national economy and Chinese citizens' lifestyle, the pressure on nurses by patients and their families for a better quality of care services could be higher. The same issues were found in the USA by Wright & Khatri and Khatri (2015) in their study, where they reported that nursing practice was almost compromised due to workplace incivility between nurses and colleagues, supervisors, patients and their relatives. Independence in decision making makes nurses feel that they have the authority and the responsibility to make appropriate decisions about patient's care in any given situation. Besides, autonomy develops in them the satisfaction of being trusted by the physician and the feeling that their contribution is appreciated and that their qualification is recognized.

#### 4.1. Limitations

This research had some limitations. The IWS questionnaire used in this study was initially designed to estimate the level of job satisfaction in a single organization. However, in this study, it was used to measure the level of job satisfaction across hospitals located in different cities of Jiangsu province. Thus, the results may be biased by some heterogeneities between hospitals and their surroundings. Data were collected from county hospitals that have approximately the same characteristics across the province to reduce this effect. Another limitation is that the data were collected in county hospitals only; the perceived level of job satisfaction reported by these respondents may not be representative of those of other types of hospitals or areas in Jiangsu province. More importantly, a comprehensive assessment of nursing satisfaction in China at the current time should include all hospitals and nurses across the entire nation. Though robust and more accurate, however, such an approach requires resources beyond those available for this study. This limitation might affect the generalizability of our findings. Thus, future studies could assess nursing job satisfaction and its components in other provinces of mainland China, considering the new and challenging context of the COVID-19's outbreak.

#### 4.2. Implications for clinical practice

The results of this study are pointers to healthcare leaders and policymakers as to how do they need to consolidate the positive aspects of the reform and address the areas that need improvements as far as the job satisfaction, and professional well-being of nurses are concerned. The study revealed that nurses' satisfaction with pay and professional status was found decreasing with age and clinical experience. Alleviating older nurses' dissatisfaction could be done by reviewing the bonuses and other benefits related to their age and seniority. Additionally, reconsidering the clauses of the Nursing Regulation published by the Ministry of Health in 2008, emphasizing on "equal pay for equal work" could help to eliminate the disparities and inequalities among nurses, reduce the dissatisfaction with salary and benefits of contract-based nurses and strengthen the adequacy and stability of hospital nurse workforce in years to come (Shang et al., 2014).

Nurses were also found to be dissatisfied with their task requirements, interactions and complained about not having enough autonomy. Training and recruiting more nurses,

clarifying, and rationalizing nurses' tasks and workload could be an effective way to improve nurses' satisfaction in the future. Hospital managers need to consider significantly the workplace incivility and employ proven methods for avoiding or resolving conflict among the medical staff (Hutchinson, Vickers, Jackson, & Wilkes, 2006). Working in a team of colleagues who support each other and work collectively to improve patients' care can contribute significantly to each member's satisfaction (Masood & Afsar, 2017). Our results also suggest that nurses need more independence in their decision making at work. Hospital managers need to develop an awareness of this and create a working environment that promotes nurses' autonomy and facilitates more balanced, healthier relationships between physicians and nurses.

#### IV. CONCLUSION

This study investigated the level of job satisfaction and its components among nurses in Jiangsu province, China. Our results indicate that after another round of national health system reform, despite some thin glimmers of hope, the overall level of job satisfaction of nurses is still low. Since dissatisfaction with one's job can lead to increased absenteeism, turnover, and workers shortage, recommendations have been made to improve nurses' satisfaction at the eve of another round of national health system transformations. Although there are some limitations to this study, results can contribute to the understanding of the current situation and serve as a signpost for improving the well-being of nurses. Nurses' professional well-being is not only beneficial for themselves, but for organizations, patients as well as communities. Ultimately, with the outbreak of the COVID-19, it has become more apparent that medical workers, especially nurses are essential to the survival of humanity (Thorne, 2020). But at the same time, it is strange to continue to talk about their lack of satisfaction and to realize that it is a profession whose image is increasingly degraded because of the sometimes-unsuitable working conditions. All believe that the heroism of nurses demonstrated during this health crisis will restore the image of this profession, which will enable them to flourish better and encourage them to continue giving the best of themselves.

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# Prevention and Control of Plastic Waste Pollution in the Polar Region: A Review.

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**Abstract-** The effect and harm done to the marine environment by plastic pollution can never be overemphasized. This research reviews and examined various policies, laws, and regulations that have been put in place to mitigate and control the devastating effects of plastic waste pollution, particular reference was made to the polar region and likely environ. Scientific researches, Journal papers, and various publications on plastic waste pollution in the polar region, also known or interchangeably referred to as the Arctic or Antarctica are also reviewed. Findings show that the threat of plastic waste pollution in the Polar region if not quickly attended to could result in devastating climate and environmental problems. Efforts from intergovernmental and international organizations on the subject matter were also investigated, e.g. United Nations Environment Programme (UNEP) the International Union for Conservation of Nature (IUCN), Arctic Council Organization (ACO), Ocean Conservancy (OC), the Arctic Initiative (AI) and the Polar Institute (PI). Various other Policies, Interventions, and Conventions were also studied and recommendations made in accordance with the conclusions reached. Recommendations made from this review include: promoting awareness and understanding of the plastic pollution issue through targeted communication and education efforts to increase community engagement and solutions co-creation; convene industry to educate about economic and environmental threats from plastic pollution and to generate reasonable and realistic practices for plastic pollution mitigation; work with industry to develop and promote guidelines that reduce plastic waste and address appropriate disposal, recycling and reuse of plastic materials.

**Key Words-** Arctic, Antarctic, Polar, Microplastic, Marine debris, Plastic.

## I. INTRODUCTION

The quick growth and rise in living standards of individuals have caused an increase in domestic waste[1]. According to an estimate, the global municipal solid waste (MSW) generation has increased by nearly 1.3 billion tons per year in 2010, and it is expected to reach 2.2 billion metric tons per year in 2025. Among this household waste, plastic waste is posing a major threat to human health as well as the environment[2]. Plastics are versatile material of synthetic long-chain polymers with low cost, lightweight, recalcitrant properties, which brings numerous social benefits and becomes an indispensable component of daily life, driving the annual demand for world production on a substantial scale[3-4].

“However, with rapidly growing plastic production from 230 million metric tons (Mt) in 2005 to 322 Mt in 2015, the associated concern must be plastic waste management in that around 6300 Mt of plastic waste have been generated globally by 2015”[3]. It is estimated that about 5 trillion i.e. over 260, 000 tonnes of plastic garbage now floats on the sea surface worldwide due to indiscriminate waste disposal [1,5-6]. Thus, the global public, with government, environmental NGOs, and science experts, has gradually voiced concern for plastic litter as a significant pollutant in the aquatic ecosystem since the early 1970s. The latest figures indicate that between 4.8 and 12.7 Mt of plastic is generated annually on the world's oceans, with almost one-third of overall pollution from 192 coastline countries and regions becoming China's one of the main aquatic litter generators. Provided there are no changes in plastic waste management on land if existing trends persist, the total amount of plastic waste from land into the oceans by 2025 will rise dramatically [7].

Plastics can broadly fall into four levels based on their sizes: **Megaplastics** (> 1 m); **Macroplastics** (< 1 m), **Mescoplastics** (< 2.5 cm); and **microplastics** (< 5mm)[3]. “Microplastics” is a collective term and was first proposed, defined as all plastic particles or debris smaller than 5 mm in diameter including nano plastics (particles with nano-scale) according to the criteria of the US National Oceanic and Atmospheric Administration (NOAA) the microplastics are surpassing the large plastic pollutants, usually found in most popularly manufactured goods such as personal care and cosmetic products (PCCPs), or may derive from the in situ environmental pollution and subsequent fragmentation of large pieces of plastics by physical, chemical and biological processes[8]. Although a novel bacterium was isolated, capable of degrading and assimilating (polyethylene terephthalate) recently, the low energy environment[9-10], low oxygen levels, extreme cold, and lack of solar ultraviolet (UV)-radiation in the benthic zone make the breakdown speed of plastic debris slowdown, further exacerbating the persistence of microplastics in the oceans[3].

It is a known fact that mishandling and mistreatment of plastic waste can cause environmental pollution [11-12]. The decomposition of plastics takes years, which may be an immense danger to the environment. toxic chemicals are released, When plastic is combusted in the air or buried in the soil this further contaminates soil and air, . Countries all over the world, whether developing or underdeveloped, are expected to face environmental degradation and scarcity of natural resources due to mismanagement of resources. In the United Kingdom, the United

states of America, Finland, Belgium, Brasil, Nordics, and South Africa[13], scientists continue to illustrate plastic risks to the environment[3]. There is currently no proper and appropriate control of plastic waste disposal in developing countries like Pakistan. Pakistan is the sixth most populous country in the world, according to the United States Census Bureau. Pakistan does not have any and restriction on using plastic products; therefore, the problem regarding the waste management is increasing with every passing year. To cope with these problems, proper waste management is required. The recycling/return of waste products is considered to be one of the ways for proper waste management.

by the subarctic[15]. The word Arctic comes from the Greek word (arktikos), "near the Bear, northern" and that from the word (arktos), meaning bear. The name refers either to the constellation Ursa Major, the "Great Bear", which is prominent in the northern portion of the celestial sphere, or to the constellation Ursa Minor, the "Little Bear", which contains

Polaris, the Pole Star, also known as the North Star. There are a number of definitions of what area is contained within the Arctic. The area can be defined as north of the Arctic Circle ( $66^{\circ} 33'N$ ),



Figure 1. Map of the Arctic (Created by US State Department Geographers; licensed under creative commons)

Different researchers have worked on the waste management and environmental protection[10].

## The Polar Region

In the northernmost portion of the World, the Arctic is sometimes known as the polar region [14]. It is composed of Alaska (the U.S.), Canada, Finland, Greenland (Denmark), Iceland, Norway, Russia, and Sweden, as well as the Arctic Ocean and surrounding oceans. Land in the Arctic region has seasonally shifting snow and ice cover and tundra mostly featuring treeless permafrost. Seas of the Arctic comprise in several areas' seasonal sea ice. The Arctic region is a unique area among Earth's ecosystems. The cultures in the region and the Arctic indigenous peoples have adapted to its cold and extreme conditions. Life in the Arctic includes zooplankton and phytoplankton, fish and marine mammals, birds, land animals, plants and human societies. Arctic land is bordered

the approximate southern limit of the midnight sun and the polar night. Another definition of the Arctic, which is popular with ecologists, is the region in the Northern Hemisphere where the average temperature for the warmest month (July) is below  $10^{\circ}C$  ( $50^{\circ}F$ ); the northernmost tree line roughly follows the isotherm at the boundary of this region[14].

## Climate and Features

The climate of the Arctic is characterized by long, cold winters and short, cool summers[16]. There is a large amount of variability in climate across the Arctic, but all regions experience extremes of solar radiation in both summer and winter. Some parts of the Arctic are covered by ice (sea ice, glacial ice, or snow) year-round, and nearly all parts of the Arctic experience long periods with some form of ice on the surface.

The Arctic consists of ocean that is largely surrounded by land. As such, the climate of much of the Arctic is moderated by the ocean water, which can never have a temperature below  $-2^{\circ}\text{C}$  ( $28^{\circ}\text{F}$ ). Although it is shrouded with polar ice in winter, this comparatively warm water holds the North Pole out of the Northern Hemisphere which is part of the reason that it is much cooler than the Arctic. In the winter months of November through February, the influence of the surrounding oceans prevents coastal regions warming as much as possible, and the sun is very low in the atmosphere of the Arctic or not at all rising. The days are shorter as it rises, and the lower position of the sun in the atmosphere means that not so much sunlight hits the surface except at 12 noon. In comparison, the light snow layer reflects much of the minimal amount of solar radiation hitting the earth. Cold snow reflects the amount of solar radiation touching it from 70 to 90%, and snow covers much of the Arctic land and ice in winter. Both conditions contribute to a marginal input of solar energy into the Arctic in winter; only the transfer of hot air and sea water from the south into the Arctic and heat from the subface and sea (who also recover heat and release it in summer) to surface and air in winter are the key factors stopping the Arctic from continuing to cool all winters.[14,16].

Arctic days in March and April are gradually lengthening and in the atmosphere the sun rises, taking the sun to the Arctic rather than in winter, respectively. Most of the Arctic also has winter temperatures during these early months of the Northern Hemisphere, but with addition of sunshine. The constant low temperatures and the permanent white snow cover mean that this extra energy from the sun in the Arctic has a sluggish effect as it is mostly reflected away without heating the earth. By Can, temperatures increase as 24-hour sunshine enters certain places, while snow cover is still the bulk of the Arctic, therefore, the Arctic area represents more than 70 percent of the sun's energy hitting the Arctic in all areas, except the Norwegian Sea and the Southern Bering Sea. The snow melt in most areas of the Arctic occurs at the end of May or sometime in June. This starts with a feedback that represents lower solar radioactivity (50% to 60%) than dry snow, meaning that greater energy is consumed and the melting process is increased. The snow on earth will consume much more energy and soon start warming the underlying surfaces[16].

## II. LITERATURE REVIEW

### **Instruments of marine microplastics at international, regional, and national levels**

Though there is currently no formal maritime international law on microplastics, there have been several constructive countermeasures – international, regional, and national voluntary or legal binding procedure (Table 1 and 2). There are three international conventions in the early 1970s which resolve plastic waste problems in the marine environment.[13,17-18]: The Convention on the Law for the Sea (UNCLOS 1982) of the United Nations (UN) as amended by the Protocol of 1978 (Marpol 73/78)

as well as the Convention on the Prohibition of Dumping Waste and Other Matters for the Prevention of Contamination by Ships (1973). and in 1972. London Convention (LC). UNCLOS is the most detailed regulatory system in aquatic plastic emissions, addressing international marine and marine science studies, marine environmental health and safety, marine technological advances, exchanges, land dispute advice and adjudication, natural resource management and marine waste treatment. Taking underwater litter contamination into account by shipping or aircraft, MARPOL 73/78 is a general prohibition on intentional dumping of plastics at sea as the most relevant international convention in Annex V[10]. The discharge during the normal operation is not regarded as dumping within the scope of Annex V in MARPOL 73/78. The LC is a Global agreement, which was later replaced by the London Protocol (LP), 1996, to control coastal waste by dumping persistent plastic and other industrial material on sea.

LP is largely in line with the reverse list precautionary principle and is more conservative than LC's black and grey lists. The Secretariat is to commission, in the form of the United Nations Environment Program (UNEP)-led Global Partnership on Marine Litter (GPML) due to concerns related to marine microplastics, including multiple waste sources under the LC/LP, a 'Record on the existing condition of the marine litters in wastes dumped in the sea under the London Convention and Protocol'[5,19]. Other key international agreements, frameworks, programs, such as the UN's Code of Ethics for the Responsible Fisheries for Food and Agriculture, Agenda 21: Rio de Janeiro UN Action Policy and Johannesburg Development Plan and Biological Diversity Convention (1992), with a Jakarta Mandate on Conservation and Sustainable Naval Usage Other important international agreements and structure and initiatives Universal UNEP projects are also being created in order to design and introduce regional activities at the 12 regional Pilot Sea (Baltic Sea, Black Sea, Caspian Sea, East Asian Sea, Eastern Africa, North-East Atlantic, North-West Pacific, South Asian Seas, and Gulf of Aden) and to promote regional activities at regional level. Global initiatives on the Regional Sea Programme (RSP, 1974) and Global Program of Action (GPA, 1995) are being developed in response to the threats posed by marine litter in 2003 including: Evaluation and measurement of Marine Litter status in each region; organization of a national regional conference and marine litter experts; drawing up a regional action plan (or regional strategy) for a safe handling of Marine Litter in each region; regional clean-up days as part of the International Clean-up Program for Coastal Coastal Affairs:[3].

As global environmental governance has also been motivated by the pressing problem of reducing polar area emissions like marine microplastics, a substantial number of global mechanisms and policies in recent years have been adopted directly or indirectly[20-21]. In 2012, 64 countries and the European Commission adopted the Manila Declaration under the Global Action Program for the Conservation of the Polar Area Ecosystem from Land Based Operations, in order to stop land-based marine litters, which also decided to create a GPML to integrate marine waste sources in the sea.[22-23]. The G7 (2015) world leaders have recognised the value of aquatic litters with a determination to make this topic a priority. The focus of the G7 Meeting was on

"Better Protection – Linking Regions – Commons Governance: Knowledge of and Monitoring of maritime areas; peaceful conflict resolution; illicit, unregulated and unreported fishing; and maritime security networking. The G7 Summit (2015) introduced the Aquatic Debris Action Plan covering land and sea sources, raising consciousness, raising public awareness, and eliminating events. More recently, the G20 Summit (2017) has released a

paper confirming and reviewing a 2030 Agenda Action Plan on G20 Sustainable Development Targets – one of the three key sustainability projects of the G20 Aquatic Litter Action Plan. Meanwhile, it is also an available approach to adopt a “circular economy” for recycling and reusing materials and reducing waste, contributing to preventing land-based waste from entering the oceans[24].

Table 1: Summary of International legislation, regulations, and instruments related to microplastics

International Instruments	Chronological Timeline	Policy content and Excerpts
<b>London Convention</b>	1972	Aimed at preventing the “deliberate disposal at sea of wastes and other matter from vessels, aircraft and other structures, including the vessels themselves”. (Annex I, paragraph 2)
<b>MARPOL 73/78</b>	1973	To prohibits “the disposal into the sea of all plastics, cargo residues, fishing gear including but not limited to synthetic ropes, synthetic fishing nets and plastic garbage bags”. Through Annex V (revised in 2011 and implemented in 2013)
<b>United Nations Convention on the Law of the Sea</b>	1982	Regulations on stringent control of marine pollution and contamination from sea-/ land-based sources.: Part XII (Articles 192–237)
<b>Basel Convention</b>	1989	Guidelines on plastic waste and microplastics matters. Discussed at the Basel Convention workstream COP 13 (Plastic waste in Annex II Y 46 (Household wastes) and Annex VIII (Non-hazardous wastes)
<b>London Protocol</b>	1996	Strategies to prevent the “dumping of any wastes or other matter including the export of waste to countries for dumping and incineration at sea except for the materials listed in Annex I”.: (Article 4.1.1, 5 and 6)
<b>UNEP – Regional Seas Programme and Global Programme of Action</b>	2003	Ammonization of purpose and rules for Regional Cooperation surveillance in 12 regional seas
<b>Manila Declaration</b>	2012	Prevention of marine pollution from land-based sources and agreement to establish a Global Partnership on Marine Litter (GPML)
<b>G7 Summit</b>	2014	G7 Marine Litter Action Plan (MLAP)
<b>United Nations Environment Assembly (UNEA) I</b>	2014	Resolutions 1/6: Discussions on “Marine plastic debris and microplastics”.
<b>UNEA II</b>	2016	Resolutions 2/11: Measures to reduce marine plastic litter and microplastics
<b>G20 Summit</b>	2017	G20 Marine Litter Action Plan
<b>UNEA III</b>	2017	Resolutions 3/7: Strategies to combat the spread of marine plastic litter and microplastics.

The first session of the United Nations Environment Assembly (UNEA I, 2014) put forward the issue of plastics (including that microplastics in the marine environment are a rapidly increasing problem) finally adopted Resolutions 1/6 on marine plastic debris and microplastics[25]. It also requests to undertake a study on marine plastic debris and marine microplastics. Meanwhile, the Secretariats of the Stockholm Convention, the Basel Convention, and relevant organizations are invited to be involved in pollution control and chemicals and waste management, to contribute to the analysis above. UNEA II (2016) has accomplished, under the

overall theme of the implementation in 2030 of the Sustainable Development Plan (17 targets), to reach a consensus on resolution 2/11 on aquatic plastics and microplastics. Goal 14 outlines its 14.1 goal which aims to "prevent and substantially reduce marine pollution of all sorts, including marine debris and nutrient pollution, by 2025 in particular by land-based activities." Along with recognizing the importance of cooperation between the UNEP and conventions and international instruments related to preventing and minimizing marine pollution from waste, it stresses that prevention and environmentally sound management (ESM) of waste are keys to long-term success in combating marine pollution, including marine plastic debris and microplastics. And it requests to undertake an assessment of the effectiveness of

relevant international, regional, and sub-regional governance strategies and approaches to combat marine plastic litter and microplastics. In the recent UNEA III (2017), Resolution 3/7 on marine plastic debris and microplastics was adopted, stressing the importance of long-term elimination of the discharge of litter and microplastics to the oceans, of avoiding detriment to marine ecosystems and the human activities dependent on them from marine litter and microplastics, urging all actors to step up actions to “by 2025, to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution”, and also encouraging all Member States to prioritize policies and measures[26-28]. Plastic waste and microplastics issues have also been included into the Basel Convention (Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal) workstream at the 13th Conference of Parties in 2017, to encourage interested regional and sub-regional centers to work under the Convention on the impact of plastic waste, marine plastic litter, microplastics, and take measures for prevention and ESM, as well as introduce the above detailed new work into the 2018–2019 work program.

### III. DISCUSSIONS

## Regional and national instruments

This section provides an outline of some of the more advanced aquatic plastic issues instruments that contain legislation, programmes and action plans drafted at a state and national level that do not span the spectrum of current interventions. A range of regulations, laws and measures aimed at marine litter interventions have been adopted by the European Union (EU), which effectively contributes significantly to international attempts to avoid, eliminate and minimise marine litter, including the European Directive on the Marine Strategy Framework Directive (MSFD)[17]. The Directive was the first EU-wide law on biodiversity conservation and was adopted on 17 June 2008. It aims to help protect and achieve the aquatic ecosystem in Europe Good Environmental Status (GES) of EU marine waters by 2020. The MSFD defines GES as: “the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive”.

Table 2: Summary of current regional and national instruments related to microplastics

Regional/National Instruments	Chronological Timeline	Policy content and Excerpts
<b>European Union (EU)</b>	2008	The first EU legislative instrument related to the protection of marine biodiversity
<b>United States:</b> National Strategies on the control of microbeads in personal care products, cosmetics, and non-prescription drugs (MSFD)	2011	Honolulu Strategy 2011
	2015	Microbead-Free Waters Act
	2017	Ban on manufacturing rinse-off products containing plastic microbeads
	2018	Ban on delivery of rinse-off products containing plastic microbeads
	2019	Ban on manufacture and delivery of rinse-off products containing PM
<b>Canada:</b> SOR (111) Regulations on Microbeads in Toiletries: cosmetics, natural health products, and non-prescription drugs	2017	Policy suggestions to prohibit the use of Microbeads in Toiletries
	2018	Ban on manufacturing and importation of toiletries containing microbeads
	2019	Ban on the use or sale Natural health products and/or non-prescription drugs containing microbeads
<b>UK</b>	2017	Discussions to ban the rinse-off of cosmetics products containing microbeads
	2018	Ban on the manufacture of the products discussed in 2017
<b>Australia</b>	2017	Legislation and eventual prohibition of the use of microbeads in any product
<b>South Korea</b>	2018	Ban on the use and sale of plastic microbeads in all cosmetics
<b>Sweden</b>	2018	Ban on microbeads in rinse-off products
<b>Taiwan Province, China</b>	2018	Ban on the manufacture, sale and import of products containing microbeads
<b>New Zealand</b>	2018	World Trade Organization informed of draft regulation: ban on microbeads in personal care products
<b>Italy</b>	2019	Ban on microbeads scrubs particles in cosmetics – 2020. Ban on plastic cotton buds – 2019.

Annex III of the Directive was also amended in 2017 to better link ecosystem components, anthropogenic pressures, and impacts on the marine environment with the MSFD’s 11 descriptors and with the new Decision on GES[29]. The EU and the European Commission ( EC) have already developed a series of detailed requirements and methodological principles to support the introduction by Member States of the Marine directive and other European marine waste litter regulations including EU Directive for port waste and cargo waste reception facilities (EC2000/59); EU Bathing Directive (76/160 / EEC and 2006/7 / EC); EC Urban Waste Water Directive (EC2000/59) and the European Commission ( EC); Most developing countries at state level have implemented policies and policy initiatives for coping with microplastics. The plastics industry in the US and UK has implemented “Operation Clean Sweep” to reduce plastic pellet loss to the environment especially during transportation and shipment. However, the measures taken by developed countries on microplastic beads are mostly limited to PCCPs[30-31]. And commercial raw materials microplastics are currently in the testing stages. The US NOAA specially developed the National Marine Debris Program (NDP) in 2006, along with the UNEP in 2011. The policy can be viewed as a holistic, global mechanism for attempts to reduce the biological, human and economic effects of marine litter in which plastics (including microplastics) are used as marine environmental contaminants. Illinois becomes the first US state to adopt regulations that forbids the manufacturing and distribution, by the end of the year 2017, of goods containing microbeads from 2014 to 2015 next to one of the world's biggest freshwater bodies of water, Lake Michigan. New Jersey followed suit, and there are a number of other states focused on the issue, including Michigan, New York and Indiana. In late December 2015, the US signed the Microbead-Free Waters Act, according to which, on 1 July 2017, no cosmetics containing plastic microbeads will be approved by all manufacturers, and that such items must,

joined to insist that the EU ban microbeads from personal food goods in 2015, expressing their clear fears at the possible threat to human health by gradually being marine. Sweden's own ban on microbeads on rinse-off goods has also been implemented (Swedish Government, 2015) and will be released in January 2018. Following the actions taken by the US in mid-2017, the UK Government has announced its intention to ban the 2018 ban and 2017 manufacture of rinse-off cosmetic items containing microbeads.[30,32]. In addition, Beach Cleanup and other literacy projects have been carried out in Britain, including the Green Blue project. On 19 December 2017, the Italian parliament approved a resolution banning the use of cosmetics by microbeads by 2020. Italy will now become the first country to ban cotton plastic buds from 2019. The Canadian government has declared a thorough ban on the sale of plastic microbeads containing shower gels, toothpaste and face scrubs effective July 1, 2018 which will set the timeline for Canada in keeping with the US to remove the small pollutant from Canadian waters. A year later 1 July 2019, the ban will be issued to microbeads discovered in herbal and non-prescription narcotics.

New Zealand has conveyed to the World Trade Organisation ( WTO), which will take effect in 2018, a ban on the management of micro-beads on personal care goods. In Australia (2016), if businesses do not willingly phase out micro-beads by 1 July 2017, the Federal Government shall enact legislation to enforce the prohibitions under statute in 2017. Similarly, from July 2018, South Korea will ban the use and sale in all cosmetics of plastic microbeads. Taiwan's county, China, is barred from producing and importing goods containing microbeads on 1 January 2018, with its sales moratorium taking effect on 1 July 2018.[17]. Taiwan Province, China has released a draught bill involving methods for qualitative screening of microbeads. China has not yet released microplastics or microbeads regulatory papers. These tools,



as of 1. July 2018, also be banned. In Europe, five nations – Austria, Belgium, Luxembourg, the Netherlands, and Sweden –

including conferences, action plans, UNEP RSP, GPA, GPML, and an interdiction of microbeads at national and international

Figure 2: Regulation and management Frameworks on marine litter across international, regional, and national levels

levels (in Tables 1 and 2). They also offer a forum for encouraging all actors to collaborate and to exchange international perspectives and practice.[3].

## Sources of Plastic Waste in the Polar Region

Plastic waste is not resistant to Arctic currents, lakes, tides, and winds. In Arctic plastic pollution, the underwater ice, sediments and even the remains of Arctic birds and dolphins are present on the beaches and pools of water in the sea. There is no sufficient knowledge of how plastic flows into and from Arctic waters and the threats to Arctic life and livelihoods plastics present[33].

Every year, over 300 million tons of plastic are produced, half of which is used to design single-use items such as shopping bags, cups and straws[34]. At least 8 million tons, from surface water and sediment from the deep seas, result in our waters each year and make up 80% of all aquatic waste. The most abundant pieces of aquatic debris are floating plastic waste.

Most marine plastics come from terrestrial sources, including municipal and storm fluxes, overflows of garbage, tourists to the beaches, poor recycling and management, factory operations, construction, and illegal dumping. Ocean-based sources come primarily from the fishery, nautism and aquaculture sectors[35].

The bad news is that plastic never goes anywhere when it is dumped into our oceans. It is not physically degrading[36]. It is literally broken into small particles called micro- and nanoplastics by natural forces, such as solar UV, wind, currents, etc. The social, economic, and ecological effect of plastic waste is important. Marine plastics pose a risk to ocean sustainability, human health, fish safety and coastal tourism.

But the good news is that these issues can be addressed by intervention. IUCN has developed numerous theoretical works to increase awareness of the degree of plastic waste and supports both the Baltic Sea and the Mediterranean strategy and programmatic action. Although the global issue of aquatic plastics demands local and regional solutions tailored to the numerous plastic sources and routes into the ocean.[34].

## Stopping the Flow of Plastic Waste to the Polar Region

Islands are particularly vulnerable to plastic contamination as remote areas are a major challenge in the organization of inter-Iceland waste logistics. The restricted resources of the Islands contribute to major and additional difficulties relative to their continental counterparts[37]. The latest initiative "Plastic Waste Free Islands" intends to increase the acceptance by the Caribbean, the Mediterranean, and the Pacific of initiatives for limiting plastic leakage across the tourism, fisheries, and waste management sectors. The project also intends to develop sector-specific alternate value chains action plans.[34].

## Collaboration: A Key Strategy

A series of public and private efforts have recently appeared on multinational, federal, domestic, and local levels to counter plastic waste at various points in the plastic chain. A cohesive big picture can be split into various programmes on different stages, complicated, and hard to remove. That is why the differences between the different actor classes need to be bridged and steps taken toward shared objectives, such as Sustainable Development Goals (SDGs)[28,38]. The initiative would also establish a blueprint for islands that federal bodies will support. The draught would set the proposed solution of the IUCN to mitigate plastic leakage on the islands on the basis of the plan for the project and learned lessons.[34].

## Global Interventions to Control Marine and Polar Region Plastic Waste Pollution

### Plastic Waste Free Islands

IUCN initiated the Plastic Waste Free Islands initiative in 2019 with the sponsorship of the Norwegian Development Cooperation Agency (NORAD). The ultimate aim of the initiative is to eliminate plastic spills into the ocean from six SIDS (the Pacific Island) and three Caribbean Islands (the Pacific)[39]. The project also aims to repurpose waste into commercially viable products, thereby generating job opportunities and income for local communities. Key regional bodies will also develop and endorse a blueprint for looking at entire value chains, from production to disposal, and at plastic usage and wastage in different sectors (such as tourism and fisheries). The regional bodies should recognize additional opportunities to extend the use of the blueprint which can be used by any island nation.

### Plastic Waste Free Islands – Mediterranean

With support from the Didier and Martine Primat Foundation, IUCN launched the Plastic Waste Free Islands project in 2019. The overarching goal of the project is to reduce plastic leakage to the ocean from two islands in the Mediterranean Sea. The project also aims to repurpose waste into commercially viable products for sale, thereby generating job opportunities and income for local communities. Key regional bodies will also develop and endorse a blueprint for looking at entire value chains, from production to disposal, and at also plastic usage and wastage in different sectors (such as tourism and fisheries)[40]. These regional bodies will also be able to identify further opportunities to scale up the blueprint's application, which can be used by any island country.

### Marine Plastics and Coastal Communities - MARPLASTICCs

In late 2017 IUCN initiated an initiative on aquatic plastics and marine coastal ecosystems in the Indian Ocean and Asia-Pacific regions with the assistance of the Swedish International Development Cooperation Agency (SIDA). The overarching aim of this three-year project is to encourage, implement and execute regulations and other appropriate steps to control and mitigate aquatic emissions from plastics in Eastern and Southern Africa and Asia regions. In this, IUCN will invest efforts to provide awareness, power, policy options and action plans for

management of plastic waste to governments, industry and community in Eastern and Southern Africa and the regions from Asia.[34].

#### **PlastiMed**

IUCN made new attempts to shut down the Mediterranean plastic tap in 2017. This two-year initiative seeks to foster our awareness of plastic sources from source to sea and to help establish local solutions.

#### **PlastiMed BeMed: Closing the plastic tap**

In 2018, IUCN initiated an initiative with the sponsorship of the Prince Albert II Foundation, with the goal of developing current plastic waste and leakage evaluation methodologies, template and data by integrating modelling and field-based methods in the Mediterranean, with an emphasis on the Northern African Countries.

#### **Tackling marine plastics in Thailand: from community-based actions to policies (Phase 1)**

The Step 1 (2018–2019) initiative, sponsored by the Coca-Cola Foundation, aims to raise awareness, and improve people's actions for the treatment of solid waste in major strategic places in Thailand. The final aim is to reduce marine plastic emissions dramatically and to catalyse crucial reforms in local and domestic plastic waste management policies.

#### **Baltic Solutions to Plastic Pollution**

The Global Marine and Polar Program (GMPP) with the help of the Swedish Postcode Foundation is working to show the climate change, ecology, and food safety implications of plastic contamination in the Baltic Region. In order to perform desk and field studies and laboratory studies, GMPP has brought together a network of scientists to provide solid scientific proof of the harmful environmental and Social effects of plastic waste within the area. GMPP will explore legislation leveraging frameworks and include access points for recommendations on this basis along with leading regional experts and grassroots organisations.[41].

#### **PlastiCoco**

Placing on the status of aquatic plastic waste in priority regions is the goal of the PlastiCoco initiative, with funding from the Agence Française de Développement (AFD). The initiative, which began in 2018 and will conclude in 2021, will also provide advice on how sustainable aquaculture can be accomplished. The introduction and distribution of these information items at appropriate forums will direct policy making and maritime spatial planning at the state, national and regional level.

#### **Azorlit - Establishing a Baseline on Marine Litter in the Azores**

A thorough awareness of aquatic plastic emissions in the Azores archipelago is desperately needed in order to take appropriate management steps. The project "Azorlit – Creating a Benchmark for Aquatic Litters in the Azores" was planned to resolve these disparities and fundamental concerns in relation to this increasing environmental problem. Project aims were to record the resources and composition of debris on the seashore and in select aquatic species and to measure plastic consumption.[30,42]. The project

also aimed at providing support through activities on the sea, especially with the children and adolescents, to the local NGO, the Azores Sea Observatory, (OMA).

#### **IV. CONCLUSION**

From what we have been able to review; various stakeholder industries can be Mobilized to enlighten the public about plastic waste economic and environmental risks and develop fair and practical initiatives to minimize plastic contamination.

Regional government coalition should also be encouraged to construct and encourage policies on plastic waste mitigation and the effective treatment and recycling of plastic products with industries.

It will be in the interest of the Polar Region to develop sub-regional and local efforts and communications initiatives adapted to individual regional needs and demands.

Stake holders should make conscious efforts to Share details on the promising initiatives already taking place in the polar region in order to maximize and improve the efforts on Arctic plastic waste mitigation.

Indigenous councils should always congregate efforts with incorporation of local cultures where necessary.

Increased investment in creative strategies from people in the Arctic for plastics mitigation, reuse, recycling, and recovery is advised.

Compel more manufacturer obligation to pay for management of environmental costs and impacts associated with a product during its life cycle, and minimize the use of plastics that cannot be recycled

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## FINE ROOT BIOMASS AND NUTRIENT CONCENTRATION AT SUBTROPICAL DISTURBED MIXED FOREST AND UNDISTURBED MIXED OAK FOREST OF MANIPUR, NORTH-EASTERN INDIA.

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### Abstract:

Fine root biomass and its nutrient concentration in different soil depths (0-10cm, 10-20cm and 20-30 cm) were studied in disturbed mixed Pine forest (forest site I) and undisturbed mixed oak forest (forest site II) at Senapati District, Manipur. Fine roots from both the study sites were collected by soil corer. Maximum fine root biomass were found in 1-10 cm (2037.80 gm<sup>-2</sup> in forest site I and 2170.63 gm<sup>-2</sup> in forest site II) throughout the year in both the study sites. Maximum fine root biomass was found in the month of December (205.65 gm<sup>-2</sup> and 223.40 gm<sup>-2</sup> in forest site I and site II respectively). The amount of nutrient (NPK) in fine roots varies in different soil depth in both the study sites throughout the year.

### Index terms:

Live fine roots, nutrient concentration (NPK), disturbed mixed Pine forest (forest site I), undisturbed mixed oak forest (forest site II).

### Introduction:

Fine roots (<2.00mm represent a dynamic portion of belowground biomass. The fine root only a small fraction of the total root biomass. The fine roots play an important role in the soil profile development and after the dead also adds to the organic matter of the soil thus enriching the soil fertility. The quantity and activity of the small diameter of the root systems are of great significance as regards to water and nutrient supply. The knowledge of fine root biomass is important for understanding energy flow and nutrient cycling (Aertis et al 1992; Khiewtmar and Ramakrishnan 1993). Fine roots conserve the nutrients by preventing the leaching losses from the ecosystem. Studies on fine root dynamics in forest ecosystem have been studied by several workers (McClougherty et al 1982; Fitter 1985, Vogt et al 1996; Pregitzer et al. 2002) but there is limited information on fine root biomass and nutrient

concentration (NPK) in three different soil depths in the disturbed mixed pine and undisturbed mixed oak forests in the subtropical forest at Senapati District of Manipur. The present study aims to study the fine root biomass and nutrient concentration (NPK) from three different soil depths in subtropical forest.

### Study sites:

The study sites are situated in the Senapati District of Manipur. The forest site I is located at Motbung that lies at 24.99°N and 93.90°E at an altitude of 970m from the mean sea level and the forest site II is located at Saparmeina that lies at 25.04°N and 93.94°E at an altitude of 933m from the mean sea level. The climate of the area is monsoonic with warm moist summer, a distinct rainy season and cool dry winter. The average annual rainfall of the study sites is 1131.8 mm. the mean monthly maximum ranges from 4.9°C (December) to 28.8°C (July) during the study period as shown in figure 1.

The disturbed mixed pine forest (forest site I) is dominated by *Pinus Khesiya* Royle, *Bauhenia Vareigata*, *Embllica officinalis*, *Cedrella toona* and other shrubs and herbs species. The disturbed mixed oak forest is dominated by *Quercus serrate*, *Schima wallichii*, *Quercus polystachya* and other shrubs and herbs.

### Result:

The soil of forest site I is sandy loam in texture (sandy 42%, silt 25% and clay 33%). The soil temperature ranges from 8° to 30°C, soil pH ranged from 4.63 to 6.67, soil moisture ranged from 21.15 to 26.13%, soil organic carbon ranged from 0.727 to 4.8%, soil total nitrogen ranged from 0.092 to 0.587%, soil available phosphorous 0.021 to 0.096% and soil potassium ranged from 0.115 to 0.482% as shown in table 1 & 2.

The soil forest site II is clayed loam in texture (sand 32%, silt 25% and clayed 42%). The

soil temperature ranged from 9°C to 30°C, soil pH ranged from 4.69 to 6.66, soil moisture ranged from 20.15 to 26.13%, soil organic carbon ranged from 0.728 to 4.90%, soil nitrogen ranged from 0.125 to 0.692%, soil available phosphorous ranged from 0.023 to 0.096% and soil potassium ranged from 0.115 to 0.482% as shown in table 1 & 2.

The live fine root biomass in forest site I ranged from 136.15gm<sup>-2</sup> to 205.65gm<sup>-2</sup> in 0-10 cm, 16.28 to 162 gm<sup>-2</sup> in 10-20 cm and 4.25 to 68.70g<sup>-2</sup> in 20-30 cm whereas in forest site II, it ranged from 145.23 to 223.40 gm<sup>-2</sup> in 0-10 cm, 20-180 gm<sup>-2</sup> in 10-20 cm and 8.32 to 78.29 gm<sup>-2</sup> in 20-30 cm as shown in fig 2. Fine root biomass decreased with the increase in soil depth in both the study sites. Mean fine root biomass declined consistently from February to July and then increased from August to December in both the study sites as shown in table 3. Seasonally fine root biomass was maximum in winter season followed by rainy and summer season in both the study sites as shown in table 3, fig 3 showed the variation of fine root biomass among the three seasons in forest site I and forest site II. In forest site I, among the three seasons, the maximum mean value of fine root biomass was shown in winter season (129.86±61.48) gm<sup>-2</sup> and minimum mean value in summer (74.58±59.70) gm<sup>-2</sup>. The variation test value in forest site I predict significant F=9.32, P<0.01). In forest site II, the maximum mean value was also shown in winter season (139.64±63.66) gm<sup>-2</sup> and the minimum mean value in rainy season (82.66±65.00)gm<sup>-2</sup>. The variation test value in forest site II showed significant statistically (F=9.24, P<0.01). Monthly variation in fine root nitrogen concentration (%) at different depth of soil is shown in fig 4. Several variation in fine root nitrogen concentration (%) at different depth of soil is shown in Table 5 for both forest site I and site II. The ANOVA of fine root nitrogen concentration (%) show significant variation in both the study sites as shown in Table 6. In forest site I, the variation of FRN concentration (%) is highly significant (F<sub>season</sub>=67.79, P<0.01; F<sub>depth</sub>69.05, P<0.01; F<sub>season with depth</sub>=2.62, P<0.05). Similar pattern of variation is observed in forest site II (F<sub>season</sub>=157.64, P<0.01; F<sub>depth</sub>=110.87, P<0.01; F<sub>season with depth</sub>=3.81, P<0.01). Monthly variation in fine root phosphorous concentration (%) at different depth of soil is shown in fig 5. Seasonal variation in fine rot phosphorous concentration (%) is shown in table 7 at different soil depth for both the study sites. The ANOVA of fine root phosphorous concentration (%) as shown in table 8 evidenced variation of fine root phosphorous concentration (%) in both the study sites. In forest site I, the variation of FRP concentration (%) is highly significant (F<sub>season</sub>=11.45, P<0.01) but

insignificant with depth (F<sub>depth</sub>=0.098, P<0.05; F<sub>season with depth</sub>=0.152, P<0.05) statistically whereas in forest site II, in all seasons, the ANOVA showed highly significant (F<sub>season</sub>=143.99, P<0.01; F<sub>depth</sub>=156.02, P<0.01, F<sub>season with depth</sub>=3.15,P<0.05). Monthly variation in fine root potassium concentration (%) is shown in fig 6. Seasonal variation in fine root potassium is shown in table 9 at different soil depth for both forest site I and site II. The ANOVA of fine root potassium concentration (%) as shown in table 10 predicted the variation of fine root potassium (FPK) concentration (%) in both the study sites. The variation of FRK concentration (%) in both the study sites. The variation of FRK concentration (%) in forest site I showed a significant (F<sub>season</sub>=118.70, P<0.01, F<sub>depth</sub>=67.52, P<0.01, F<sub>season with depth</sub>=8.91, P<0.01). Similar pattern is also observed in forest site II showing highly significant in all three season (F<sub>season</sub>=146.34, P<0.01; F<sub>depth</sub>=104.26, P<0.01; F<sub>season with depth</sub>=12.38, P<0.01).

#### Discussion:

Fine root biomass was maximum in winter season and minimum in summer and rainy season in both the study sites. The decrease in fine root biomass in summer and rainy seasons may be due to root mortality and decomposition. Similar seasonal trend in fine root biomass have been observed in several ecosystem (Harris et al, 1977, Santantonio and Hermann 1985 and Uma et al 2002). Table 11 compares the ranges of fine root biomass estimated in the present study with that of different forest ecosystem of the world. The present value of fine root biomass across the soil depth layer falls with the range reported for most of the Indian forests in which the value of fine root biomass varied from 32 to 340 gm<sup>-2</sup> for <2 mm diameter to a depth of 30 cm (Behra et al, 1990 and Parthasarthy 1988). The greater in fine rot biomass in forest site II compared to forest site I may be attributed due to relativity low soil moisture, low temperature and relativity undistributed condition prevailing in forest site II. The maximum concentration of fine root nutrient concentration (%) exhibited in rainy season in both the study sites. In the present study, the fine root nutrient concentration is comparatively higher in forest site II that forest site I. the lower fine root concentration of nutrient (NPK) in forest site I may be due to more nutrient leaching on the upper soil surface and the sandy soil possibly may not hold much nutrients due to their low water holding capacity or alternately get accumulated in thicker root or in the upper ground part by translocation as fine root biomass and nutrient concentration varies greatly

with respect to season and other abiotic factors and sites quality.

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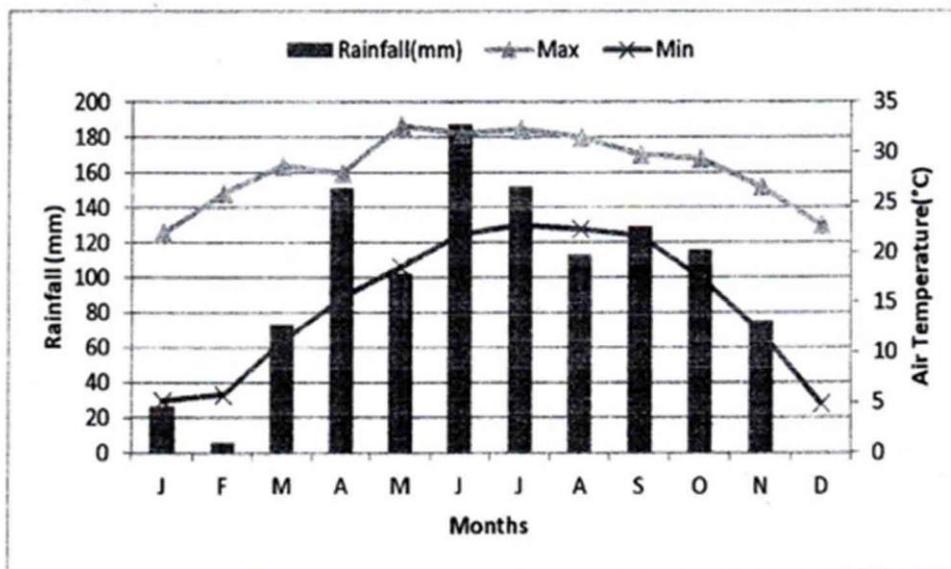


Figure 1: Climatic data of the study period

Table 1: Abiotic variables and physicochemical characteristics of soil.

Abiotic variables	Forest site I	Forest site II
Soil temperature (°C)	20.33	21.32
Soil moisture (%)	24.60	24.75
Rainfall (mm)	94.31	94.31
Air temperature(°C)	23.65	23.65

Table 2: Soil physicochemical characteristics.

Texture	Forest site I	Forest site II
Sand (%)	42	32
Silt (%)	25	25
Clay (%)	33	42
Soil organic carbon (%)	0.73-4.8	0.73-4.9
Soil total N (%)	0.09-0.58	0.125-0.692
Soil available P (%)	0.021-0.096	0.023-0.096
Soil Potassium K (%)	0.115-0.482	0.115-0.482

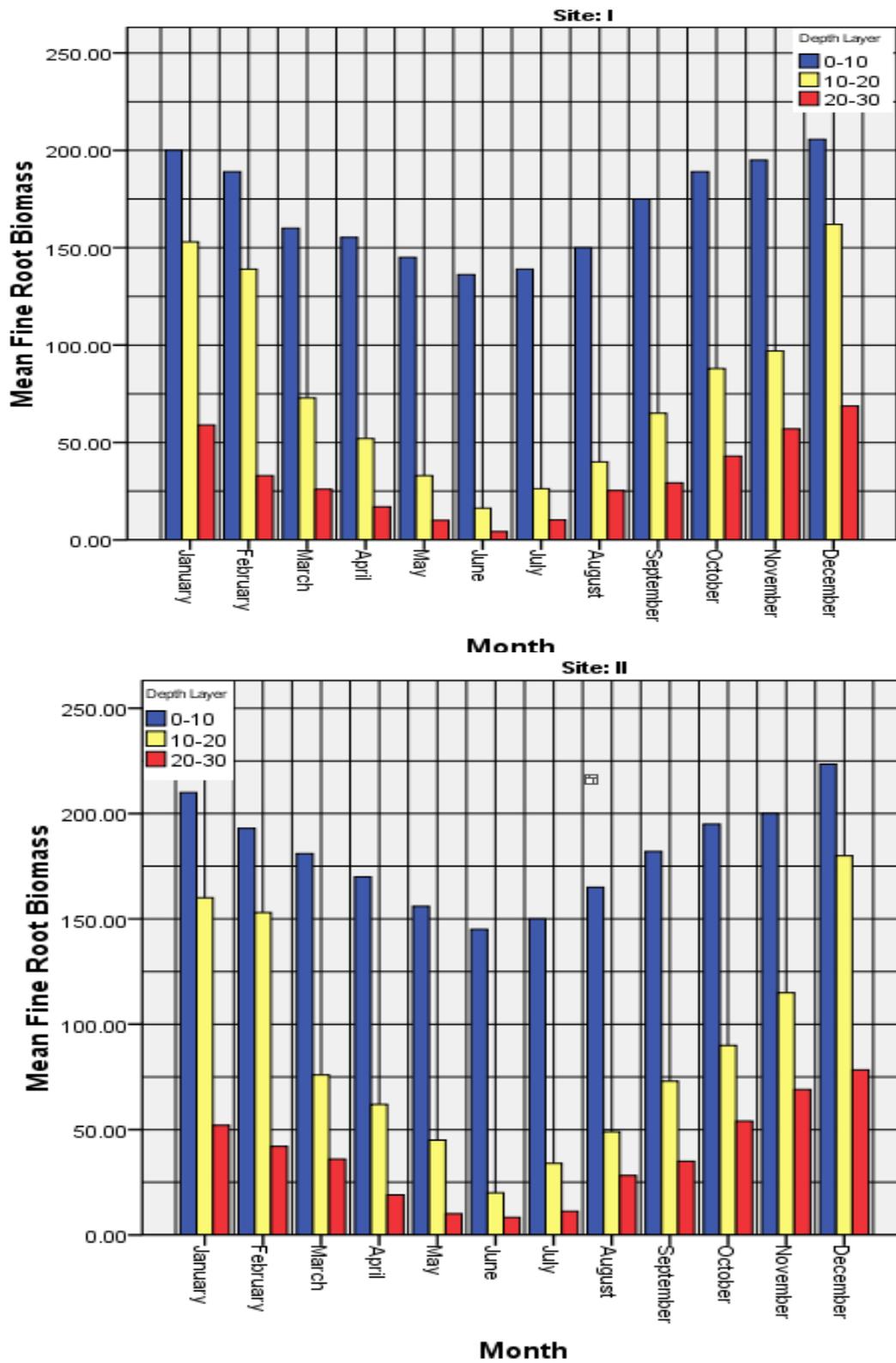


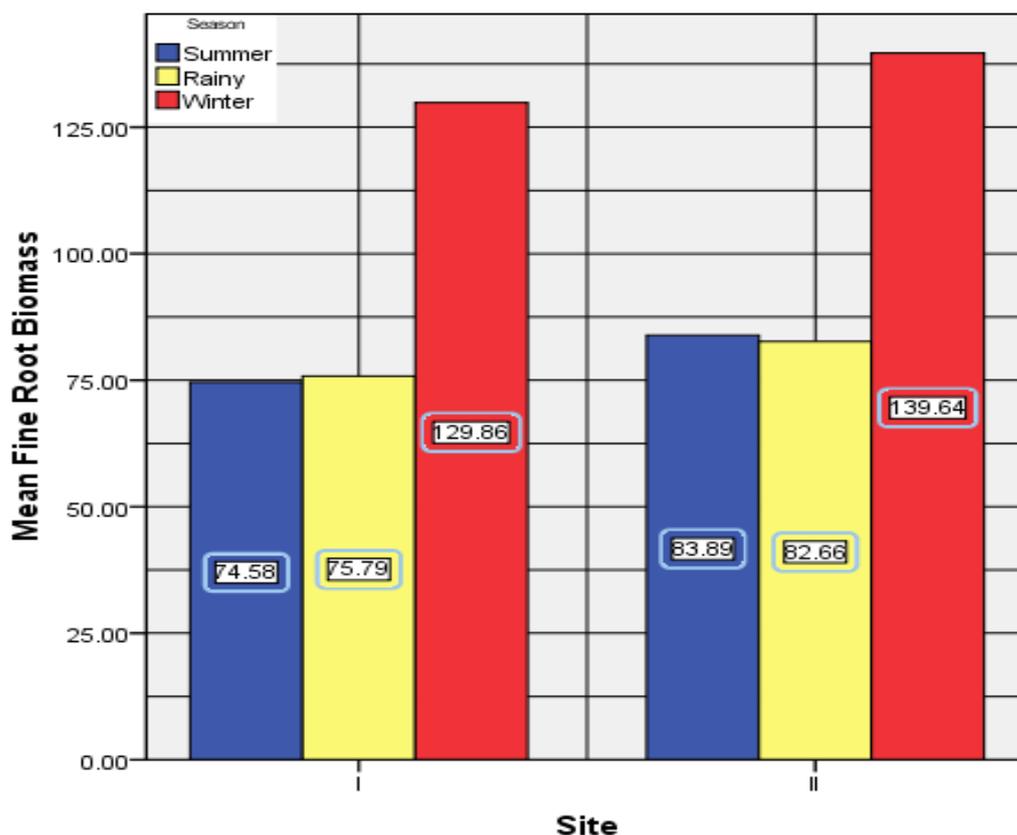
Figure – 2: Monthly variation in fine root biomass at different soil depth

**Table – 3**  
**Variation in fine root biomass in forest Site I and forest Site II**

Site	Month	N	Mean	S. D	95%CI for mean		Test value
					Lower	Upper	
<b>I</b>	January	9	137.33	62.20	89.52	185.14	F=2.25 P<0.05
	February	9	120.33	69.01	67.29	173.38	
	March	9	86.29	58.91	41.02	131.58	
	April	9	74.78	62.32	26.87	122.68	
	May	9	62.67	62.57	14.57	110.76	
	June	9	52.23	63.16	3.68	100.77	
	July	9	58.51	60.77	11.80	105.23	
	August	9	71.76	59.04	26.37	117.14	
	September	9	89.77	65.78	39.20	140.33	
	October	9	106.67	64.77	56.88	156.46	
	November	9	116.33	61.51	69.05	163.61	
	December	9	145.45	60.59	98.87	192.03	
	Total	108	93.51	66.53	80.82	106.20	
<b>II</b>	January	9	140.67	69.96	86.89	194.44	F=2.23 P<0.05
	February	9	129.33	67.77	77.24	181.43	
	March	9	97.67	64.88	47.80	147.54	
	April	9	83.67	67.40	31.86	135.47	
	May	9	70.33	66.04	19.57	121.09	
	June	9	57.79	65.62	7.35	108.23	
	July	9	65.08	64.46	15.53	114.63	
	August	9	80.74	63.85	31.66	129.82	
	September	9	96.67	66.10	45.85	147.48	
	October	9	113.00	63.47	64.21	161.79	
	November	9	128.00	57.58	83.74	172.26	
	December	9	160.56	64.51	110.97	210.15	
	Total	108	101.96	69.22	88.7543	115.16	

**Table – 4**  
**Seasonal variation in fine root biomass in forest Site I and forest Site II**

Site	Season	N	Mean	S. D	95% CI for mean		Test value
					Lower	Upper	
I	Summer	27	74.58	59.70	50.96	98.20	F=9.32 P<0.01
	Rainy	45	75.79	63.19	56.80	94.77	
	Winter	36	129.86	61.84	108.94	150.79	
	<b>Total</b>	<b>108</b>	<b>93.51</b>	<b>66.53</b>	<b>80.82</b>	<b>106.20</b>	
II	Summer	27	83.89	64.53	58.36	109.42	F=9.24 P<0.01
	Rainy	45	82.66	65.00	63.13	102.18	
	Winter	36	139.64	63.66	118.10	161.18	
	<b>Total</b>	<b>108</b>	<b>101.96</b>	<b>69.22</b>	<b>88.75</b>	<b>115.16</b>	



**Figure – 3: Seasonal variation in fine root biomass at Site-I and Site-II**

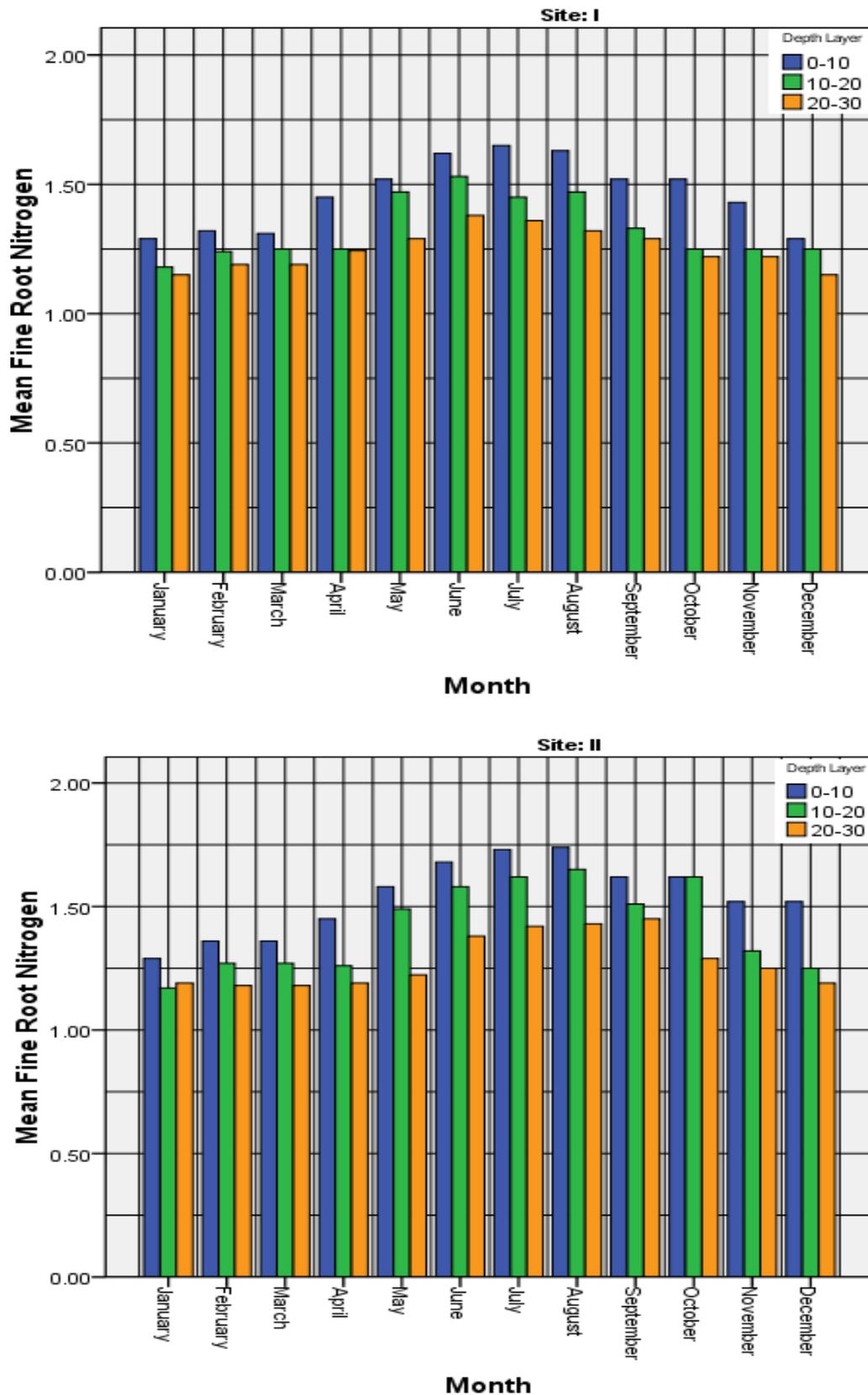


Figure – 4: Monthly variation in fine root Nitrogen concentration (%) at different soil depth

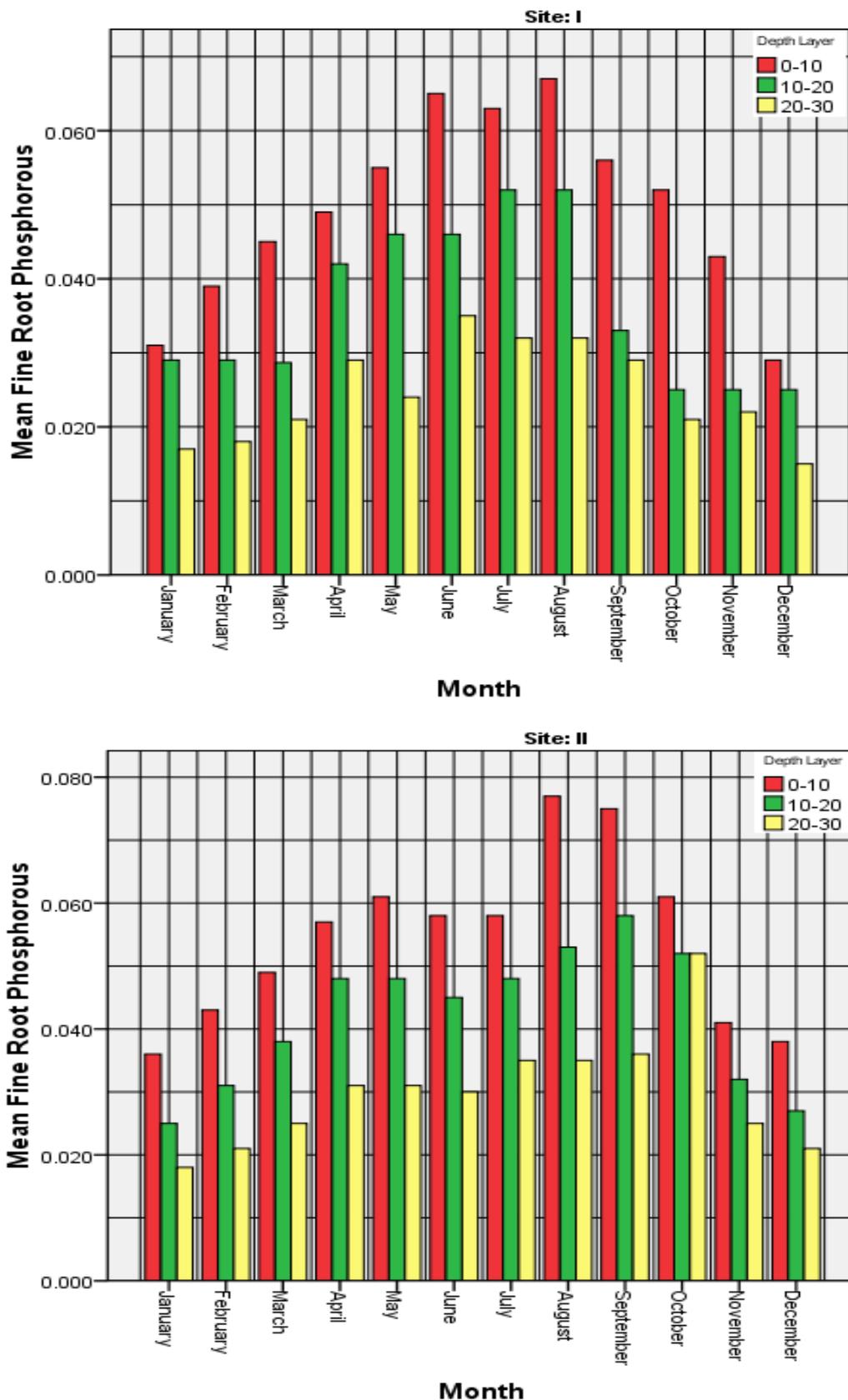
**Table - 5**

**Variation in fine root nitrogen concentration (%) at different soil depth**

Site	Season	Depth layer	Mean	S. D	N
<b>I</b>	Summer	0-10	1.43	0.09	9
		10-20	1.32	0.11	9
		20-30	1.24	0.06	9
		<b>Total</b>	1.33	0.12	27
	Rainy	0-10	1.59	0.06	15
		10-20	1.41	0.11	15
		20-30	1.31	0.06	15
		<b>Total</b>	1.44	0.14	45
	Winter	0-10	1.33	0.06	12
		10-20	1.23	0.03	12
		20-30	1.18	0.04	12
		<b>Total</b>	1.25	0.08	36
	Total	0-10	1.46	0.13	36
		10-20	1.33	0.12	36
		20-30	1.25	0.08	36
		<b>Total</b>	1.35	0.14	108
<b>II</b>	Summer	0-10	1.46	0.10	9
		10-20	1.34	0.11	9
		20-30	1.20	0.04	9
		<b>Total</b>	1.33	0.14	27
	Rainy	0-10	1.68	0.06	15
		10-20	1.60	0.05	15
		20-30	1.39	0.06	15
		<b>Total</b>	1.56	0.13	45
	Winter	0-10	1.42	0.11	12
		10-20	1.25	0.06	12
		20-30	1.20	0.03	12
		<b>Total</b>	1.29	0.12	36
	Total	0-10	1.54	0.15	36
		10-20	1.42	0.17	36
		20-30	1.28	0.11	36
		<b>Total</b>	1.41	0.18	108

**Table - 6**  
**Analysis of Variance of fine root nitrogen (%)**

<b>Site</b>	<b>Source</b>	<b>d. f</b>	<b>F-value</b>	<b>P-value</b>
<b>I</b>	Season	2	67.79	<0.01
	Depth	2	69.05	<0.01
	Season * Depth	4	2.62	<0.05
	Error	99		
<b>II</b>	Season	2	157.64	<0.01
	Depth	2	110.87	<0.01
	Season * Depth	4	3.81	<0.01
	Error	99		



**Figure - 5: Monthly variation in fine root Phosphorus concentration (%) at different soil depth**

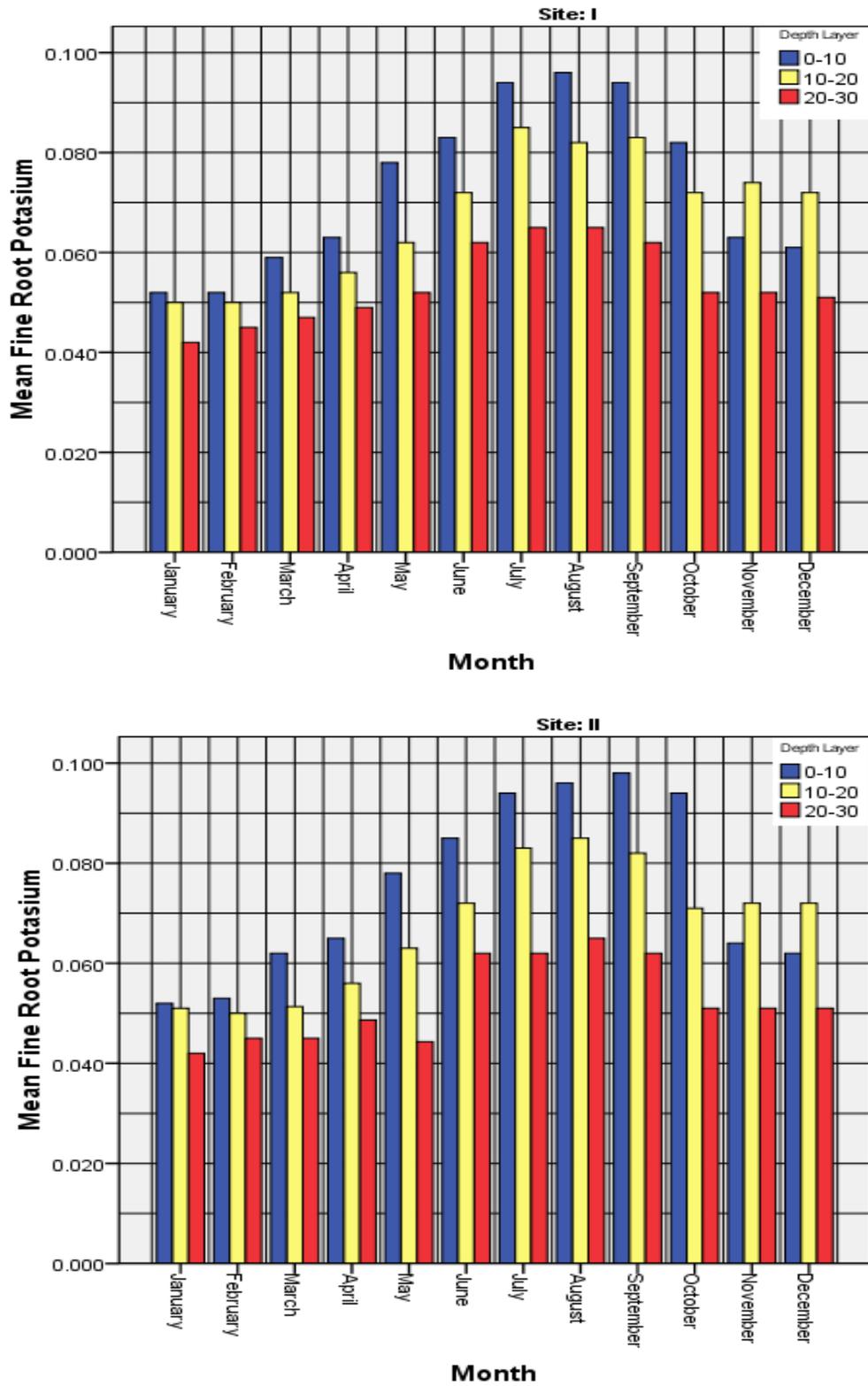
**Table - 7**

**Variation in Phosphorus concentration (%) in fine root at different soil depth**

Site	Season	Depth layer	Mean	S. D	N
<b>I</b>	Summer	0-10	0.050	0.005	9
		10-20	0.039	0.009	9
		20-30	0.025	0.004	9
		<b>Total</b>	0.038	0.012	27
	Rainy	0-10	0.655	0.748	15
		10-20	0.546	0.629	15
		20-30	0.720	0.587	15
		<b>Total</b>	0.640	0.647	45
	Winter	0-10	0.698	0.694	12
		10-20	0.640	0.638	12
		20-30	0.601	0.610	12
		<b>Total</b>	0.646	0.631	36
	Total	0-10	0.518	0.671	36
		10-20	0.450	0.588	36
		20-30	0.507	0.580	36
		<b>Total</b>	0.492	0.610	108
<b>II</b>	Summer	0-10	0.056	0.006	9
		10-20	0.045	0.005	9
		20-30	0.029	0.003	9
		<b>Total</b>	0.043	0.012	27
	Rainy	0-10	0.066	0.009	15
		10-20	0.051	0.005	15
		20-30	0.038	0.008	15
		<b>Total</b>	0.052	0.014	45
	Winter	0-10	0.040	0.003	12
		10-20	0.029	0.003	12
		20-30	0.021	0.003	12
		<b>Total</b>	0.030	0.008	36
	Total	0-10	0.055	0.013	36
		10-20	0.042	0.011	36
		20-30	0.030	0.009	36
		<b>Total</b>	0.042	0.015	108

**Table - 8**  
**Analysis of Variance of fine root phosphorous (%)**

<b>Site</b>	<b>Source</b>	<b>d. f</b>	<b>F-value</b>	<b>P-value</b>
<b>I</b>	Season	2	11.45	<0.01
	Depth	2	.098	>0.05
	Season * Depth	4	.152	>0.05
	Error	99		
<b>II</b>	Season	2	143.99	<0.01
	Depth	2	156.02	<0.01
	Season * Depth	4	3.15	<0.05
	Error	99		



**Figure - 6: Monthly variation in fine root Potassium concentration (%) at different soil depth**

**Table - 9**

**Variation of Potasium concentration (%) in fine root at different soil depth**

Site	Season	Depth layer	Mean	S. D	N
<b>I</b>	Summer	0-10	0.067	0.009	9
		10-20	0.057	0.005	9
		20-30	0.049	0.003	9
		<b>Total</b>	0.058	0.009	27
	Rainy	0-10	0.090	0.006	15
		10-20	0.079	0.006	15
		20-30	0.061	0.005	15
		<b>Total</b>	0.077	0.013	45
	Winter	0-10	0.057	0.006	12
		10-20	0.062	0.012	12
		20-30	0.048	0.005	12
		<b>Total</b>	0.055	0.010	36
	Total	0-10	0.073	0.016	36
		10-20	0.068	0.013	36
		20-30	0.054	0.008	36
		<b>Total</b>	0.065	0.015	108
<b>II</b>	Summer	0-10	0.068	0.008	9
		10-20	0.057	0.005	9
		20-30	0.046	0.003	9
		<b>Total</b>	0.057	0.011	27
	Rainy	0-10	0.093	0.005	15
		10-20	0.079	0.006	15
		20-30	0.060	0.005	15
		<b>Total</b>	0.077	0.015	45
	Winter	0-10	0.058	0.006	12
		10-20	0.061	0.011	12
		20-30	0.047	0.004	12
		<b>Total</b>	0.055	0.010	36
	Total	0-10	0.075	0.017	36
		10-20	0.067	0.013	36
		20-30	0.052	0.008	36
		<b>Total</b>	0.065	0.016	108

**Table 10**  
**Analysis of Variance of fine root potassium (%)**

Site	Source	d. f	F-value	P-value
<b>I</b>	Season	2	118.70	<0.01
	Depth	2	67.52	<0.01
	Season * Depth	4	8.91	<0.01
	Error	99		
<b>II</b>	Season	2	146.34	<0.01
	Depth	2	104.26	<0.01
	Season * Depth	4	12.38	<0.01
	Error	99		

**11: Fine root biomass in various forests of the world**

Sl.No	Forest type	Location	Diameter (mm)	Forest root biomass gm <sup>-2</sup>	Authors
1	Hardwood forest	USA	<2mm	471	Fahey and Hughes, 1994
2	Scot pine forest	Sweden	<2mm	145-656	Pearson et al, 1995
3	Tropical forest	India	<2mm	309	Sundarapandian et al, 1966
4	Cove hardwood forest	Coweeta	<2mm	468	Davis, 1997
5	Low elevation mixed oak	Coweeta	<2mm	793	Davis, 1977
6	High elevation mixed oak forest	Coweeta	<2mm	765	Davis,1997

7	Nothern hardwood forest	Coweeta	<2mm	657	Davis, 1997
8	Scot pine forest	Finland	<2mm	220-408	K.Mokkonin, 2001
9	Pine forest	Manipur, India	<2mm	132-236	Uma et al, 2002
10	Oak forest	Manipur India	<2mm	115-225	Uma et al, 2002
11	Pine forest	Norway	<2mm	250	Muukkonaen et al, 2006
12	Moist tropical forest	Florida	<2mm	433	OJ Valver de Barrentes et al, 2007
Sl.No	Forest type	Location	Diameter (mm)	Forest root biomass gm <sup>-2</sup>	Authors
13	Lowland forest	Florida	<2mm	433	Oscar et al, 2014
14	Deciduous temperate forest	USA	<2mm	357.96	Oscar et al, 2015
15	Picca abies forest	China	<2mm	278-366	Z.Y.Yuan 2017,2018
16	Sub tropical forest				
	i. Forest site I	Manipur, India	<2mm	31.89-169.82	Present study
	ii. Forest sitell	Manipur, India	<2mm	36.92-180.88	Present Study

# Accessibility and Utilisation of Antenatal Care (ANC) Services Among Pregnant Mothers Attending Antenatal Clinics. Case study: Mbale Regional Referral Hospital, Mbale, Uganda

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## Abstract

**Introduction:** World Health Organization (WHO) passed a resolution that ANC is a basic human right and all pregnant women should receive irrespective of age, parity, race, faith of the pregnant women and many interventions have been put in place to ensure that worldwide and nationwide. ANC is a necessary component of maternal health in order to identify complications and danger signs during pregnancy. Despite the interventions that have been undertaken to truncate the maternal and infant mortality rates through ensuring improved access by women to reproductive health care services in Uganda; the effectiveness of the interventions has not been observed thus a study on accessibility and utilisation of ANC services was conducted at ANC clinic of MRRH, Mbale district.

**Objectives:** The general objective of the study was to establish the factors influencing the accessibility and utilization of ANC services among pregnant mothers attending ANC clinic in Mbale Regional Referral Hospital. Specific objectives were: to determine the level of utilization of ANC services among pregnant mothers attending ANC clinic in MRRH, to assess the quality of ANC services provided to pregnant mothers attending ANC clinic in MRRH and to establish mother's attitudes and suggestions on improving ANC services in MRRH, Mbale district. **Methodology:** This was a descriptive cross-sectional study. Ninety-seven (97) questionnaires were self-administered to the mothers from the ANC clinic during their visit. While three (3) interviews were held with the health workers. Data were presented and analyzed in tables and figures, interpreted using frequencies, percentages. **Results:** Many of the mothers were between age of 20-24 43(44.3%), cohabiting mothers were the majority to be interviewed 47(48%). Those with gravid 5 were 5 (5%), 43(44%) had attained secondary education, 40% were peasants, 47(48%) had attended 2 visits, 76(78%) were aware of the importance of ANC early in pregnancy, 68 (70%) said opening days were convenient for them, 83(86%) didn't incur costs while utilizing ANC services. 93(96%) rated health workers as rude. Among the mothers interviewed 67(69%) received health education, 92(95%) received drugs for prevention of Malaria and Anaemia, 17(18%) were dewormed, 41(42%) underwent screening for hypertension, HIV infection, syphilis. **Conclusions:** Factors that were found to be associated with the utilization of ANC services included. Age, marital status, parity, gravidity, tribe, educational level, income level status of pregnant mothers, awareness about ANC services, distance, health facility inadequacy and ANC provider behaviors.

**Recommendations:** The researchers recommend the following; recruitment of more health workers, more emphasis on health education and extension of more ANC services to the remote areas by the Ministry of Health to increase the availability of the services and increase their awareness about ANC services. Mothers are recommended to seek services immediately they realize they are pregnant.

**Key Words:** Accessibility, Utilisation, Antenatal care, Pregnant Mothers, Mbale, Ilukor, Mayanja

## 1.0 Introduction and Background to the study.

### 1.1 Background of the study

Antenatal care is a planned programme of medical care offered to pregnant women by a skilled birth attendant, from the time of conception to delivery, aimed at ensuring a safe and satisfying pregnancy and birth outcomes. (UCG 2016, interactive)

According to the *United Nations Millennium Development Goals (2012)*, every year, at least half a million women and girls needlessly die as a result of complications during pregnancy, childbirth or the 6 weeks following delivery. Almost all (99%) of these deaths occur in developing countries. Reproductive health is a priority program for all African countries, including Uganda, a developing country, where maternal mortality continues to be a major problem.

*World Health Organization (2009)* passed a resolution that antenatal care is a basic human right and all pregnant women should receive irrespective of age, parity, race, faith of the pregnant women and many interventions have been put in place to ensure that worldwide and nationwide. ANC is a necessary component of maternal health in order to identify complications and danger signs during pregnancy. Regular ANC visits can provide some benefits for the women such as a strong relationship between women and the health care provider that can result in reducing complications during pregnancy. Women in rural areas in Uganda tend to receive less ANC visits than urban women. Developing countries account for more than 99% of all maternal deaths; about a half occurring in sub Saharan Africa and a third in South Asia.

There is a slow progress towards achieving the fifth goal of the Millennium Developments Goals (MDG) of 2020 in most developing countries including Uganda. The fifth goal aims to reduce the maternal mortality rate through ensuring that women access good quality reproductive health care and effective interventions some of which include ANC (WHO, 2005). But with failure to achieve the goal the maternal mortality will be seen to continue rising.

According to WHO (2003), ANC plays an important role in ensuring a healthy mother during pregnancy and a healthy baby after delivery. It was estimated that 25% the maternal deaths were mainly due to five major causes: hemorrhage; followed by eclampsia, infection (sepsis), abortion complications and obstructed labor yet such problems can be prevented since ANC programs are designed to maximize good health outcomes like low maternal mortality rates and low neonatal mortality, low cases of postpartum anemia and delivery of children with appropriate birth weight. Other issues compounding maternal mortality are lack of knowledge and preparedness about reproductive health in the family, community and health providers. Also there are inadequate numbers of reproductive health specialists to manage complicated pregnancies and deliveries and there is inadequate quality and access to all levels of obstetric care and other reproductive health service. To prevent unwanted outcomes of pregnancy, antenatal care (ANC) is the most important method for detecting pregnancy problems in the early period.

ANC is a critical element for reducing maternal mortality, and for providing pregnant women with a broad range of health promotion and preventive health services. One of the most important functions of ANC is to offer health information and services that can significantly improve the health of women and their infants. ANC is also an opportunity to inform women about the danger signs and symptoms for which immediate assistance should be sought from a health care provider. Furthermore, in many developing countries a Traditional Births Attendant (TBA) is still the dominant person, especially in rural areas. In Uganda, TBAs are popular with pregnant women for a number of reasons; such as not being expensive, similar beliefs, tolerant and kind. In addition, some of the reasons for high antenatal visit drop-outs in Mbale Uganda were: women perceived the need for the midwife only if there was a problem; women were more comfortable with a TBA because she spent more quality time with them and used a barter system for payment; women feared they could not afford to pay

the price of the health center midwives; and women didn't have confidence in the new village midwives because they were often young, unmarried, and inexperienced.

According to a World Health Organization (*WHO, 2015*) report, the Indonesia Maternal Mortality Rate (MMR) continues in the high range of 420/100,000 live births, while coverage of births assisted by skilled providers is still low. And analytical review of the recent World Health Statistics showed that ANC coverage, between 2006 and 2013, was indirectly correlated with MMR worldwide. This indicates that countries with low ANC coverage are the countries with very high MR. For instance, ANC coverage in United Arab Emirates was 100% with MMR of 8 per 100,000 and Ukraine had 99% ANC coverage and MMR of 23%. By comparison, in the sub-Saharan Africa with ANC coverage of 49%, Ghana had ANC coverage of 96% and MMR of 380/100,000. Chad had 43% ANC coverage with MMR of 98/100,000 Nigeria had ANC coverage of 61% and MMR of over 560/100,000. Nigerias MRR is clearly above the African and global average of 500 and 210 respectively. In Kenya the maternal mortality rate of 1,000 per 100,000. (*WHO, 2011*). The poor maternal health outcome in Nigeria could be as a result of poor ANC utilization but could also be as a result of poor quality care. Despite the association of maternal health with quality of care the ANC coverage may not provide information on the quality of care provided.

The numbers of ANC visits vary depending on the country. In Western Europe, North America and many other countries ANC includes 12-16 visits to health care services by the pregnant woman, as well as provider visits to her home. Even so, the WHO and the Uganda government recommended a minimum of four ANC visits for a woman with a normal pregnancy; first visit being at 12 weeks but not later than 16 weeks of gestation, second visit at 24 weeks to 28 weeks, third visit at 32 weeks and fourth at 36 weeks. A review of studies from various countries indicates that the ANC utilization rate is still low due to many factors that need to be examined such as socio-demographic features, knowledge of social support and ANC services. Maternal and child welfare is not only related to health services provided by government and private organizations, it is also related to women as mothers including their education, economic status, culture, environment, and professional development. For example, a study in Xien Khouang Province, Lao PDR showed that significant predictors of ANC utilization were level of education, income, knowledge, attitude, distance to service, availability of public transportation, cost of transportation, and cost of services. Inadequate access and under-utilization of modern health care services were major reasons for poor health in developing countries. To improve planning and provision of ANC in a specific setting it is important first to be able to characterize those women and their families not receiving adequate care. Few studies with that perspective have been conducted in developing countries including Uganda.

### **1.2 Statement of the problem.**

In the MRRH hospital profile written in November 2015, it showed an annual attendance of ANC of 28,141 women and an annual delivery number of 1014. The trend of the deliveries in the health facility and attendance of ANC, shows a close relationship between the two evidenced by the decreasing trend of attendance of ANC in view of this the researchers sought to establish the causes responsible for the trend of ANC utilization in MRRH. Therefore, the task of the study was to determine the level of utilization of ANC services among pregnant mothers and to assess the quality of ANC services provided to pregnant mothers as well as establishing mother's attitudes and suggestions on improving ANC services.

Antenatal care service utilization in developed countries of better compared to that in developing countries. In Uganda 48% of pregnant mothers who made four or more antenatal visits during pregnancy for their most recent births, less than 40% were assisted by a skilled health provider. (*WHO/UNICEF, 2003*), factors that have led to low utilization of ANC services include; lack of awareness and inadequate health education about ANC services, inadequate health workers, unskilled health workers who don't abide by medical ethics, long distance from the health facilities, low male participation in ANC services and traditional beliefs.

Low utilization of ANC services has resulted into complications to both mother and new born, for example mother to child transmission of HIV/AIDS and any other risk factors in pregnancy like anemia which results into increased maternal and child mortality and morbidity rates.

### **1.3 Objectives of the study**

The study was guided by both general and specific objectives

#### **1.3.1 General Objective**

The study aimed to establish the factors influencing the accessibility and utilization of ANC services among pregnant mothers attending ANC clinic in Mbale Regional Referral Hospital so as to reduce on infant morbidity and mortality rates.

#### **1.3.2. Specific Objectives.**

The study was guided by the following specific objectives;

- a. To determine the level utilization of ANC services among pregnant mothers attending ANC clinics in MRRH.
- b. To assess the quality of ANC services provided to pregnant mothers attending ANC clinics in MRRH.
- c. To establish mother's attitudes and suggestions on improving ANC services in MRRH.

### **1.4 Research questions**

The study sought to answer the following research questions;

- a. What is the level of utilization of ANC services among pregnant mothers attending ANC clinics in MRRH?
- b. What is the quality of ANC services provided to pregnant mothers attending ANC clinics in MRRH?
- c. What are the mother's attitudes and suggestions on improving ANC services in MRRH?

### **1.5 Justification of the study**

Despite the Uganda government efforts through the ministry of health to provide and promote ANC services, effects of not or underutilizing these services such as maternal and infant morbidity and mortality rates are still high. Low utilization of antenatal care services is the major cause of high maternal and child mortality rates in Uganda. it's important that factors affecting the utilization of antenatal services should be identified first in the communities.

Over the world studies have been conducted by different individuals on the factors influencing the accessibility and utilization of antenatal services among pregnant mothers. However not much is known about antenatal care in MRRH so there is a need to design most appropriate interventions for most pregnant mothers to attend, get access to and utilize antenatal services. My study will establish whether ANC services are utilized and will thus provide information which may be used in future to make appropriate interventions to improve on the accessibility, utilisation of ANC services by mothers and quality of ANC services effectively and efficiently

### **1.6 Significance of the study**

This study was intended to fill in gaps on the existing information about the utilization of antenatal services by adding on the growing body of information needed by mothers, health workers of MRRH, MOH by providing strategic information to complement facility-based ANC services.

The findings in this study helped in developing appropriate message and opportunity that may in future help pregnant mothers to get access to and utilize antenatal care services effectively

This study determined the number of women who attend and utilize ANC services, assess the quality of ANC services provided to pregnant mothers and establishment of mother's attitudes and suggestions on improving ANC services and resources. The results of the study will be used to make necessary interventions to reduce morbidity, mortality and complications during pregnancy and delivery

Their perspectives provided vital information for policymakers, health workers, donors, and communities on how to prevent infant, maternal mortality and morbidity rates.

### **1.7 Scope of the study**

This was categorized as content scope and time scope and geographical scope

#### **1.7.1 Content scope**

The study was about accessibility and utilisation of antenatal care services among pregnant mothers attending ANC clinic, the level of utilization of ANC services and the quality of ANC services provided to pregnant mothers as well as the mother's attitudes and suggestions on improving ANC services.

#### **1.7.2 Time scope**

The study covered a period of five months that is from January to May 2018.

#### **1.7.3 Geographical scope**

The study was conducted in Mbale Regional Referral Hospital in Mbale district

#### **1.7.4 Respondent scope**

The study was limited to the pregnant mothers attending ANC in MRRH

### **1.8 Limitations to the study**

The researchers encountered the following limitations in the study;

First, some health workers were not willing to give their opinions. Here, the researchers probed the health workers and got their opinions on the study.

Secondly, Financial resources to support research were inadequate since the researchers had to meet all the costs in the study. However, the researchers did their best to minimize the costs of the study as much as possible and seek financial support from family and friends

Thirdly, there was limited time to conduct the research due to the busy schedule of school activities.

Lastly, the researchers were also limited by language barrier since mothers spoke different language some of which was completely different from what the researchers knew.

## **2.0 Literature Review**

Antenatal care is observed to be a necessity for every woman and the newborn baby. The researchers reviewed literature related to; the level of utilization of antenatal services among pregnant mothers attending ANC, the quality of ANC services provided to pregnant mothers in MRRH and mother's attitudes and suggestions on improving ANC services in MRRH. This information was obtained from several publications including textbooks, Reports, Journals, and the Internet sources.

### **2.1 Level of Utilization of ANC services among pregnant mothers attending ANC.**

The experience of being pregnant encompasses physiological, psychological, spiritual and socio- cultural dimensions (*WHO, 2003*). Antenatal care (ANC) services are essential for a healthy pregnancy and child delivery though some workers argue that this is still an on-going debate (*Adjiwanou & LeGrand, 2013*). *Conrad et al. (2012)* argue that experience from countries which have achieved low maternal mortality suggests that access to good-quality maternity services is critical to the improvement of maternal health. ANC is an interactive process between the pregnant woman and the medical personnel such as doctors, nurses and midwives. Like any other social interaction, it is influenced by socio-cultural definitions and perceptions particularly on pregnancy itself in this case. These definitions, perceptions and beliefs depend on the cultural and value systems.

In 2007, the World Health Organisation reported that 1,500 women die every day from pregnancy and childbirth related complications the world over. In 2005 it was estimated that 536,000 maternal deaths occurred

worldwide due to pregnancy related complications (*WHO,2007*). Though in 2012 a 47% decline in annual maternal deaths was reported (*UNFPA/UNICEF/WHO/ World Bank, 2012*), it was still noted that many countries, particularly in sub-Saharan Africa will fail to reach the Millennium Development Goal target of reducing maternal death by 75% from 1990 to 2015. Developing countries account for 99% of all the deaths and most of these deaths are due to direct causes of pregnancy complications (*WHO, 2014*). In developing countries, complications of pregnancy and child birth are the leading causes of death and disability among women within the reproductive age group.<sup>46</sup>

Countries with good indicators in maternal and infant mortality have pregnancy related complications identified and managed early, however according to UBOS the overall one-time antenatal attendance in Uganda was found at 94% with women in rural areas being twice less likely to attend ANC than the urban women. According to the report only 8% of rural women in Uganda received ANC from a doctor. Regionally Southwestern Women were more likely to receive skilled care (20%), than Eastern women (3%), while only 2% of the women in Karamoja were reported to seek the same. It was reported that women in Uganda tend to seek antenatal care very late—37% attending for the first time at 6 months or more. Globally, developing countries still face a challenge of poorly implemented ANC programs with irregular clinical visits and long waiting times plus poor feedback to the women. (*United Nations, 2012*).

A study in Hadiya zone, Ethiopia found that majority of the mothers who attended ANC did not receive adequate number of visits and initiated the visits later than recommended by the World Health Organization. A similar study done in Nigerian teaching hospital found that Nigerian women tended to obtain care late in pregnancy, and about one third the care was inadequate with almost half (47 percent) of women attending the ANC clinic in the third trimester. The ANC Service utilization in Ethiopia was significantly influenced by maternal age, where mothers aged between 25 – 29 years were less likely to utilize ANC service than women who were 35 years and older. Positive husband attitude towards ANC was also significantly related to ANC service utilization. Mothers' level of education influenced the use of ANC for which Mothers with primary educational level were more likely to attend ANC than women who are unable to read and write. This study further revealed that availability of women's time is important as women spend more time on their multiple responsibilities for care of children, collecting water or fuel, cooking, cleaning, and trade than on their own health (*USAID, 2010*).

In Hadiya; Ethiopia; Family size was a strong determinant of ANC service utilization with greater household size limiting the use of ANC service. A study done by *Simkhada B, et al. (2015)* also included maternal education, husband's education, marital status, availability, cost, household income, women's employment, media exposure and having a history of obstetric complications. But not leaving out Cultural beliefs, Parity and ideas about pregnancy. Whilst women of higher parity tend to use antenatal care less. Another study done in Ibadan, Nigeria (*owoyokun KE, 2010*) revealed that Women who were Muslims or other religions were more than 2 times likely to attend ANC clinic than women who were Christians. The same study showed that Women who were 25 years and older utilized ANC more than women who were below 25 years of age which agrees with study made in Bangladesh. (*Schmidt j-O and Wang H, 2012*). A study done in rural Local Government Area in Ogun State, Nigeria, identified that women preferred TBAs for various reasons which included: cheap easily accessible culturally acceptable services and more compassionate care than orthodox health workers, and for some it was the only maternity they knew. However, some respondents acknowledged that complications could arise from TBA care. (*UNFPA, 2011*)

In many countries, TBAs are an important source of social and cultural support to women during childbirth and due to economic constraints, and the difficulty in posting trained professionals to rural areas; many women continue to deliver with TBAs. A study done in rural Uganda (*Ebuehi OM and Akintujoje IA, 2012*) revealed ANC attendance being irregular with few women appreciating the fact that ANC attendance was to monitor both the growth of the baby and the health status of the woman. This study also identified Parity as significantly influencing ANC attendance, but level of education, religion and marital status did not. Several factors influenced Ugandan women ANC seeking behavior which included: perceived high cost of (ANC services, conducting a delivery and treatment), and perceived inadequacy of services provided by the formal health system. Another study in India economic disparity along with cultural belief and restrictions determined care seeking behavior and utilization of health care, resulting in slow decline of child mortality rate. (*Cathy Tukei, 2015*), The recent Uganda Maternal Health review revealed that access to the basic antenatal care services has significantly declined. The Ministry of Health, Uganda in adherence of *WHO (2016)* recommends a simplified antenatal care of four visits; First visit: occurring in the first trimester, between (10 – 20) week of pregnancy, second visit: scheduled close to week 26 (20 – 28) of pregnancy, third visit: occurring in or around week 32 (28 – 36) of pregnancy, and lastly Fourth visit (final visit): taking place between weeks 36 and 38 (>36) of pregnancy.

## **2.2 Quality of ANC services being provided.**

Quality of ANC has been designated one of the four Pillars of Safe Motherhood along with clean and safe delivery, essential obstetric care and family planning which could contribute to reduction of neonatal mortality (*Akter et.al 2016*)<sup>47</sup> and maternal mortality (*Carroli, et al 2011*). Good quality maternal health services are those which among others, are readily accessible, are safe, effective, acceptable to potential users and are the antenatal visits at a health facility staffed by technically competent people, provide prompt comprehensive care and/or linkages to other reproductive health services provide continuity of care and where staff are helpful, respectful and non-judgmental (*Ashish et.al, 2016*).

Quality of ANC depends on how women attend, initiate antenatal visits at a health facility. According to *UNICEF/WHO(2013)*, about 70% of women worldwide had at least one antenatal visit with a skilled provider during pregnancy. ANC coverage was extremely high in the industrialised countries, with 98% of women having at least one visit. In the developing world antenatal care use was around 68%. The region of the world with the lowest levels of use was South Asia, where only 54% of pregnant women have at least one antenatal care visit. In the Middle East and North Africa, use of antenatal care was somewhat higher (65%). In sub-Saharan Africa, about 68% of women report at least one antenatal visit. The levels in the remaining regions of the world range from 82% to 86%.

Availability of resources plays a bigger role in provision of quality ANC services (*Valera, 2014*).<sup>47</sup> However, despite the high ANC attendance in most developing countries, a major problem hindering quality of ANC is inadequate resources. In a qualitative study done in Zimbabwe, health workers during in depth interviews expressed concern over shortage of antenatal resources such as drugs, staff, electricity and telephone and debilitated condition of the facility. Another study to assess quality of ANC IN Tanzania revealed that the quality of ANC was affected by lack of skills by staff, shortage of drugs, and inadequate stationary. Supply shortages (lack of drugs, equipment, gloves and reagents for urine and VDRL), infrastructure problems, and human resources to provide antenatal services have been cited as the major shortfalls in providing quality ANC

in developing countries .Furthermore in many facilities often the available supplies are inadequate and erratic (*Chintu & Susu 2012*). This is not unexceptional in Uganda though no study has come out clearly.

Substandard care resulting from poor staff supervision, underpayment, overworking and inadequate staff training or lack of refresher courses to upgrade staff skills have been reported in some studies. A study in Masawingo Zimbabwe revealed substandard care during antenatal period which resulted from lack of skills contributed to significant proportion of maternal deaths. (*Boller, 2013*).

### **2.3 Mother's attitudes and suggestions on improving ANC services.**

Improve routine screening for pregnancy induced hypertensive disorders, anemia and syphilis Rationale: Hypertensive disorders, anemia and syphilis are some of the leading maternal conditions associated with still births in developing countries (*WHO 2016*). Screening for these conditions during antenatal care therefore facilitated early identification and hence treatment of these complications in a bid to reduce the high macerated still birth rate of 8.9/1000 live births (*Jan – Dec 2014, baseline data*) in the SMGL supported facilities in the region. Hypertensive disorders were the third leading cause of maternal death in 2015/16 in Uganda. Although preeclampsia may not be absolutely preventable, deaths due to this condition can be prevented by routine screening, which involves blood pressure measurements and urine testing. These must be done for all pregnant mothers in pregnancy and during labor as guided by the Ministry of Health, whose improvement Objective is to increase to 80% the number of ANC mothers screened and managed for pregnancy

According to the delivery of improved services for health (*DISH*) project (2000), their clients recommended that those concerned should address the following, qualified staffs, accessibility, long waiting times, provider behaviour, drug availability, maternal education, husband education, lowering costs of ANC services, reducing long distances from the health facilities, house income, men involvement and media exposure.

Identify and register pregnant women in the community, Specific Problem being addressed, Change concept, Change ideas tested, Steps in introducing the change ideas. Evidence that the changes led to improvement Scale of implementation, No information on existing pregnancies in the community, Develop a system of identifying pregnant women in the community Register women of child bearing age and evaluate for signs and symptoms of pregnancy. VHTs records all household members in the village register. For every woman of child bearing age registered, the VHT asks women if they experienced the signs of pregnancy on his list. Women who missed the past two menstrual periods are sent to health facilities for a test using a referral. Evaluated with medium rank 80 villages Ask women about possible pregnancies in the community. During community meetings or interactions with community members, a VHT asks non-pregnant women about pregnant women in their neighborhood. The VHT is informed about the locations of the pregnant women and are visited, Evaluated with high rank 80 villages Identify unregistered pregnant women during ANC visits, (*UNICEF 2013*).

All pregnant women attending ANC at health facilities are asked if they are registered by their VHT. VHTs are informed by the health worker about the women who are not registered in their villages. The household number from the village register is written on the mothers ANC record by the VHT as proof of registration. A mother missing this number implies no registration (*WHO, 2015*). Mothers also suggest that in order to escalate the numbers of pregnant women utilising ANC services, key influencers should be involved e.g. mothers in law, use pregnant women to link their peers to VHTs, elder women, Traditional Birth Attendants, VHT talks to influence mothers during a home visit. VHT explains the benefit of early ANC to influencers. Using the list of

pregnancy signs, he asks elder persons or mothers in-law, he also asks if there are suspected pregnancies in the household. ( *USAID, 2017*).

Follow up pregnant women for ANC, locate pregnancies in the community Update and identify homes of pregnant women on the village map. Raise awareness on benefits of ANC and facility delivery and danger signs, Involve opinion leaders in low uptake communities to raise awareness about importance of ANC and facility deliveries, Conduct focused dialogue meetings with pregnant women and community members to find reasons for low uptake for services and address concerns ( *WHO, 2017* ) .

### **3.0 Methodology**

#### **3.1 Study design**

This study was a descriptive cross-sectional design. This design was chosen for study because it would generate results in a relatively short time and may serve as a foundation for further studies about ANC service utilisation.

#### **3.2 The study area.**

The study was carried out in antenatal clinic of MRRH in Mbale district Eastern Uganda. MRRH is located in Mbale municipality. Mbale district is 224.2km from Kampala the capital city of Uganda. The hospital services benefit the following districts; Tororo, Sironko, Pallisa, Kumi, Bududa, Budaka, Busia, Manafwa. MRRH is a teaching and practicing hospital for medical students. The hospital has got 6 major departments which include; gynecological and obstetric department, surgery, pediatrics, medicine and psychiatric department. Antenatal care was my study area, under gynecological and obstetrics department. It is headed by a senior nursing officer who is the in-charge.

Activities carried out in ANC clinic in MRRH include: Health education /health promotion, Counseling to alert mothers on danger signs and help mothers to plan for child birth, Assessment of mothers which includes history taking, physical examination and screening tests, and giving prophylaxis medication and immunization against tetanus.

#### **3.3 Study variables**

The study variables were;

**Table 3.1 Showing the study variables**

<b>Independent Variables</b>	<b>Dependent Variables</b>
-Level of Quality of ANC Services -Attitudes of Mothers	-Level of Utilization of ANC Services

### **3.4 Study population**

The study consisted of all pregnant mothers that attended the antenatal clinic department in April 2018.

#### **3.5.0 Selection criteria**

The selection of participants in the study depended on some factors and these factors led to either inclusion or exclusion from the study.

##### **3.5.1 Inclusion criteria**

All pregnant mothers who attended MRRH antenatal clinic in the month of April 2018 and who accepted to be interviewed after consenting were recruited in the study until a projected sample size was achieved.

##### **3.5.2 Exclusion criteria**

Mothers with the following characteristics were excluded;

All the mothers who didn't consent to the study and those unwilling to participate were excluded

All mothers who were not residents of Mbale district.

### **3.6 Sample size determination**

About 25% of the mothers attending ANC clinic in MRRH have children aged 0 to 5 years. Due to limited resources and for convenience purposes, a sample size of 100 respondents was used. The sample size of this study was calculated using the following formula:

$$n=QR/O \text{ (Bourbon's formula)}$$

Where n= sample size

Q= number of days spent in data collection.

R= maximum number of respondents interviewed per day.

O= maximum time taken while interviewing.

$$Q=10$$

$$R=10$$

$$O=1$$

$$\text{Then } n=10 \times 10/1$$

$$n= 100 \text{ respondents}$$

**Table 3.2: showing distribution of participants**

Category of respondents	Number
Mothers	97
Health worker	3
<b>Total</b>	<b>100</b>

### 3.7 Sampling techniques.

The researcher used purposive sampling and simple random sampling.

#### 3.7.1 Purposive sampling

Health workers were selected using purposive sampling techniques. Purposive sampling refers to selecting samples based on the characteristics of the population and objective of study.

#### 3.7.2 Systematic random sampling

Systematic random sampling technique was used to select mothers. Systematic sampling is a method in which sample members from a larger population are selected according to a random starting point and a fixed periodic interval

### 3.8 Sampling procedure

#### 3.8.1 Purposive sampling

Health workers were selected since they were aware of the study and had knowledge about it. Those who were interested to participate were included in the study maximum of 3 (three).

#### 3.8.2 Systematic random sampling

Mothers were selected systematically as every 3rd pregnant mother was selected to be part of the study.

### **3.9 Data collection methods**

Questionnaire survey and interviewing methods were used in data collection.

#### **3.9.1 Questionnaire survey**

The researcher used self-administered questionnaires to collect data from respondents.

#### **3.9.2 Interviews**

In this method, the researchers met the respondents face to face and obtained information concerning the study under investigation. The interviews were conducted with an interview guide

### **3.10 Data collection tools.**

#### **3.10.1 Questionnaire**

*Ahuja (2005)* defines a questionnaire as a form of interrelated questions prepared by the researcher based on objectives of the study. The data for the study was collected by use of a self-administered and structured questionnaire (see a copy in appendix IV). The questions gained insight on the factors influencing the utilization of ANC among pregnant mothers. The questionnaire was therefore used to collect quantitative data.

It was issued to mothers who visited the ANC clinic during the month of February 2018. After they had made informed consent by signing a consent form. For those who didn't know how to read or write but were willing to participate were assisted by the researcher.

#### **3.10.2 Interview guide**

Three interviews were held with health workers to get in depth information on the study especially the quality of services delivered and the health worker role in providing ANC services with the use of the interview guide (see a copy in appendix III).

### **3.11 Data collection procedure**

After approval of the research proposal and data collection instruments by the Supervisor, an introductory letter was obtained from the Principal of Mbale School of Clinical Officers permitting the researchers to conduct research at ANC clinic in MRRH. This letter was given to the District Health Officer (DHO), Mbale district. The DHO sent the author to the in charge of MRRH who allowed the author to carry out the study in that area. The hospital staff informed the respondents, then the interviewers introduced themselves and explained the study to the respondents

The respondents participated in the study by informed consent either verbally or by signature. Data was collected using pretested questionnaire and was either be sent administered for literature respondents or by interview for illiterate respondents. At least 10 respondents were interviewed each day for 10 days until 100 respondents were achieved.

### **3.11 Data quality control**

Quality was ensured on data collection by allowing enough time for interviews, repeating some interviews with questionnaire which had incomplete work, explained the meaning of each question, translated questions to local languages and ensured confidentiality of the information that was collected

### **3.12 Data analysis and presentation**

Data analysis was immediately done after data collection. Data was coded. The authors analyzed data using SPSS statistical package (version 20.0). After data analysis, data was presented in frequency tables and bar graphs. Descriptive statics such as mean, frequencies, and percentage were used.

### **3.13 Ethical consideration.**

Ethical consideration in relation to scientific research is premised on the protection of the right of participants in such research projects.

The introduction letter (see a copy in appendix x) from the Academic Registrar, Mbale School of Clinical Officers was presented to the relevant authorities in MRRH who granted permission for the study to be conducted in the antenatal clinic. (see a copy in appendix ix)

The researchers assured the staff of MRRH that the data obtained was kept confidential.

The participants were duly informed that their participation in the research survey was purely voluntary. There was no punitive measure taken against those who declined to participate neither any reward for participation. The researcher explained in details the purpose of carrying out the study and highly safeguarded and observed the respondent's confidentiality and privacy by not writing or disclosing the respondent's name in the report.

All information therefore obtained in the course of the study was treated with confidentiality and was not used outside the scope of the study.

### **3.14 Project Management and Administration.**

#### **3.14.1 Project administration**

The project was administered as follows; -

**Table 3.3: Showing Project Administration**

<b>Title</b>	<b>Responsibility</b>
▪ Researcher	▪ Designing data collection tools, collecting and analyzing data and report writing.
▪ Research Assistant	▪ Collecting data
▪ Data Entrant clerk	▪ Entering data into SPSS
▪ Supervisor	▪ Reviewing the data and report

### 3.14.2 Project Work Plan.

This project took five months that is from January 2018 to May 2018 (see a copy of the work plan in appendix IV).

### 3.14.3 Project Budget

This project costed an estimated figure of seven hundred thousand shillings (700,000). (see a copy in appendix V attached).

### 3.15 Dissemination of results

Five copies of this study were printed out and distributed as follows; One copy to the school administration, and the second copy to the administration of Mbale Regional Referral Hospital for reference purposes, the fourth copy was retained by the researchers for future references when doing research in a related field.

## 4.1 Findings

### 4.1 Social-demographic characteristics

This section presented the socio economic and demographic characteristics of respondents. The study considered the age, religion, tribe, marital status, number of lives births, level of education, participants' employment status.

**Table 4.1.1 Showing the distribution of respondents by age.**

<b>Age group (years)</b>	<b>Frequency(n=97)</b>	<b>Percentage (%)</b>
15-19	15	15.5
20-24	43	44.3
25-29	30	30.9

>30	09	9.3
<b>Total</b>	<b>97</b>	<b>100</b>

Source; Field data, (2018)

As seen in table 4.1.1 above, of the total 97 pregnant mothers recruited in the study, there were 15(15.5%) were between the age of 15-19 years, 43(44.3%) were between 20-24years, 30(30.9%) were between 25-29 years, 09(9.3%) were above 30 years.

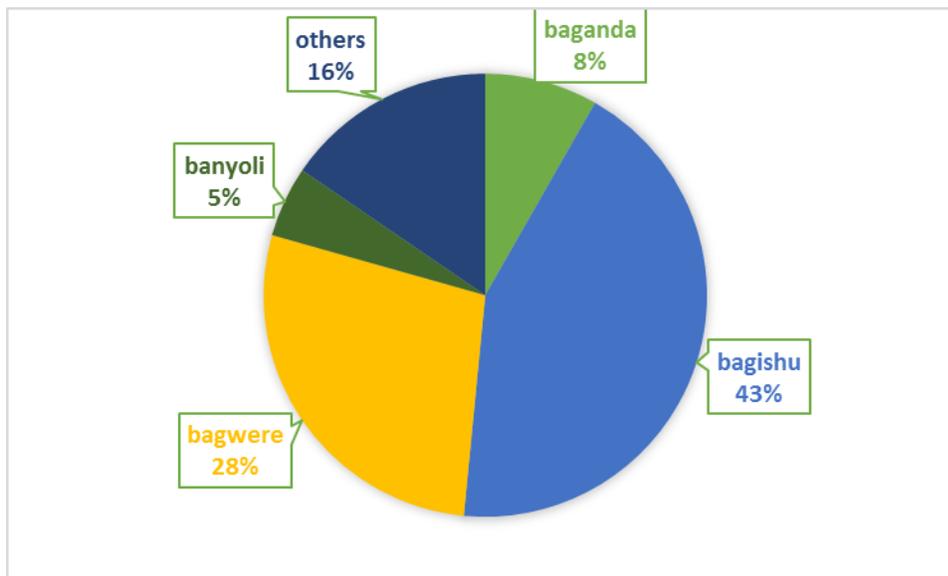
**Table 4.1.2 Showing the distribution of respondents’ religion**

Religion	Frequency(n=97)	Percentage (%)
Catholic	48	49.5
Muslim	05	5.1
Protestant	25	25.8
Others	19	19.6
<b>Total</b>	<b>97</b>	<b>100</b>

Source; Field data, (2018)

Data in respondent's religion shows that 48(49.5%) respondents were Catholics, 05(5.1%) were Muslims, 25(25.8%) were protestants, 19(19.6%) were from other religions

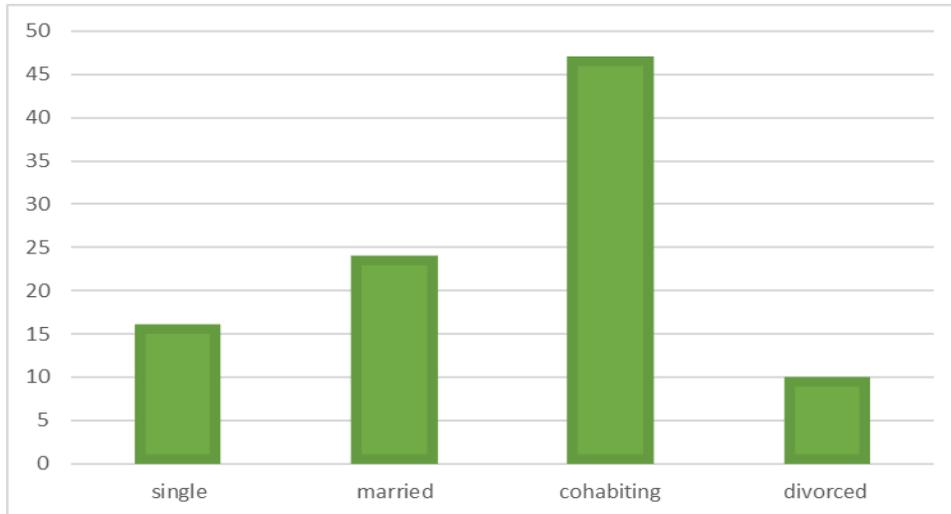
**Figure 4.1.1; Distribution of respondents according to tribe**



Source; Field data, (2018)

Majority of the respondents, 42(43%) were Bagishu, 27(28%) were Bagwere, 15(16%) were from other languages ,8(8%) were Baganda, and 5(5%) were Banyoli.

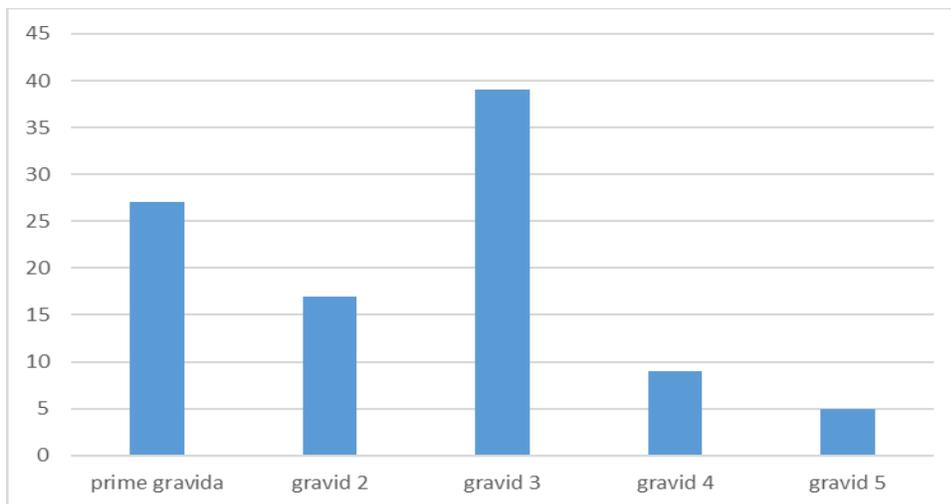
**Figure 4.1.2. Showing the distribution of respondents according to marital status**



Source; Field data, (2018)

Of the pregnant mothers interviewed, 47(48%) were cohabiting, 24(25%) were married,16(17%) were single. 10(10%) were divorced.

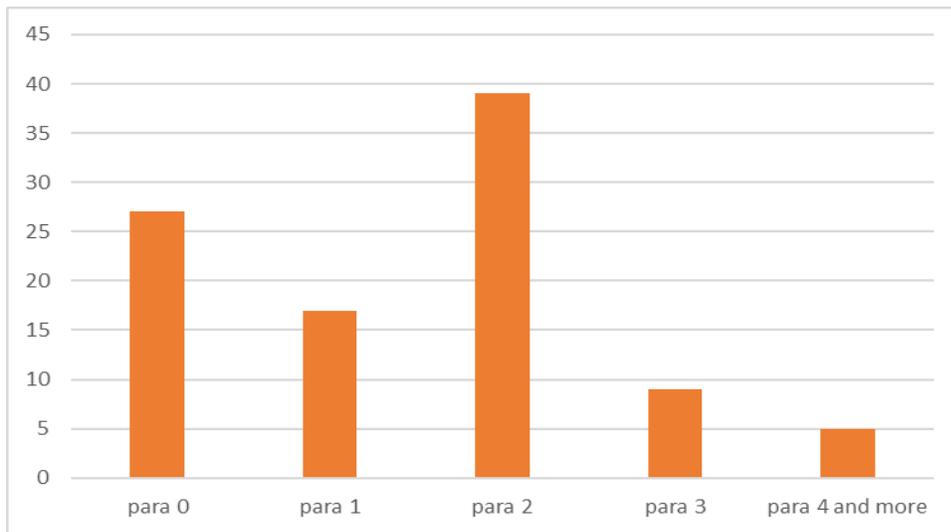
**Figure 4.1.3; Distribution of respondents by gravidity**



Source ; Field data, (2018)

More of the respondents were gravida 3 40%(39) ,28%(27) prime gravida, 18%(17) gravida 2, 9(9%) gravida 4, and 5(5%) were gravida 5.

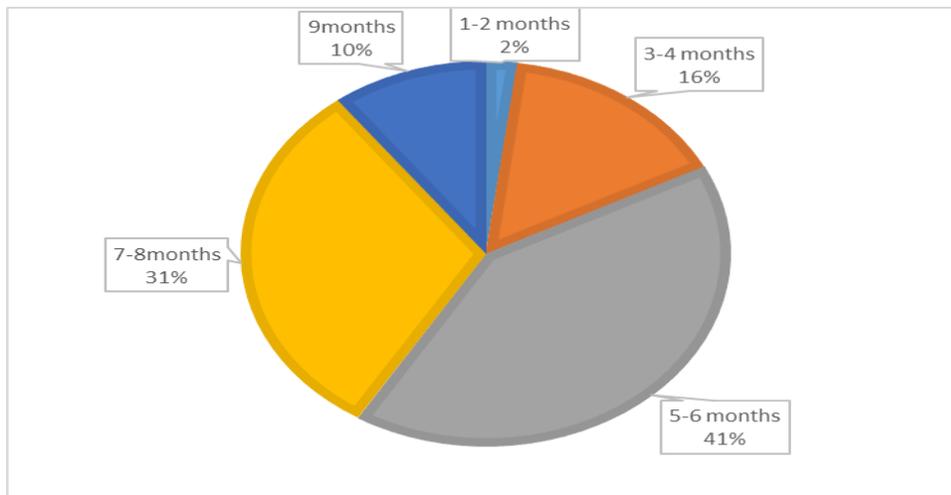
**Figure 4.1.4: Distribution of respondents by the number of live births.**



Source; Field data, (2018)

More of the respondents were para 2 40%(39) ,28%(27) para 0, 18%(17) para 1, 9(9%) para 3, and 5(5%) were para 4 and more.

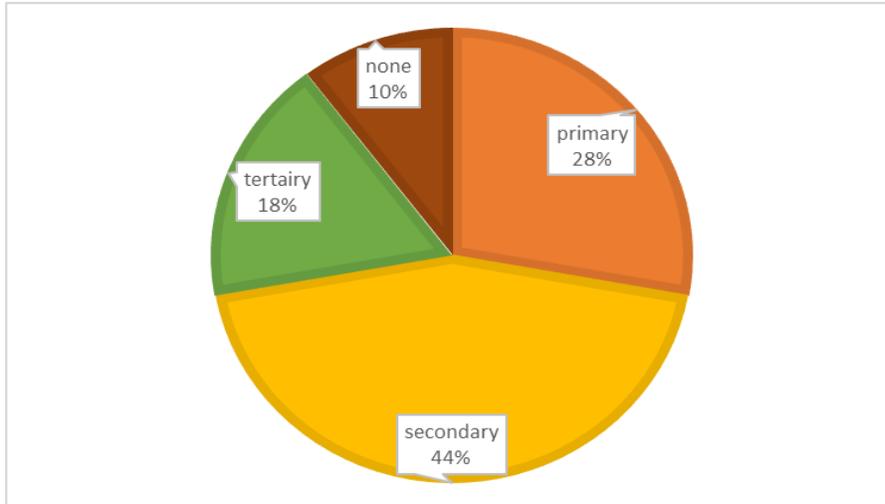
**Figure 4.1.5; Distribution of the gestation age of the pregnancy**



Source; Field data, (2018)

In relation with the gestation age of the pregnancy, more of the respondents were 5-6 months 40(41%), 30(31%) 7-8 months, 15(16%) 3-4 months, 10(10%) 9 months, and only 2(2%) were 1-2 months.

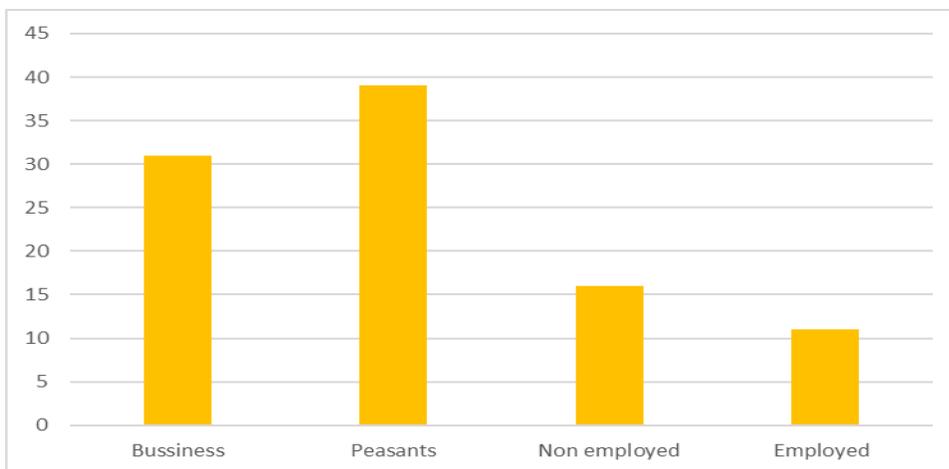
**Figure 4.1. 6; Distribution of respondents according to level of education.**



Source; Field data, (2018)

43(44%) of the pregnant mothers attending ANC in MRRH had attained secondary education, 27 (28%) had attained primary education, 17 (18%) had attained tertiary education and 10(10%) had not attained any education..

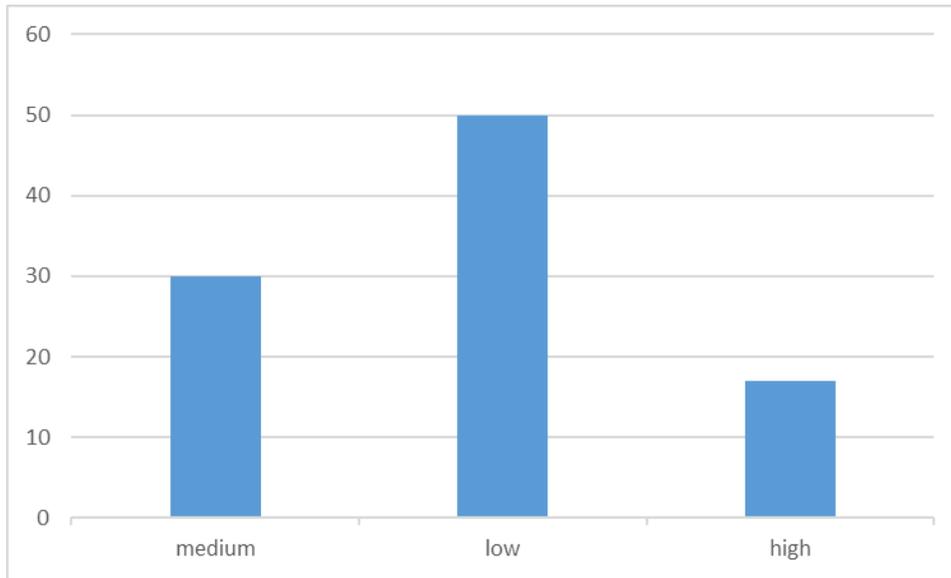
**Figure 4.1.7; Distribution of the respondents by occupation.**



Source; Field data, (2018)

39(40%) of the pregnant mothers attending ANC in MRRH were peasants, 31 (32%) business, 16 (17%) non employed, and 11(11%) were employed.

**Figure 4.1.8; Distribution of the respondents by level of income.**



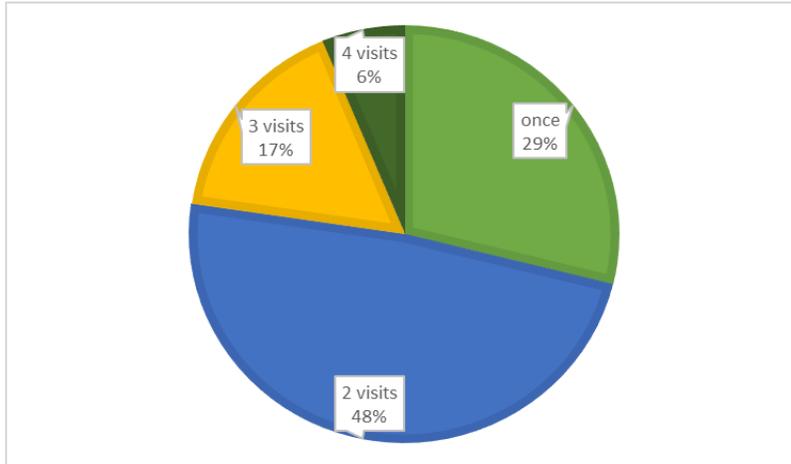
**Source; Field data, (2018)**

As indicated in figure 4.1.8, 50(52%) of the respondents were low income earners, 30(31%) medium, and 17(17%) were high earners.

### 4.2 Objective one; To determine the level of utilization of ANC services among pregnant mothers attending ANC at MRRH.

This section presented the parameters to determine the level of utilization of the ANC services by the pregnant mothers.

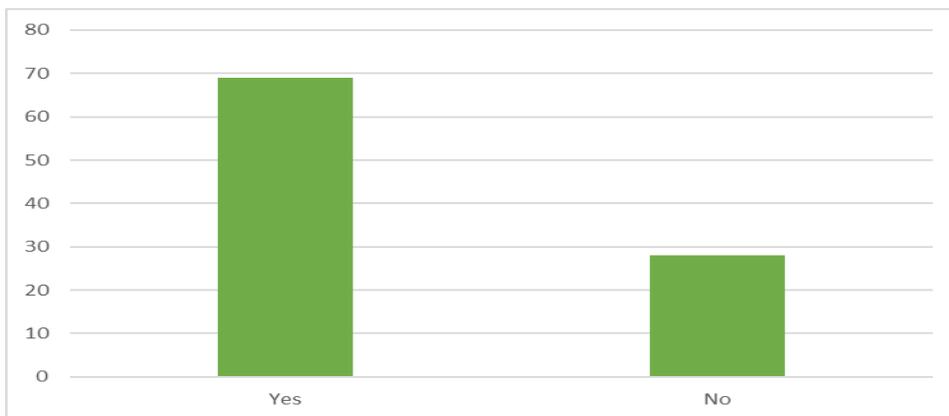
**Figure 4.2.1;**Showing the number of antenatal visits attended during present pregnancy



**Source; Field data, (2018)**

Among the respondents 47(48%) were for their 2<sup>nd</sup> visit, 28(29%) were for their 1<sup>st</sup> visit ,16(17%) were for their 3<sup>rd</sup> visit, 6(6%) were for their 4<sup>th</sup> visit.

**Figure 4.2.2;** showing the distribution of respondents on whether they were using ANC services.



**Source; Field data, (2018)**

More than half of the respondents interviewed were using ANC services 69(71%) and only 28(29%) were not using ANC services.

**Figure 4.2.3; Showing the distribution on how far it was from respondent’s home to the health facility.**



Source; Field data, (2018)

The majority of the respondents were 0-5 km from MRRH 56(58%), 27(28%) were 6-10 km, and 14(14%) were more than 10km away from MRRH.

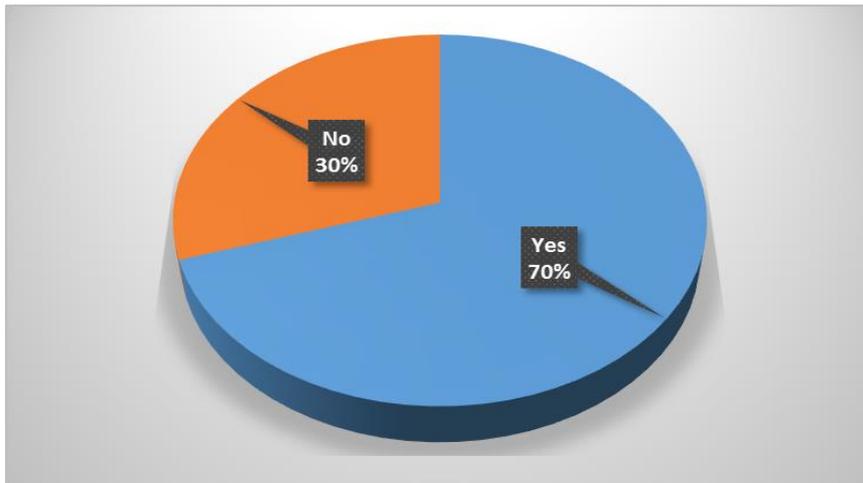
**Table 4.2.1; Showing distribution of respondents on their awareness about the opening days for ANC clinic.**

Days	Frequency(n)	Percentage (%)
Daily	53	55
Weekly	8	8
Twice a week	7	7
Monthly	1	1
Don't know	28	29
<b>Total</b>	<b>97</b>	<b>100</b>

Source; Field data, (2018)

The biggest percentage of mothers 53(55%) thought that ANC clinic was opened daily, 28(29%) knew nothing, 8(8%) weekly, 7(7%) twice a week, 1(1%) monthly.

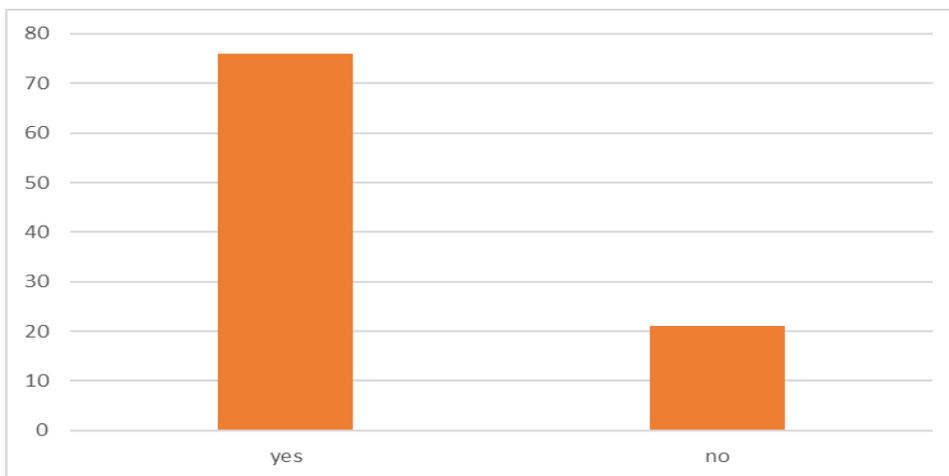
**Figure 4.2.5; showing distribution of respondents on whether the opening days of ANC clinic were convenient for them.**



Source: Field data, (2018)

More than half of the pregnant mothers attending ANC in MRRH 68(70%) said opening days were convenient for them and only 29(30%) said they were being inconvenienced by the opening days.

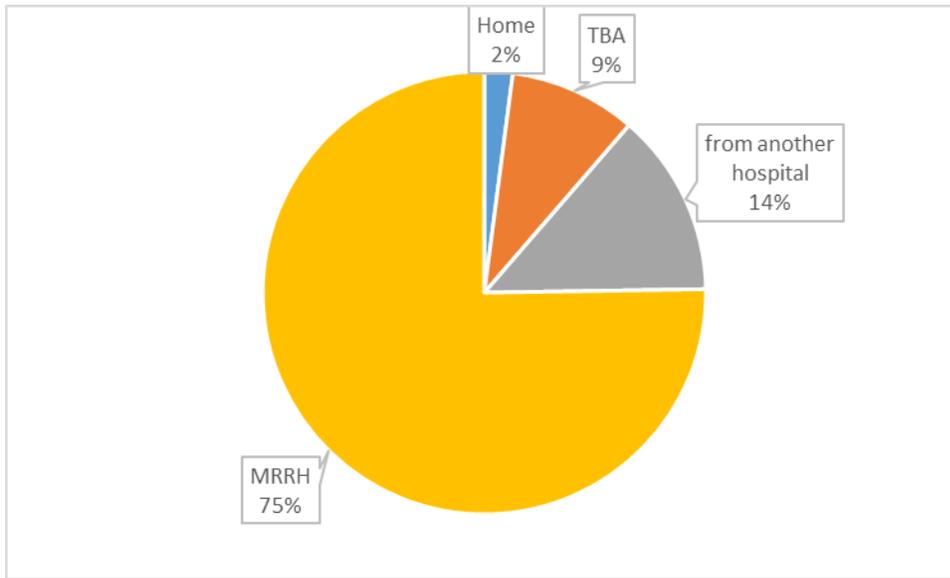
**Figure 4.2.6; Showing the number of pregnant mothers who knew the importance of going for ANC early in pregnancy.**



Source: Field data, (2018)

More than half of the pregnant mothers attending ANC in MRRH 76(78%) were aware of the importance of attending ANC early in pregnancy and 21(22% ) were not aware.

**Figure 4.2.4; Showing where respondents were planning to deliver from.**



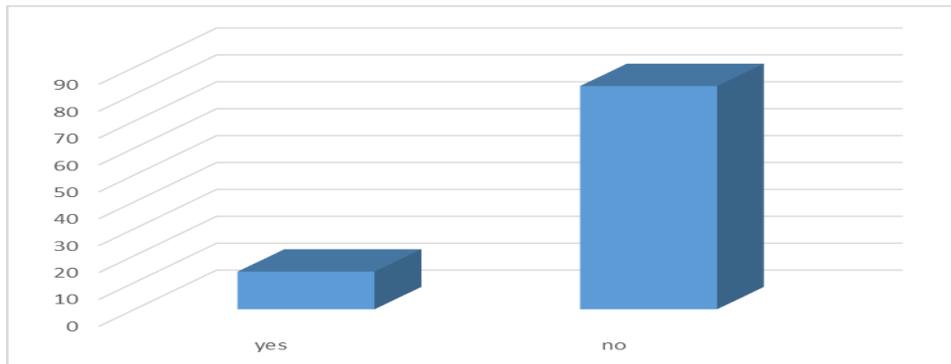
**Source; Field data, (2018)**

Majority of the pregnant mothers 73(75%) were planning to deliver from MRRH, 13(14%) from another hospital, 9(9%) from TBA, and 2(2%) from home.

### 4.3; Objective 2; To determine the quality of ANC services provided to pregnant mothers attending ANC clinic in MRRH.

This section presented the parameters used to determine the quality of ANC services provided to pregnant mothers attending ANC clinic in MRRH.

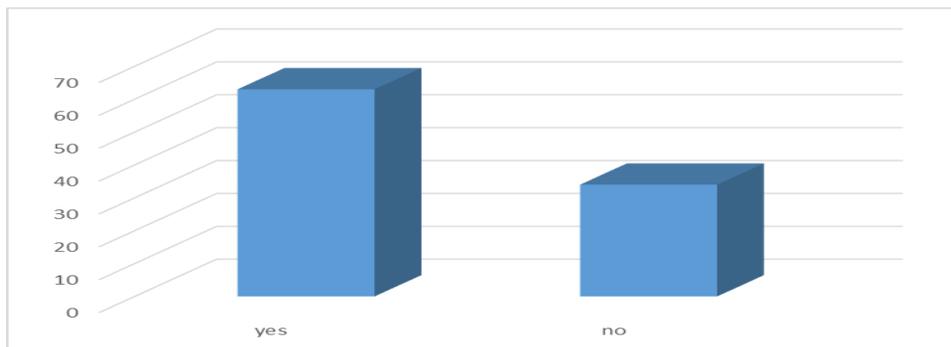
**Figure 4.3.1: Showing distribution of respondents who incurred costs in utilizing ANC services.**



Source Field data, (2018)

Majority of the respondents 83(86%) didn't incur costs while utilising ANC services and only 14(14%) incurred costs during ANC.

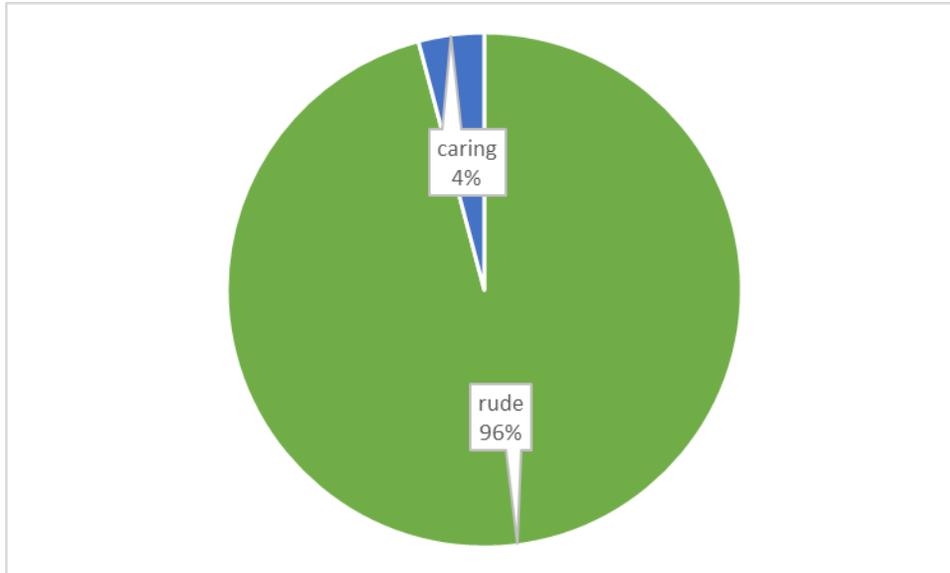
**Figure 4.3.2: Showing distribution of respondents that were hindered by the inadequate health facilities from accessing ANC on time.**



Source; Field data, (2018)

Majority of the respondents reported being affected by inadequate health facilities from accessing ANC on time and these added up to 63(65%) while only 34(35%) reported not being affected by the inadequate health facilities from accessing ANC on time.

**Figure 4.3.3; Showing distribution of respondent`s rating of health workers.**



Source Field data, (2018)

Among the mothers interviewed majority 93(96%) of them rated the health workers as rude and only 4(4%) rated the health workers as caring.

**Table 4.3.1; Showing distribution of ANC services were offered to pregnant mothers.**

ANC	Yes	No.
Health Education	67	30
Drugs for prevention of malaria and anemia	92	5
Tetanus vaccination	53	44
Deworming	17	80
Examination of the pregnancy	77	20
Screening for hypertension, HIV infection, syphilis	41	56

Source; Field data, (2018)

Among the mothers interviewed 67(69%) received a health education while 30(31%) didn't, 92(95%) received drugs for prevention of malaria and anemia while 5(5%) didn't, 53(55%) received Tetanus vaccine while 44(45%) didn't, 17(18%) were dewormed while 80(82%) didn't, 77(79%) underwent examination of the pregnancy while 20(21%) didn't, 41(42%) underwent screening for hypertension, HIV infection, syphilis while 56(58%) didn't.

#### **4.4; Objective 3; Mothers' attitudes and suggestions on improving ANC services.**

##### **4.4.1; Qualitative data for pregnant mothers on the factors hindering ANC utilization and accessibility in their area.**

On discussing with the mothers some of the things that hindered their accessibility to ANC services, uncertainty about when to start attending ANC services was one of them since mothers realize late that they pregnant.

Mothers also reported shortage of ANC cards which leads to reprimands from health workers.

They also reported a difference in the attitudes and services provided by different health workers as some of them are rude, few are caring and few carryout the ANC procedures like checking fetal wellbeing.

Some mothers reported language barrier as a hindering factor while others reported over waiting time.

##### **4.4.2 Qualitative data for pregnant mothers on their suggestions to improve ANC services in their area.**

Mothers suggested that health workers should increase their awareness on when to start attending ANC clinic.

Mothers also suggested that health workers should always provide ANC cards to avoid reprimands from health workers

They suggested that health workers should be empathetic while carrying out ANC services.

They also suggested that more health workers who are time conscious should be employed in order to reduce on waiting time.

##### **4.4.3 Qualitative data with the health workers**

When the health workers were interviewed out of the three interviewed one reported having done physical examination and laboratory investigations for every mother, they also reported opening for at least 6hours a day for the five working days of the week. They reported a low utilization on the ANC services which they attributed to the low level of awareness about the services since majority of the women usually started ANC by chance that is to say they come for ANC when they get a problem during the pregnancy.

## **5.0 Discussions, Conclusions and Recommendations**

### **5.1 Discussions**

#### **5.1.1 Social demographic data.**

The study shows that all the respondents 97 (100%) were from 15years to above 30 years (Table 4.1) of the total 97 pregnant mothers recruited in the study, 15(15.5%) were between the age of 15-19 years, 43(44.3%) were between 20-24years, 30(30.9%) were between 25-29 years, 09(9.3%) were above 30 years. Due to the tender age, mothers between the age of 15-19years were afraid to seek health service care as they may be judged for being pregnant at an early age hence accounting for the low numbers attending ANC, thus agreeing with the study done in Ibadan, Nigeria (*Owoyokun ME, 2010*) where women aged 25 years and older utilized ANC more than those aged below 25 years which also agrees with the study made in Bangladesh. (*Schmidt j-O*

and Wang H, 2012). Due to the preconception of experience in matters related to pregnancy and delivery accounts for the low numbers of mothers in the age range of 30 years and above. This is similar to the findings of the study done in Ghana by Christopher et al, (2015) where they found out that the youth (age group 24-29 years) frequently sought Antenatal care than any other age group.

Majority of the respondents 48(49.5%) were Catholics, 05(5.1%) were Muslims, 25(25.8%) were protestants, 19(19.6%) were from other religions. This study findings disagrees with the findings of study in Ibanda, Nigeria done by Owoyokun KE (2010) in which they revealed that Muslims or other religions were more than 2 times to attend ANC clinic than women who were christians.

Majority of the respondents 42(43%) were Bagishu, 27(28%) were Bagwere, 15(16%) were from other languages ,8(8%) were Baganda, and 5(5%) were Banyoli. Most respondents were Bagishu because the study site was located in Bugishu land where Bagishu form the largest proportion of the population according to the year 2012 census.

Of the pregnant mothers interviewed 47(48%) were cohabiting, 24(25%) were married,16(17%) were single. 10(10%) were divorced. The big number of married and cohabiting is attributed to the ignorance among women about family planning methods. Most of people in this area have false beliefs about family planning like becoming infertile after using contraceptives and Catholics being the biggest number and they are not recommended to use any of the family planning methods. This disagrees with a study done by Akter et. al (2016) where they said that in order to reduce neonatal mortality, essential obstetric care and family planning should be emphasised through increasing mother's awareness about merits of family planning.

More of the respondents were gravida 3 40% (39) ,28% (27) prime gravida, 18% (17) gravida 2, 9 (9%) gravida 4, and 5(5%) were gravida 5. This was associated to the fact that the greater the gravidity the greater the misconception of having enough experiences about issues concerning pregnancy and hence less attendance of ANC. This corresponds with the study done by Simkhada B, et al. (2015) in Hadiya, Ethiopia where they found out that women of higher gravidity tend to use antenatal care less.

More of the respondents were para 2 40% (39) ,28%(27) para 0, 18%(17) para 1, 9(9%) para 3, and 5(5%) were para 4 and more. This was associated to the fact that the greater the parity, the greater the misconception of having enough experiences about issues concerning pregnancy and hence less attendance of ANC. This corresponds with the study done by Simkhada B, et al. (2015) in Hadiya, Ethiopia where they found out that women of higher parity tend to use antenatal care less.

More of the respondents were 5-6 months 40(41%), 30(31%) 7-8 months, 15(16%) 3-4 months, 10(10%) 9 months, and only 2(2%) were 1-2 months. Most of the respondents 40 (41%) started attending ANC clinics at 5-6 months of pregnancy because this is the time when most women realize that they are pregnant and start looking for where to deliver from. This corresponds with a study carried out by *Anuja et. al (2008)* about utilisation of ANC in developing countries and United nations (2012) which indicated that most pregnant mothers attend first and more visits at 6 months or more.

As presented in the results, 43(44%) of the pregnant mothers attending ANC in MRRH had attained secondary education, 27 (28%) had attained primary education, 17 (18%) had attained tertiary education and 10(10%) had not attained any education. This agrees with the study done by *USAID (2010)* in Ethiopia where mothers with primary educational level were more likely to attend ANC than women who are unable to read and write while a study in rural Uganda(*Ebuehi OM and Akintujoje IA, 2012*) revealed ANC attendance wasn't affected by level of education.

Majority of respondents 39(40%) of the pregnant mothers attending ANC in MRRH were peasants, 31 (32%) business, 16 (17%) non employed, and 11(11%) were employed. This disagrees with the study done by *Simkhada B, et al. (2015)* where mothers with multiple responsibilities had less time for ANC services, lack of financial support for transport payments and private services accounted for low numbers of ANC attendance by unemployed mothers, this agrees with the findings by *UNAIDS Inter-Agency Task Team* on gender and also in line with *Frontiers,(2015)* findings in Eastern Nepal.

As indicated in figure 4.1.8 50(52%) of the respondents were low income earners, 30(31%) medium, and 17(17%) were high earners. The low attendance numbers of higher earners was attributed to the multiple responsibilities limiting the time for pregnant mothers to attend ANC clinic thus agreeing with *USAID(2010)* study done in Hadiya zone.

### **5.1.2 Objective One; To determine level of utilization of the ANC services among pregnant mothers attending ANC clinic in MRRH.**

The level of utilization of ANC services was determined by the following;

Among the respondents 47(48%) were for their 2<sup>nd</sup> visit, 28(29%) were for their 1<sup>st</sup> visit, 16(17%) were for their 3<sup>rd</sup> visit, 6(6%) were for their 4<sup>th</sup> visit. This shows there is an underutilization of ANC services since few of the pregnant mothers attended the four visits as recommended by WHO. This corresponds with the study done in Hadiya zone, Ethiopia by *USAID (2010)* where majority of the mothers who attended ANC didn't receive

adequate number of visits which was attributed to negative husband attitude and lack of knowledge about the number of times, they have to attend ANC clinic.

More than half of the respondents interviewed were using ANC services 69(71%) and only 28(29%) were not using ANC services. The increased usage of ANC services is attributed to the improved service delivery thus disagreeing with the study done in rural local government Area in Ogun state, Nigeria, where women preferred TBAs for various reasons which included; cheap easily accessible culturally acceptable services and more compassionate care than orthodox health workers (*UNFPA, 2011*)

The majority of the respondents were 0-5 km from MRRH 56(58%), 27(28%) were 6-10 km, and 14(14%) were more than 10km away from MRRH. 56(58%) of the respondents lived within the vicinity of MRRH. This made it easier for most respondents to trend as many times as they required in order to utilize the ANC services hence agreeing with a study done by *Valera (2014)* that availability of ANC resources nearer plays a bigger role in ANC utilization.

The biggest percentage of mothers 53(55%) thought that ANC clinic was opened daily, 28(29%) knew nothing, 8(8%) weekly, 7(7%) twice a week, 1(1%) monthly. The alarming false awareness about the opening days of ANC depicts low ANC attendance hence *WHO (2017)* encourages us to raise awareness on benefits of ANC utilisation and address concerns.

More than half of the pregnant mothers attending ANC in MRRH 68(70%) said opening days were convenient for them and only 29(30%) said they were being inconvenienced by the opening days. This depicts improved service delivery since the majority of the mothers are not affected by the opening days thus, corresponding with the study done in Tanzania by *Chintu and Susu (2015)*.

More than half of the pregnant mothers attending ANC in MRRH 76(78%) were aware of the importance of attending ANC early in pregnancy and 21(22%) were not aware. Since the majority of the mothers in MRRH were aware of the importance of ANC attendance so my results disagreed with the study done in rural Uganda by *Ebuehi OM and Akintujoje IA (2012)* revealed ANC attendance being irregular with few women appreciating the fact that ANC attendance was to monitor both the growth of the baby and the health status of the woman.

Majority of the pregnant mothers 73(75%) were planning to deliver from MRRH, 13(14%) from another hospital, 9(9%) from TBA, and 2(2%) from home. The low number of planning deliveries at home and TBA's is suggestive of the awareness on the importance of delivery from hospital to avoid risks and any other maternal

complications which is corresponding to the study done by *UNFPA (2011)* in Ogun state, Nigeria where respondents acknowledged that complications could arise from TBA care.

### **5.1.3 Objective Two; To assess the quality of ANC services provided to pregnant mothers attending ANC clinic in MRRH.**

The quality of ANC services was assessed using the following parameters;

Majority of the respondents 83(86%) didn't incur costs while utilizing ANC services and only 14(14%) incurred costs during ANC. Since the majority reported for not having incurred any costs, there is improved service delivery by health workers and hence utilization of the services thus matching with *WHO(2016)* guideline recommendation which says all ANC services are free of charge. The low numbers of those who incurred costs corresponds with the study done in India by *Cathy Tukei(2015)* where economic disparity determined care seeking behaviour and utilisation of health care, resulting in slow decline of child mortality rates due to low ANC attendance which is meant to monitor fetal well-being(*Akintujoje IA, 2012*).

Majority of the respondents reported being affected by inadequate health facilities from accessing ANC on time and these added up to 63(65%) while only 34(35%) reported not being affected by the inadequate health facilities from accessing ANC on time. Adequate health facilities are readily accessible, are safe, effective, acceptable to potential users and ANC visits staffed by technically competent people, provide prompt comprehensive care and linkages to other reproductive health services provide continuity of care and where staff are helpful, respectful and non-judgmental(*Ashish et. al, 2016*). Inadequate services lead inconsistency in the services delivered, this agrees with the study done by *Valera(2014)* and *Ebuehi OM (2012)* in Uganda where inadequacy of services provided by formal health system affected ANC utilisation.

Among the mothers interviewed majority 93(96%) of them rated the health workers as rude and only 4(4%) rated the health workers as caring. Rating the health workers as caring depicts a good mother- health worker relationship this increase mothers urge to seek for health services due to the friendly atmosphere and hence good compliance to the ANC services and therefore good utilization of the services (*Christopher et al, 2013*) hence attitudes of health workers doesn't affect the utilization of services in MRRH.

Among the mothers interviewed 67(69%) received a Health education while 30(31%) didn't, 92(95%) received drugs for prevention of malaria and anemia while 5(5%) didn't, 53(55%) received Tetanus vaccine while 44(45%) didn't, 17(18%) were dewormed while 80(82%) didn't, 77(79%) underwent Examination of the pregnancy while 20(21%) didn't, 41(42%) underwent screening for hypertension, HIV infection, syphilis while 56(58%) didn't. This was so because those services are free of charge in government health facilities. This

corresponds with the *WHO guidelines (2016)* recommendations of ANC services, such as treatment of hypertension to prevent Eclampsia, preeclampsia, tetanus immunization, intermittent preventive treatment for malaria, elimination of mother to child transmission of HIV, micro nutrient supplement and information about danger signs during pregnancy and child birth.

## **5.2 Conclusions.**

Based on the presentation, analysis and discussion of findings, the following conclusions were drawn chronologically as per the specific objectives.

### **5.2.1 Social demographic factors.**

The social demographic factors found to affect the utilization of the ANC services were, extremes of age (either too young or old), marital status were the unmarried under-utilized the services, higher parity of the mother causing under-utilization, low education status leading to under-utilization, level of income status of mothers were by mothers with high income had the lowest utilization due to their busy schedule.

### **5.2.2 Level of utilisation of ANC services.**

The level of utilization was found to be low since majority of mothers didn't attend 4 visits for ANC as recommended by WHO because of all the 97 respondents only 6 (6%) were for their fourth visit.

### **5.2.3 Quality of ANC services provided.**

Quality of the services was found to be moderately good since majority of the respondents didn't incur cost during utilization of the services, mothers were offered the following ANC services; Health education, deworming, screening for hypertension, HIV infection, syphilis, tetanus vaccination, drugs for prevention of malaria and anemia, examination of the pregnancy. Attitudes of health workers were rated rude by majority and health facilities inadequacy were found to affect the attendance.

### **5.2.4 Mother's attitude towards ANC services.**

Mother's attitudes and suggestions on improving ANC services were increasing level of awareness among pregnant mothers about ANC by health workers since majority of the mothers were uncertain when to start ANC attendance, providing ANC cards to avoid reprimands from health workers, health workers should be empathetic while carrying out ANC services since majority of the respondents rated health workers as rude, more health workers who are time conscious should be employed to reduce on waiting time and more health facilities should be put in place to shorten distance thereby improving service delivery.

### **5.3 Recommendations.**

Since ANC directly affects the mortality rates of mothers and infants in Uganda and Mbale Regional Referral hospital in particular resulting into a nation burden. The researchers feel that the problem should be curbed only when efforts are combined with various bodies for example; Ministry of Health, Mbale Regional Referral Hospital, mother, and community members at large and therefore, the researchers came up with the following recommendations;

#### **5.3.1 Recommendations of Ministry of Health.**

- The Ministry of Health needs to put up interventions to increase the awareness about ANC services this can be through health talks on media like radio, TV, and these should be in the simplest language to be understood by majority and with all the necessary message they need to know.
- The Ministry of Health needs to put up more health facilities that can offer ANC services to mothers in the remote areas and also improve the already existing facilities in remote areas to reduce the work load in the referral hospital hence be able to use the available resources effectively.

#### **5.3.2 Recommendations to Mbale Regional Referral Hospital.**

- The management of Mbale Regional Referral hospital should recruit more health workers in the ANC department to avoid over working the available service providers and make the work quick hence short waiting time for the mothers
- The service providers of MRRH should be advised to put some more emphasis on the delivery of health education to mothers about ANC. Health workers should deliver message to mothers in the language they understand most and all health workers at large all those from others wards like medical or surgical should advise the mothers to go for ANC. MRRH staff should also continue sensitizing people through Health out reaches and on gatherings e.g schools, weddings, churches etc.
- Health workers in ANC clinic in Mbale Regional Regional Referral Hospital should be encouraged to regularly inform and explain to mothers about their findings from every check up and should be there to listen to any questions mothers may have as this may improve their understanding about ANC services provided to them and those they ought to receive.

#### **5.3.3 Recommendations to Mothers and Community members.**

- Mothers should be encouraged to always report to the hospital immediately they find out that they are pregnant and they should be encouraged to always keep the appointments for return dates they are given for subsequent visits.

#### 5.4 Suggested area for further research.

The researchers suggested the following area for further study;

- Factors influencing male participation in antenatal care in Mbale Regional Referral Hospital in Uganda.

#### 6.0 Acknowledgements

The Researchers wish to acknowledge the different personalities and stakeholders that provided technical, moral and financial assistance during the study, most especially; the staff of Mbale regional referral hospital, Mbale College of Health Sciences, Mbale district health Office, and the participants who volunteered to take part in this study.

#### 7.0 Competing Interests

None declared.

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## Appendices

### Appendix I: Introductory Letter

Telephones: 0785 689788  
045 4437384



THE REPUBLIC OF UGANDA

Ministry of Education & Sports  
Mbale School of Clinical Officers  
P.O.BOX 1672  
Mbale - Uganda

In any correspondence on this  
Subject, please quote File No. *MSOCO/047/INTL/018*

23/03/2018

The Hospital Director,  
Mbale Regional Referral Hospital  
Mbale



#### INTRODUCTION OF MAYANJA JIMMY

**Mayanja Jimmy** Index number **UA/DCM/056/15** is a third year student in Mbale School of Clinical Officers.

As a partial requirement for the fulfillment of the award of a Diploma in Clinical Medicine and Community Health (DCM), he is conducting a research titled "**Factors influencing the accessibility and utilization of antenatal care services among pregnant mothers attending antenatal clinic in Mbale Regional Referral Hospital in Mbale district**"

Any assistance accorded to him will be highly appreciated.



Babalanda Jean,  
Principal

## Appendix II: Letter of Approval

**Telephones: General Line: 0393280584**



MINISTRY OF HEALTH  
MBALE REGIONAL HOSPITAL  
P.O. BOX 921  
Mbale – Uganda

**E-mail: [mrrhrec@gmail.com](mailto:mrrhrec@gmail.com)**

In any correspondence on this **THE REPUBLIC OF UGANDA**

Subject, please quote: MRRH-REC IN - COM 021/2018

**Date: 23<sup>rd</sup> March 2018**

**MRRH-REC ACCREDITED BY THE UNCST, REGISTRATION NUMBER UG-REC-011**

**Dear**

MAYANJA JIMMY

UAHEB/DCM/056/15

Diploma student of Clinical Medicine

And community health SOCO

**Type of approval**

Administrative Clearance

**Initial**

Continuous

Reactivation

SAEs

Principal Investigator

**Study Title:** FACTORS INFLUENCING THE ACCESSIBILITY AND UTILISATION OF ANTENATAL CARE SERVICES AMONG PREGNANT MOTHERS ATTENDING ANTENATAL CLINIC IN MBALE REGIONAL REFERRAL HOSPITAL

**Ref: Full Ethical Approval for the study** factors influencing the accessibility and utilization of antenatal care services among pregnant mothers attending antenatal clinic in Mbale regional referral hospital.

Thank you for submitting to Mbale Regional Referral Hospital-REC (MRRH-REC) the above study that we received on the 16<sup>th</sup> March 2018 for research and ethical Approval. All the information submitted the committee was considered during the Administrative review, minute: 4 under SOP#004 enacted on the 23rd March 2018.

### **Confirmation of ethical opinion**

On behalf of the MRRH-REC, I am pleased to confirm a favorable opinion for the above research on the basis of submitted protocol and the additional supporting documents that are subject to the conditions below.

### **Conditions of the favorable Ethical opinion**

Approval is contingent upon the received protocol and supporting documents submitted to MRRH-REC on the 16<sup>th</sup> March 2018 and the corresponding documents submitted on the same date. It is the responsibility of the principal investigator to ensure that protocol adherence is maximumly observed. In addition, the Principal investigator or their designee will be responsible for contacting the responsible Authorities in each of the study site(s).

MRRH-REC will be visiting your study site(s) to monitor protocol adherence. You shall submit to MRRH-REC a copy of your progress and final report(s). Consequently the submitted research proposal stipulated above is granted approval for implementation and will take immediate effect within the stamped date(s). If you wish to continue data collection or analysis beyond the approved date please submit an application for continuation approval at least two months before the expiry date.

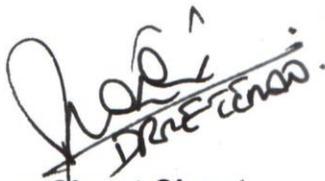
In Addition to your application, the documents reviewed and approved in this meeting include:



Document type	File name	Version	Date of submission
Letter of introduction: from the principal investigator and Mbale school of clinical officers. Dated 23 <sup>rd</sup> march 2018		NA	23 <sup>rd</sup> March 2018
<b>Study protocol</b> Factors influencing the accessibility and utilisation of antenatal care services among pregnant mothers attending antenatal clinic in Mbale regional referral hospital.		March 2018	16 <sup>th</sup> March 2018
<b>Informed consent form</b> In English language appendix I page 27		January 2018	16 <sup>th</sup> March 2018
<b>Data collection tools:</b> use of questionnaire for direct interview 28-35, interview guide, page 36		January 2018	16 <sup>th</sup> March 2018
<b>Time frame:</b> four months as indicated by the dates of the stamp.		NA	

On behalf of MRRH-REC, I wish you the best in your study.

Yours sincerely,



**Assoc. Prof Peter Olupot-Olupot**

MB.Ch.B, MPH, PhD , Secretary General MRRH-REC



**Appendix III: Consent Form**

GOODMORNING / GOOD AFTERNOON MADAM/SIR,

I am, Jimmy Mayanja, from Mbale School of Clinical Officers conducting a study on the factors influencing the utilization of ANC services among pregnant mothers attending ANC clinic in MRRH.

The purpose of the study is to identify the possible factors that affect the use of ANC services

The interview will approximately take 20 minutes and will be asked questions as in the questionnaire.

There are no monetary benefits for participating however by participating you will contribute to information that will assist Ministry of Health and policy makers to consider

community opinions as they formulate policies.

I would like to assure you that the personal information you disclose to me will not be disclosed to any third party unless required legally. Your identity will be kept anonymous by using a number to identify you instead of your name.

I am therefore requesting you to participate in this study. Your participation is solely voluntary and free to withdraw from the study at anytime without penalty.

Your free to ask questions about this study.

Please sign this form if you have accepted to participate.

Thank you in advance,

Signature (thumbprint) of respondent.....

Signature of Interviewee.....

**Appendix IV: Questionnaire for Direct Interview**

**Topic**

**Factors Affecting The Accessibility And Utilization Of Antenatal Care Services Among Pregnant Mothers Attending Anc Clinic In Mbale Regional Referral Hospital.**

**Date.....**

**Number.....**

Am Mayanja Jimmy carrying out a “**study to determine the factors affecting the accessibility and utilization of antenatal care services among pregnant mothers attending ANC clinic in MRRH**”.

Please participate in the study by answering the following questions as honestly as possible. No names are required and your responses will be treated with sincere confidentiality and will be used for the purpose of the study (**TICK: the most appropriate answer where applicable.**)

**SECTION A: SOCIO-DEMOGRAPHIC DATA**

1. How old are you?

15-19 years

20-24 years

25-29 years

>30 years

2. Religion.

Catholic

Muslim

Protestant

Others specify.....

3. Tribe

Mugishu

Muganda

Mugwere

Itesot

Munyoli

Others (specify).....

4. What is your present marital status?

Single

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<http://dx.doi.org/10.29322/IJSRP.10.12.2020.p10805>

[www.ijsrp.org](http://www.ijsrp.org)

Married

Divorced

Widowed

5. How many pregnancies have you had in total?

Number.....

6. How many live births altogether?

1

2

3

4 or more

7. How old is your pregnancy?

1-2months

3-4months

5-6months

7-8months

9months

8. What is the highest educational level you attained?

Primary

Secondary

Tertiary

None

9. Occupation of the participant

Peasant

Business

Employed

Non employed

10. Level of income

- Medium
- Low
- High

**SECTION B: UTILIZATION OF ANTENATAL CARE SERVICES**

11. How many antenatal care visits have you attended during this pregnancy?

- 4visits
- 3visits
- 2visits
- Once

12. Have you been using ANC services?

- Yes
- No

13. If no, what other alternatives have you been using?

.....  
.....

14. How far is it from your home to this Health Facility?

- 0-5 km
- 6-10km
- More than 10 kms

15. What mode of transport have you used to this health facility?

.....  
.....

16. What are the opening days for ANC at this facility?

- Daily
- Weekly
- Twice a week
- don't know
- Monthly

17. Are the opening days convenient for you?

Yes

No

18. Give reasons for your answer above

.....

.....

19. Do you know why a pregnant woman should go for antenatal care early in pregnancy?

Yes

No

20. Give reasons why you go for antenatal care

.....

.....

21. Where are you planning to deliver from?

Home

TBA

From another hospital

MRRH

### SECTION C: QUALITY OF ANC SERVICES PROVIDED

22. Do you incur any cost in utilizing ANC services?

Yes

No

23. Could inadequate health facilities prevent you from accessing ANC on time?

Yes

No

24. How do you rate the health workers in providing the services?

Rude

Caring

25. Were you offered the following ANC services?

a. Health education.

Yes

No

b. Drugs for prevention of malaria and anemia.

Yes

No

c. Tetanus vaccination.

Yes

No

d. Deworming.

Yes

No

e. Examination of the pregnancy

Yes

No

f. Screening for hypertension, HIV infection, syphilis.

Yes

No

g. Any other services offered apart from the above, specify.

.....

**SECTION D: MOTHER'S ATTITUDES AND SUGGESTIONS ON IMPROVING ANC SERVICES.**

26. What are the factors hindering ANC service utilization and accessibility in your area?

.....  
.....

27. In your own view what can be done to improve on accessibility and utilization of ANC services in your area?

.....  
.....

**END**

**THANK YOU FOR YOUR COOPERATION, GOD BLESS YOU**

## **Appendix V: Health Worker Interview Guide**

### **Factors Influencing The Utilisation of ANC Services Among Pregnant Mothers Attending ANC Clinic In MRRH**

Date of Interview.....

Name of Facility.....

#### **Demographic data**

1. Sex of Person being interviewed Female ( ) Male ( )
2. Age in years.....
3. Level of education.....
4. Working experience.....

#### **Health workers role guiding questions**

1. What role do you play in the care of maternity client?.....
2. What history do you take from antenatal mother who come to your clinic?
3. What do you check when doing physical examination?.
4. What Laboratory investigations do you carry out?
5. At the hospital, what time do you and close the ANC clinic?
6. What is your comment on the quality of antenatal services provided in the hospital?.
7. What is your comment on the women's utilization of the antenatal services?

**Appendix VI: Workplan**

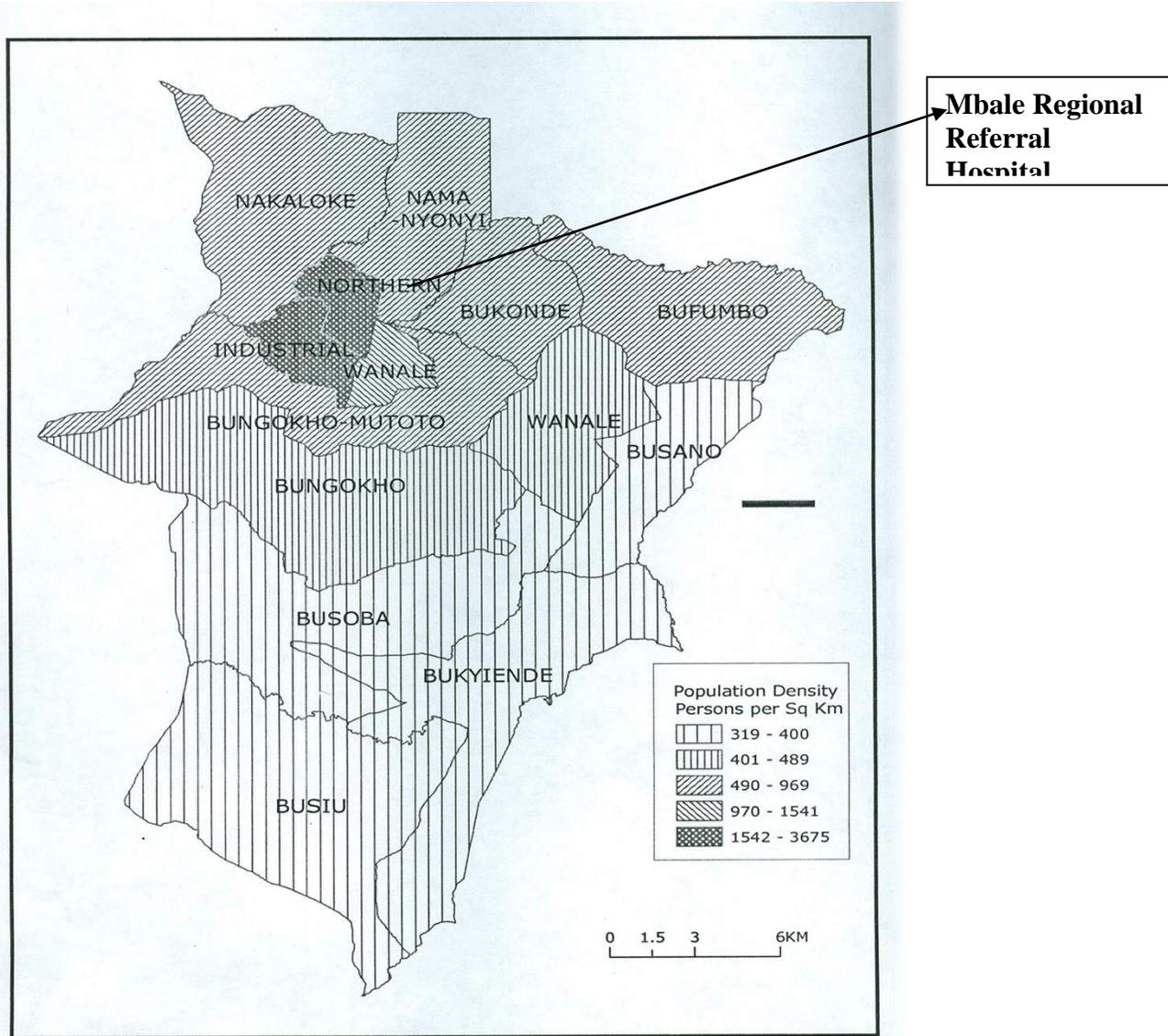
			2017			2018				
SN	ACTIVITIES	PERSONNEL	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
1	Proposal development	Researcher & Supervisor								
2	Proposal approval	Supervisor								
3	Preparation of data tools	Supervisor								
4	Pretesting tools	Researcher								
5	Introductory letter issuing	Supervisor								
6	Permission from local authority	Researcher								
7	Data collection process	Researcher								
8	Analysis of the findings	Researcher								
9	Presentation of findings	Researcher								
10	Discussion and conclusion	Researcher								

**Appendix VII: The Research Project Budget**

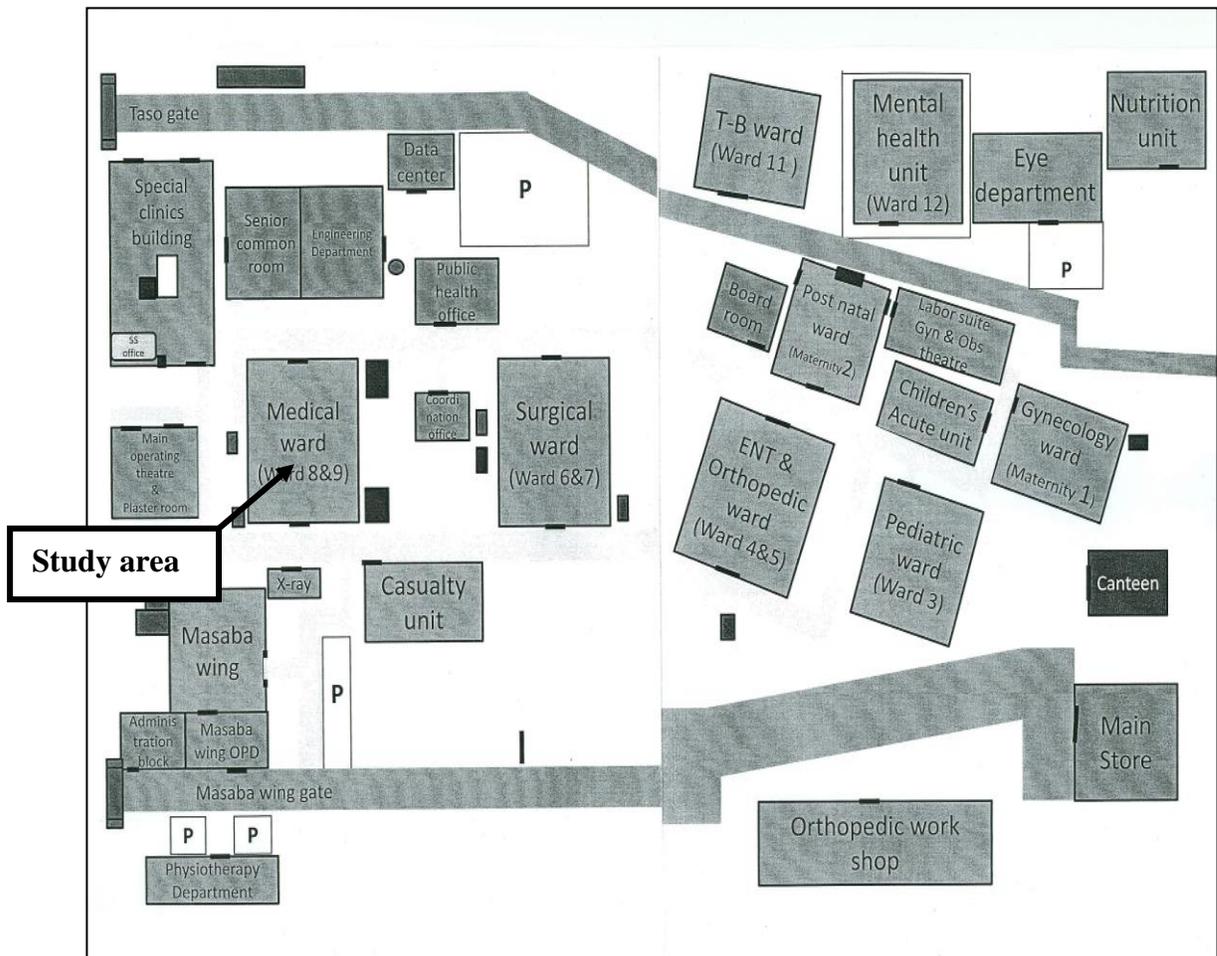
No.	Item	Description	Quantity	Unit cost	Amount (ugsh)
1	Stationary	This involves;			
		❖ A ream of ruled papers	1	35000	35000
		❖ A ream of photocopying papers	2	18000	36,000
		❖ Pens	5	1000	5000
		❖ Long ruler	1	500	500
		❖ Folder file	2	6000	12,000
2	Services Printing	This will be printing of the;			
		✓ Proposal		4,800	20,000
		✓ Report	3	9,000	30,000
			3		
	Photocopying	This will be for;			
		✓ Questionnaires of four pages.	150	800	120,000
	Binding	This will be for the;			
		✓ Proposal copies	3	3000	9,000
		✓ Report copies	3	3000	9,000
3	Transport	✓ Field transport	16days	2000	80,000
4	Lunch	✓ Balanced diet	16days	5000	100,000
5	Communication	✓ Airtime and internet		30,000	143,500
	Miscellaneous			100,000	100,000
	<b>Total</b>				<b>700,000/=</b>



### Appendix IX: A Map Of Mbale Showing The Study Area



### **Appendix X: Map of Mbale Regional Referral Hospital**



# Revitalizing Cooperative Programmes Activities for Active Participation of Rural Women Towards Enhancing Community Development in Nigeria

Dr. Blessing Chinyere Elekwa

Dept. Of Adult Education, Faculty Of Education Nnamdi Azikiwe University, Awka.

DOI: 10.29322/IJSRP.10.12.2020.p10806

<http://dx.doi.org/10.29322/IJSRP.10.12.2020.p10806>

**Abstract-** This study focused on revitalizing cooperative programmes activities for active participation of rural women towards enhancing community development. The need for the study arose as a result of less access to education, unemployment, poverty, low income status, burden of child bearing and lack of adequate information on cooperative programmes experienced by rural women in Nigeria. However, these cooperative programmes which includes Agricultural cooperative, thrift and credit cooperative, cooperative education programme, as well as, leadership training activity, will enhance the rural women's potentials, improve their standard of living and equip them to deal with the dynamism of the modern society. Also, the study focused on the concept of rural women, participation, cooperative programme activities and community development respectively. Furthermore, strategies for revitalizing rural women's participation in cooperative programmes for active participation of rural women towards enhancing community development, factors that hinder rural women from active participation in cooperative programmes and the way forward, were discussed.

**Index Terms-** Cooperative programmes, Rural women, Participation, and Community Development.

## I. INTRODUCTION

Rural women are active agents of economic and social change who play vital roles in the development of the nation. The importance of rural women in taking care of their families and communities to realize food security, increase income and improve their quality of life cannot be overemphasized. According to Okeme & Akpama (2018), they noted that women in the rural areas are known for their hard work in farm work, they make foods available and cheaper, so as to reduce hunger, malnutrition, extreme poverty and build a healthy generation.

Unfortunately, in the rural areas, especially in developing countries like Nigeria, rural women are the poorest and more vulnerable among the poor, yet, they are made up of about 43% of the agricultural work force as reported by FAO (2011). Furthermore, the rural women are regarded as effective farmers just like men despite their low productivity output which may be attributed to less access to information, resources, labour and financial support. Aside this, successive governments in Nigeria had initiated programmes in the past for the betterment of the rural

dwellers, especially the rural women. Such programmes include National Poverty Reduction Programme/Community Based Poverty Reduction Agencies, Peoples Bank, National Directorate of Employment, Family Support Programme and Better Life for Rural Women, You Win Programme and Vision 2020, among others.

These programmes which were established for the integration of rural development, reduction of poverty, enhancement of the status of rural dwellers and improvement of the overall standard of living, had little or no effect on the beneficiaries. However, Ekom (2002) maintained that development programmes has always been the top down approach where the designing and implementation are carried out at the government circle without involving the beneficiaries at the decision making stage. This maybe the reason, Ekesionye & Okolo (2012), noted that majority of the rural women are not beneficiaries of the different government programmes, even though these women are engaged in income generating activities that require financial assistance. To bring development nearer to the rural dwellers, especially the rural women there is need to help them out of their poverty state by collective pursuance of economic interest and as well reduce the economic effects of Covid-19 pandemic. Such situation requires expedient actions by governmental and non-governmental agencies, policy makers, community leaders in boosting the rural women's sources of income through cooperative programmes.

In this study, cooperative programme activities are entrepreneurial activities that motivate people to collectively join their efforts and resources together and engage in any meaningful and productive ventures that will enhance their status. According to Dogaruwa (2008) cooperatives are democratic, community-based and resilient association that involves participation. They are essential ingredients for improving the living conditions of people, especially the rural women. Similarly, AFCD (2019), stated that a cooperative is an independent association of persons that voluntarily joined together to meet their socio-economic, cultural needs and aspirations through an enterprise that is democratically controlled. This means that cooperative programme activities offer a sense of belonging, create employment opportunities, increase food production, reduce poverty and illiteracy as well as, increase the income level of the rural women. These cooperative programme activities include Agricultural cooperative, thrift and credit cooperative, cooperative education programme, as well as leadership training activities.

Regrettably, Maleko & Msuya (2015) noted that, these cooperative programme activities have not been given the required attention they deserve in the community in reducing the scourge of poverty among the poor rural women. Perhaps, it may be due to the fact that these rural women do not seem to appreciate these cooperative opportunities open to them and that makes them to have little or no interest in these cooperative programmes (Ikonne & Duru, 2015). In order to sustain their interest on cooperative programme activities, these rural women should have access to relevant, timely information and knowledge about cooperative programmes and resources that can assist them to participate actively and contribute meaningfully to the general development of the society. When these rural women participate actively in cooperative programme activities, their socio-economic life will change and opportunities for self-accomplishment, economic growth, modification of public opinion about them and more especially their total wellbeing will be enhanced (Uhegbu, Unagha and Amaechi 2017).

Participation of women as observed by Deji (2007) is inevitably significant to the success and sustainability of community development programmes, because they are the majority of the workforce in the rural areas. This shows that participation, not only empowers women, but also brings development and growth. In this regard, Organization of Economic Cooperation and Development (2012) stated that strengthening the rural women's ability to participate in work force is seen as a means of challenging scourge of poverty and issues of economic sustainability. Sustainable economic development and growth in any nation can be achieved through rural transformation and empowerment of rural dwellers, especially the rural women. It is important to note that active participation of rural women in cooperative programme activities is a driving force that brings women together, so as to improve their quality of life and enhance community development (Ekong, 2013).

In this paper, community development is a process that involves community members participating actively in their own affairs, and enabling them to contribute meaningfully in the cultural, political and socio-economic growth of their communities. Hence, the rural women's active participation in cooperative programme activities empower them to fit into the dynamism of the modern society. Therefore, the view of this paper focuses on the revitalization of cooperative programme activities through active participation of rural women for self accomplishment and satisfaction towards enhancing community development. For better understanding and clarification of the subject of this discourse, efforts were made to get the views of scholars on the main concepts of this paper.

## II. COMMUNITY DEVELOPMENT

Community development is a combination of two distinct variables, 'Community' and 'Development'. Primarily, a community is an association of individuals who live in a locality and are guided by norms, religion, values, customs, identity and mutual interest. It is this mutual interest that binds people of the same group to share a common geographical area. Tonnies as cited in Mondal (n.d) viewed community as a normal living social group where people are bound together with a mutual relationship

generated through daily contacts within the comprehensive scope of human activities. Medina (2018) posited that a community is a group of people that lives in the same place, sharing certain attitudes and interest in common.

From the point of view of Frazer (2000), a community is a set of values that brings elements of solidarity, commitment, mutuality, self-help, communality and trust among the people. Community as a concept can be approached in terms of its descriptive category or as a set of variables.

These variables include:

1. Community as a place: According to Ramsey & Beesley (2007), Territorial or place community is a community of people who are held together because of their common locality or place of work or where they spend most of their time.

2. Community as an interest: According to Henri & Pudelko (2003), a community of interest is a community of people who come together for a common interest and share a common characteristics.

3. Community as a communion: This means a community that share the same ideology, have a sense of attachment to a particular place or group, without actually residing in a particular area. Such include the religions communities, education communities among others. This implies that community is defined in terms of common interest, belongings, attachments and affiliation of community members. This entails that communities can be urban, suburban and rural respectively.

In this study, community is defined as a group of people who resides in a given locality with common identity, interests, norms, cultural traits and willingly pursuing a common goal for the development of their community.

Development means an improvement in the quality of life through conscious process. It is associated with growth, progress, positive change, empowerment, betterment and capacity building. According to Israel (2018), development is a procedure that creates growth, progress, social, economic, physical, environmental and positive change. This positive change removes inequality, poverty and increase the material welfare of the people through access to education, health and housing. In this regard, there is need to allow necessary changes to take place, so that people could have the amenities and facilities they deserve. The more people develop themselves, the more they would become instrument for further changes. Therefore, development in the context of this study, is a continuous process whereby resources both human and material are utilized for the purpose of community development.

Community development is believed to be a major strategy for rapid development, particularly at the grass root level. In other words, it embraces all efforts towards the advancement of community interest and growth, thus enabling one to contribute significantly to material progress. Hence, the importance of community development in the growth of any nation cannot be over-emphasized.

The United Nations (2014) defines community development as, "a process where community members gather to take collective action and generate solutions to common problems". In the same vein, Kularatne cited in UKEssays (2017), defines community development as improving the living standard of people and expanding their abilities to make their own futures

through enhancing their welfare. This implies that community development produces a feeling of acceptance and open more potentials for individuals to develop as a team. In another dimension, SCDC (2019), views community development as a way of guiding people to take measures on issues that concerns them. This shows that community development is rooted in the belief that all people should have access to health, well being, justice and opportunity.

Furthermore, Owamalam (2010) enumerated the objectives of community development to include:

- Enhancement of life at the local level through resources (human and material).
- To spread an even living condition in the community in other to avoid neglect of any aspect of living.
- To bring about innovation in the physical and human processes of change.
- To reduce unemployment and abject poverty, provide governmental services and use any creative, technical and accessible assistance outside the community.
- To aim at agricultural development and extension, health programmes & disease control, rural industrial disinfection, rural education planning and planning for rural funds, development of communication and other recreation facilities. It is necessary to point out that community development in this context empowers the rural dwellers, especially the rural women.

Rural women who engage in subsistence farming, petty trading, artisans crafts seem to be voiceless in their communities. They are usually illiterates and lack access to formal education, finance and infrastructural facilities as observed by (Alosede cited in Ugwunnadi, 2014). These barriers make these rural women to contribute insignificantly to decisions that affect their lives and future. Amadi (2017) noted that the goals of National Policy on Women (2000), National Gender Policy (2006) and National Gender Policy Strategic Implementation Plan (2008) is aimed at empowering men and women and achieving gender equality that will eventually lead to development and elimination of poverty. Yet, these women still wallow in abject poverty and ignorance which affects their political status. Regrettably, Kumar (2018), noted that women are still faced with challenges in their political participation worldwide in this 21<sup>st</sup> century. This shows that women are under-represented and removed at the decision-making levels. Hence, there is urgent need to involve women at the decision-making stage, as it will improve their status, through active participation in cooperative programmes activities.

The essence of participation is exercising voice and choice. When people participate actively in their own affairs, it leads to empowerment, self reliance, economic sustainability and development of leadership skills. Thus, participation of rural women in cooperative programmes involve self help, democracy and equity. According to Cleaveir (2001), participation is a process during which individuals, groups and organizations are given the opportunity to become actively involved in programmes of development. Jamadar (2018) stated that participation is the extent through which beneficiaries were involved in information sharing, negotiation, discussion, decision makings and initiating actions in the programme activities. In line with the notion of

Jamadar, Osuji (as cited in Adekola, 2010), stressing on the components of participation noted that sharing of decision making, its execution, monitoring and appraisal of the needs identification of programmes revives and optimizes the benefits of rural women in their involvement of the programme activities. In other words, participation has a lot of benefits to the participants. As a vital factor, benefits are the main criterion for the recipients of the programme. Once the recipients start receiving benefits from the programme, the participation in the activities becomes enhanced.

### **Strategies For Revitalizing Cooperative Programmes For Active Participation Of Rural Women Towards Enhancing Community Development.**

The following strategies can be utilized in revitalizing cooperative programmes for active participation of rural women towards enhancing community development.

- a) **Agricultural Cooperative Programme Activities:-** The usefulness and importance of agricultural cooperatives cannot be overemphasized. Akinwumi and Abdulahi (2000), observed that rural women formed the highest membership in agricultural cooperatives in Nigeria, because they are virtually found in every village in all the rural communities. Although, agriculture is the backbone of rural economy of every nation, it is mostly carried out by rural women ranging from raising small scale livestock such as goats, sheep, poultry, growing of economic trees, fruits & vegetables. Other activities include rice farming, cassava processing, oil palm processing and palm kernel oil extraction, among others. All these activities are geared towards increased food production, its availability and affordability. Okeme and Akpama (2018), opined that rural women are known for their hard work, they make foods available and cheaper in order to reduce hunger, malnutrition, extreme poverty and build a healthy generation. Agricultural cooperative as an economic enterprise empowers the rural women so that they can be able to buy improved seedlings, new farm implement, pesticides and fertilizers at reduced prices. Moreso, rural women who belong to agricultural cooperatives are taught by agricultural extension workers on new improved methods of farming, in order to get them acquainted with knowledge of plant pests and disease control, new method of fertilizer application for soil fertility so as to boost their crop yield. All these improved methods of farming will enhance the rural women's production for both subsistence and commercial use. Also, the agricultural cooperative programme creates employment opportunities for women, men and the youths in the rural areas. This will increase their income level, enhance their status and reduce poverty.
- b) **Thrift and credit cooperative programme activities:-** Is an entrepreneurial activity that can be carried out in all sectors of the economy. Its members include small scale farmers, traders, craftsmen and women, workers of the same occupation and market women. Adekunle and Henson (2007), observed that thrift and credit cooperative programme activities mobilize local savings

and administer credit to members. Otto & Ukpere (2011), noted that thrift & credit cooperative is one of the distinct cooperatives that are known globally especially in Nigeria, because it mobilizes local savings and enhances the income generating activities of the rural women. As a cooperative programme activity that creates employment opportunities particularly in the rural communities, Akereke and Adekunmbi (2017) observed that thrift and credit allows disadvantaged groups to be organized for social and economic benefits. Such socio-economic benefits will enhance their economic activities, thereby making them to become self-reliant, self-esteemed and economic independence.

c) **Cooperative education programme activities:-** In this study, cooperative education programmes can be defined as a purposeful effort that is aimed at imparting quality education and training to rural women in order to reposition and enhance their knowledge, skills and competencies. This means that, quality education and training offers a relaxed environment for capacity building in conjunction with literacy, vocational, entrepreneurial and life skills. Literacy, vocational, entrepreneurial and life skills are embedded in cooperative education. According to Uchendu (2002), cooperative education aims at organizing literacy programmes, developing skills through organized vocational training and developing leadership qualities among members. This implies that through cooperative education, members will understand the principles of cooperatives which will enable them to solve their social and economic challenges in order to become self-reliance. The cooperative principles include among others, establishment of learning/training centres, teaching using interactive skills, providing equal opportunities for participants and exchanging of ideas among participants in cooperative education programmes. Tchami (2007), observed that cooperative education is a set of practices and methods that are used to make members to be aware of these aforementioned cooperative principles and its usefulness. To increase participants awareness on cooperative issues and community matters, they need to be equipped with appropriate skills and competencies that will help in problem solving, leadership and self-management skills. Acquisition of these skills will boost the rural women's confidence, knowledge and as well make them function better in the society. In other words, cooperative education programme activities can strengthen the capabilities of disadvantaged groups in the community, because it will enable them improve themselves, their families and the community at large. Thus, Cooperative education programme activities if well designed and implemented, will be a potential vehicle for rural development and transformation.

d) **Cooperative leadership training:-** This is a cooperative programme activities that is geared towards empowering the women for effective leadership in decision-making.

Ebonyi and Jimoh (2002), noted that every cooperative programme depends on its leadership style. This implies that training of both members and executives will enhance the progress of the cooperatives. Such training which includes in-service training, workshops and seminars is geared towards enhancing their leadership and management skills, learning how to communicate clearly, so as to make decisions that will motivate, inspire, show respect for loyalty and trust in the subordinates (Gill, 2005). In line with this view, D'Souza (2005) noted that cooperative leadership training prepares and equips women in effective leadership training and decision-making techniques. Thus, cooperative leadership training empowers the rural women and enables them to be politically active. Unfortunately, gender bias, socio-cultural, political, discrimination and other challenges have prevented majority of women from participating in community development planning and decision-making process. These discriminations and other challenges persisting in most parts of the world as observed by ILO (2005), has caused the unsatisfactory representation and participation of women in cooperative leadership.

### III. CHALLENGES THAT HINDER RURAL WOMEN FROM PARTICIPATING IN COOPERATIVE PROGRAMME ACTIVITIES TOWARDS ENHANCING COMMUNITY DEVELOPMENT.

The challenges facing effective women's participation in cooperative programme activities in the rural areas are as follows: Insufficiency of funds, less access to education and training, Lack of knowledge and sensitization and Existence of some cultural practices.

Firstly, insufficiency of funds limits the rural women's active participation in cooperative programmes. This is because the rural women in the rural areas are the poorest, voiceless and lack certain material possessions, as well as finance. Due to poverty and lack of unemployment opportunities, these women engage in low income generating activities. These low income generating activities cannot assist them to acquire the basic goods and services that can sustain them and their families. Hence, insufficiency of funds experienced by these women weaken their capabilities and opportunities to improve their quality of life and that of their families. This lack of funds experienced by these rural women has always been reported in various works by researchers as a barrier to rural projects (Aremu 2004, Ekong 2007, Ndifon 2012).

Another challenge faced by the rural women is less access to quality education and training. This has been identified as a key barrier to rural women's advancement in cooperative programme. According to Anania & Rwekaza (2018), the practice has always been the exclusion of members in most of the opportunities for cooperative education and training; while the leadership and management are given priorities in most cases. On the other hand, the education and training for the members are done haphazardly with no formal modalities. In addition, problems of ignorance, illiteracy, poverty, poor communication network, poor sensitization and lack of self-confidence among the rural women

have contributed to their low participation in cooperative programme activities. This may be attributed to lack of access to suitable information services as observed by (Zaid & Popoola, 2010, Kamba, 2011 and Ugwunnadi, 2014).

Furthermore, low managerial skills among the leadership and lack of commitments by members who defaulted in loan repayment indicates insincerity and dishonesty. This is seen as a barrier to cooperative programmes which may cause uproar among the members (Gbadeyan, 2000).

Moreso, the existence of some cultural practices denies women their rights to land ownership and inheritance, access to credit facilities and human rights (Nwaura, 2014). Also, Okechukwu & Ugwumba (2016) observed that family responsibilities and the existence of some cultural practices which demand that a married woman seek prior consent of the husband before joining any form of association have placed a major constraint to rural women's participation in cooperative activities.

#### IV. THE WAY FORWARD

To ensure active participation of rural women in cooperative programmes, there is need for extensive public sensitization and enlightenment campaigns, using any traditional media, such as the town criers, town union meetings and village meetings, as vital sources of information. Other valuable sources of information are audio-visual and interpersonal communication which include mass media, radio, television, recorded audio, video programmes, age grade associations, associations of trade, churches, agricultural extension workers and any other creative means that can be used equally in exchange of information among the rural women in the rural communities in Nigeria.

Also, community outreach programmes should be organized by Community Based Organizations, Faith-Based Organizations, Non-Governmental Organizations and Government Agencies through cooperative education programme activities to reduce problems of illiteracy and ignorance. This will enhance the rural women's knowledge, skills and information utilization capacity. Relevant information dissemination will equally enhance the socio-economic and political status of the rural women's active participation in cooperative programmes.

To ensure continuity and expansion on the cooperative skills, cooperative education and training should be learner-centered, that is education and training should be based on the members, because they are leaders-in-making. In addition, leadership and management of cooperatives should not take decisions at the top without consulting the members for review. This implies that transformation in structure is very important for meaningful and productive cooperative programmes in the communities.

The progress or failure of any cooperative programmes depend on its leadership style. Every cooperative should take the training of its members staff and leaders very serious, so as to enhance their performances for the advancement of the cooperatives. This can be done through in-service training to orient and re-orient members, workshops and seminars for cooperative leaders, community leaders, market women leaders and other stakeholders in cooperative society matters. Such training is very necessary, as it is geared towards enhancing the

knowledge of leaders on leadership and management skills of cooperative programmes

Government at all levels especially during this Covid-19 pandemic, should support the cooperative programmes by mobilizing to provide relief to rural women. This will encourage them to do more in community based poverty alleviation programmes. Community leaders should encourage more women to participate in this programme in other to increase economic activities at the rural level. Sequel to this, government, non-governmental organizations and cooperate bodies should provide aids and financial assistance to reduce the problems of inadequate funds and small size loans.

More importantly, existing traditions that do not favour women, that is, the land and property ownership legislation and as well as inheritance should be revisited. Women should no longer be discriminated against in access to land, resources and human rights. This will enable these women to gain more control over life decisions that can improve their status, their families, health and economic independence.

In recognition of the usefulness and importance of cooperative programmes in enhancing the status of rural dwellers, if well implemented and managed with sincere leadership, will take care of abject poverty, unemployment, problems of illiteracy, gender inequality, experienced among the rural women in the rural communities.

#### V. CONCLUSION

This paper has communicated the fact that rural women needs to be revitalized in cooperative programme activities towards enhancing community development. Thus, the usefulness and importance of cooperative programme activities for community development cannot be over emphasized. Undoubtedly, the rural women for whom the programme was meant for and their active participation in this programme will create employment opportunities, increase food production, reduce illiteracy and poverty levels and as well increase their income generating levels. As a productive venture, that offers a sense of belonging, the cooperative programme activities improve the living conditions of the rural women and equip them with appropriate skills and competencies that empowers them to fit into the dynamism of the modern society. Once this is achieved, not only will their status change, rural development and transformation will be enhanced, and maternal mortality rate, unemployment, abject poverty and diseases ravaging the rural women in the rural areas will be drastically reduced.

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# Executive Financial Compensation And Organizational Resilience Of Deposit Money Banks In Rivers State, Nigeria

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**Abstract-** The purpose of this paper is to examine the relationship between executive financial compensation and organizational resilience of Deposit Money Banks in Rivers State, Nigeria. The predictor variable is executive financial compensation which was used as a uni-dimensional variable while the criterion variable: organizational resilience has three measures vis-à-vis adaptive capacity, situational awareness and innovation. The study adopted a correlational and cross-sectional research design and uses questionnaire as the research instrument which was distributed to 57 top executives of 19 DMBs operating in Rivers State which comprises of 3 executives from each DMBs. The data generated were analyzed through the use of Spearman's Rank Order Correlation Coefficient as well as t-statistics to test the relationship between the variables of the study through the use of Statistical Package for Social Sciences within a significance level of 0.05. The findings showed that executive financial compensation has positive and significant effect on organizational resilience vis-à-vis adaptive capacity, situational awareness and innovation of DMBs in Rivers State respectively. We therefore recommend among others that DMBs should apply effective and efficient executive financial compensation to motivate their executives so as to withstand environmental threats.

**Index Terms-** Executive Financial Compensation; Organizational Resilience; Adaptive Capacity; Situational Awareness; Innovation

## I. INTRODUCTION

The business environment Deposit Money Banks (DMBs) found themselves has today become so complicated, uncertain as well as more volatile than before, as such today's strategy that yield enhanced performance might become obsolete as well as miss the set target overnight. More so, the 21<sup>st</sup> century organizations including the DMBs are faced with increased vulnerability because they are subject to more and unforeseeable risks due to globalization and rapid changes from the business environment that might hinder their ability to be successful. However, in the events of this rapid changes, most organizations are not prepared and have no plans to navigate through. Thus the lack of business continuity plans in today's organizations especially developing countries like Nigeria shows that most organizations are not well prepared for disruptive events such as

changes in cultural practices, increasing competition, dynamics and environmental uncertainty. To explain further, Gabriel (2015) expressed that Nigerian organizations are scarcely prepared for challenges, especially in the wake of current sociopolitical and economic quandaries like the disruption brought about by "ENDSARS". Though the "ENDSARS" struggle in Nigeria was not initially meant to suffocate the economy until it was hijacked by hoodlums who went about disrupting business activities and injuring lots of peaceful protestant.

Business organizations that must survive in today's business environment must be resilient enough in its daily operations. In other words, organizations have to possess resilience as quality in order to be able to manage threats externally on their way to achieving their set objectives. Thus, Eketu and Ahiauzu (2015) expressed that the ability of an organization to succeed and survive is a function of its capacity to adapt to its environment continuously. Consequently, organizations that want to be prosperous and survive in nowadays dynamic and complex environment must be able to adapt to it. Seville, Porter and Askew (2008) expressed that given that environment of business cannot be wholly controlled, organizations must be resilient in their daily operations. Furthermore, the challenge for organizations in today's business environment is to build up capacities to respond continuously to changes in the environment. To attain this, organizations must of necessity engage more in executive compensation package such as financial compensation. This is because, in today's uncertain business environment with all its complexities, for organization to adapt, the organization needs higher effective and efficient compensation especially that of the executives. Based on the fact that, the executives are sets of organizations' human resources that are very strategic and essential to the success of the organization due to the role they play in ensuring the organization attain its goal(s).

Compensation provided to executives in organizations is very important to their motivation which provides the basis on how well the operations of the organization will be coordinated; this can provide the motivation that can facilitate resilience in the organization during emergency. Thus, if financial compensation is effectively given, executives will have the motivation to carry out their tasks effectively and efficiently which can provide the ability of the organization to bounce back during turbulence. The need to study the relationship between executive financial compensation and organizational resilience in today's business environment has

become urgently needed due to frequent environmental changes that is affecting the performance of all organizations across the globe especially in the developing world. More so, studies (Sheffi, 2005; Mullich, 2009; Dewald & Bowen, 2010; Wicker, Filo & Cuskelly, 2013; Umoh, Amah & Wokocho, 2014) on organizational resilience from extant literature especially in this part of the world has not looked in the direction of executive financial compensation in regards to organizational resilience. Thus, taking into consideration previous research on organizational resilience, there seems to be a lacuna on how financial executive compensation can influence organizational resilience. Therefore, this study abridged this gap through examining the role of executive financial compensation in enhancing organizational resilience vis-à-vis adaptive capacity, situation awareness and innovation of DMBs in Rivers State, Nigeria. This study would therefore be of great significance to managers of DMBs, in the sense that its outcome would have a significant policy implication for organizational success since the compensation of executives is an issue common to all organizations. It would further help organizations especially the DMBs in knowing the relationship that exist between executive financial compensation and organizational resilience.

## II. RESEARCH QUESTIONS

The following are the research questions that guided this paper:

- i. What is the relationship between executive financial compensation and adaptive capacity of DMBs in Rivers State, Nigeria?
- ii. What is the relationship between executive financial compensation and situation awareness of DMBs in Rivers State, Nigeria?
- iii. What is the relationship between executive financial compensation and innovation of DMBs in Rivers State, Nigeria?

## III. RESEARCH HYPOTHESES

The following are the study research hypotheses stated in the null form:

H0<sub>1</sub>: There is no significant relationship between executive financial compensation and adaptive capacity of DMBs in Rivers State, Nigeria.

H0<sub>2</sub>: There is no significant relationship between executive financial compensation and situation awareness of DMBs in Rivers State, Nigeria.

H0<sub>3</sub>: There is no significant relationship between executive financial compensation and innovation of DMBs in Rivers State, Nigeria.

## IV. LITERATURE REVIEW

### Theoretical Framework

This paper is anchored on agency theory as its theoretical foundation. Agency theory focused on the relationships between the owners of a business (called principals) and the hired executives (called agents) (Jensen & Meckling, 1997). The theory further expressed that for the organization to achieve set

objectives, the principal must have a good relationship with the agent by ensuring that the agent do not seek self-gratifying interests rather than the interest of the organization's owners. This could be achieved by adequately providing regular compensation plans to managers as this would motivate them to attain greater efficiency levels, whereby reducing the occurrence of agency problem (conflict of interest) between managers and the business owners, fostering the maintenance of adequate financial reserves and the addition of value to the organization which might bring about the enhancement of organizational resilience in challenging times. Clearly, the executives of the organization, determines the level of productivity that will be attained and performance that will be achieved in the organization, thus, executives should be well compensated as it would energize and propel them to work harder towards attaining the organization's goal(s) in times of crisis.

## V. CONCEPT OF EXECUTIVE FINANCIAL COMPENSATION

Compensation can be seen as a system of rewards that is capable of inspiring a worker to do more in a given task. In the view of Martocchio (2004) compensation has to do with intrinsic (psychological satisfaction) and extrinsic (monetary and non-monetary) rewards given to employee. These psychological satisfaction and monetary reward energizes him or her to put more effort in making sure a given task is performed effectively and efficiently. More so, the concept of executive compensation represents intrinsic and extrinsic rewards given to an organization's top executives for job done. Thus, Junaidu and Sanni (2014) defined executive compensation as financial and non-financial awards given to the executives for services rendered to the organization. This includes of salary, bonuses, share benefits etc. In a more succinct way, executive compensation is the remuneration packages set aside for the top management of an organization which goes with executive labor services (Jegade, 2012; Bebchuk, Grinstein & Peyer, 2010). Executive compensation is different from that of lower-level employees. This is because the salary and other benefits are negotiated and documented in a formalized employment contract (Heatfield, 2018). The contract contains all agreement and other special terms of employment. Executive compensation is negotiated between the potential executive and the employer. Non-executive compensation is similar among functional level employees under a standard remuneration (Heatfield, 2018). Thus, executive compensation, is negotiated and agreed upon in an employment contract. It includes substantial differences in benefits and salary different from the regular rewards by the organization.

Furthermore, executive financial compensation is the financial payments and non-monetary benefits provided to high level management in exchange for their work on behalf of an organization. It is a compensation that is concerned with monetary terms which comprises financial rewards and financial incentives provided to top executives of an organization. According to Armstrong (2003); Martocchio (2004) executive financial compensation provide financial recognition to top executives for attaining or exceeding their performance targets or reaching certain levels of competence or skill. It therefore, has to do with the act of providing top executives with money or other things of economic value in exchange for their labour or to provide for the costs of injuries that they have incurred in cause of carrying out

their executive functions and it includes salary, bonuses, and merit based pay. Salary is a compensation paid to executives which can be fixed weekly, monthly, or annually. It is the remuneration to the services of the executives by the organization and it is a tool of payment in the form of currency. It includes the basic and the auxiliary pay. The basic pay is the foundation to determining various allowances, insurances and bonuses which depends on the following factors vis-à-vis labour's skills, work experiences, labor intensity, responsibility, work importance in the organization's strategy, work years etc. The auxiliary pay include allowances, free working meals, housing subsidies, etc. The payment of good salary is one of the strategies in motivating any human resource including the executives in order to enhance their performance, commitment and satisfaction. This is because it influences the workers' behaviour as well as attract, and increase the intention to stay and lead to organization's higher performance (Tella, Ayeni & Popoola, 2007).

Bonus is the extra payment which is received as a reward by the executive for effectively and efficiently performing his or her job well. It usually comes along with salary of the executive. It is the gesture of appreciation from the organization towards their executives. It is not only given for the job well done but also to keep the employees vis-à-vis the executives motivated and focused. The distribution of bonus is completely depends upon the policies and profitability of the organization. The reason of the payment of bonus is basically to bridge the gap between the ideal of a living wage and the wages paid (Park & Sturman, 2009). Merit based pay is a compensation program where basic pay increase are determined by individual performance, as opposed to across the board increases. According to Jensen (2014), merit- based pay play a vital role to bring job satisfaction, organizational commitment and job performance whereby most organization are using the merit based pay system as a strategic reward plan that can enhance the workers performance and influence the workers' working behaviour toward higher fulfillment with the organization.

### **Organizational Resilience**

The unpredictable business environment makes business firms susceptible to risk emanating from the environment; thus organization must be resilient in its day to day operation in order to be able to withstand these changes. Thus, organizational resilience is the ability of an organization to respond rapidly to unforeseen changes, even chaotic disruption, pursue its goals despite disruption through mindfulness, agility, and consistency. It is a proclivity of an organization to attain a flexible quality in order to respond effectively to its environment as changes occur in it. Organizational resilience is more of the capacity of an organization to predict a changes or disruption and adapt to same as well as recovering quickly as much as possible from perturbation (Madni, 2007). It also has to do with the ability of the organization to be creative as well as having the enthusiastic to react quickly to the effect of unanticipated changes from the environment (Weick, Sutcliffe & Kathleen, 2007). Hence, it is the ability of an organization to acclimatize during turbulence so as to maintain high performance. This definition suggests that organizations must be able to develop an adaptive capacity to mitigate the impact of negative environmental events as well as a bounce back, or rebound, to earlier levels of performance

following a period of inferior performance or performance decline.

Furthermore, McManus, Seville, Vargo and Brundson (2008) expressed that the numerous concepts that emerge from definitions of organizational resilience include knowledge of the environment, level of preparation, anticipation of perturbations, adaptation, capacity to recover, etc. The ability of organizations to absorb shock or develop resistance in the face of turbulences and disruption within its environment is a reflection of how prepared the organization can be. According to Robb (2000), a resilient organization is able to sustain competitive advantage over time through its capability to do two things simultaneously; deliver excellent performance against current goals, and effectively innovate and adapt to rapid, turbulent changes in markets and technologies. The measures of organizational resilience used in this study include adaptive capacity, situation awareness and innovation discussed below:

Adaptive capacity has to do with the culture in the organization which allows the organization to make effective and efficient decisions on time as well as on daily basis in the face of crises (McManus *et al.*, 2008). Adaptive capacity depends on the attributes of individuals, organizations and institutions that foster learning when faced with change and uncertainty, such as willingness to learn from mistakes, engage in collaborative decision-making arrangements, and encourage institutional diversity (Armitage, 2005). It include the ability of the organization to learn to live with uncertainty, combining various knowledge for learning and creating opportunities for self-organization. It is the engagement and involvement of organizational staff so that they are responsible, accountable and occupied with developing the organization's resilience through their work because they understand the links between the organization's resilience and its long term success.

Situation awareness has to do with the ability of the organization to have future projection of the environment and understand same from their current position. Endsley (1988) posits that situation awareness has to do with the ability of the organization to perceived elements in the environment within a volume of time and space, the comprehension of their meaning and a projection of their status in the near future. Thus, it is the mindful, vibrant and active thoughtfulness of the situation or changes in the environment an organization operates which gives the organization the capability to think of about the potentials that lie in the future and not necessarily focusing on the past (Bedny & Meister, 1999). The dynamic reflection contains logical-conceptual, imaginative, conscious and unconscious components which enables the organization to develop mental models of external events.

Innovation relates to seeking out unsatisfied needs and taking of strategic steps to create a new product or service that will become a solution to needs of the society. It has to do with the process of adding a new feature to a product or making a whole change to the product or the process involves in making a given product which bring about a new product or service that gives value or satisfy the needs of customers (Abdul & Syeda, 2014). It therefore has to do with the ability of the organization to be creative (Damanpour, 1991). The ideal culture of innovation would include the willingness to cannibalize existing products, balanced marketing and technology ideation, embrace risk and

focus on the future. The ability to innovate in times of difficulties and crisis is very important to ensuring the resiliency of the organization towards organizational success (Tellis, 2013).

### VI. METHODOLOGY

We used correlational research design through cross-sectional studies focused on top executives of DMBs in Rivers State in order to know the relationship that exists between executive financial compensation and organizational resilience. Consequently, research survey design was adopted using questionnaire as the research instrument which consists of four response choices with 5 Point Likert scales ranging from 1 to 5 indicating strongly disagree, disagree, indifference, agree and strongly agree respectively. To ascertain the validity and reliability of the research instrument, we adopted face and content validity while the reliability of the instrument was done using Cronbach Alpha which showed a Cronbach Alpha value of 0.862 for executive financial compensation, 0.925 for adaptive capacity, 0.893 for situation awareness and 0.858 for innovation. The predictor variable is executive financial compensation and it is

used as a uni-dimensional variable while the criterion variable is organizational resilience with three measures vis-à-vis adaptive capacity, situational awareness and innovation. The population of the study comprised of 57 top executives of 19 DMBs operating in Rivers State which comprises of 3 executives from each DMB. Though, these DMBs have their Head offices in Lagos, they however have their regional offices in Rivers State and the executives range from General Managers (GM), Deputy General Managers (DGM), Assistant General Managers (AGM), Executive Directors (ED), Divisional Executives (DE), Principal Managers (PM), Zonal Managers (ZM). More so, all the 57 executives were also used as the sample size. Furthermore, out of the 57 questionnaires distributed 53 representing 92.98% were retrieved and were properly filled which were used for our analysis while the other 4(7.02%) questionnaire were not retrieved. Data gathered were analyzed through the use of Spearman's Rank Order Correlation Coefficient as well as t-statistics was used to test the relationship between the variables of the study through the use of Statistical Package for Social Sciences (SPSS) Windows version 25 within a significance level of 0.05.

### VII. DATA ANALYSIS AND RESULTS

#### The Strength of the Relationship between Executive Financial Compensation and Adaptive Capacity

**Table 1: Correlation between executive financial compensation and adaptive capacity**

		Executive Financial Compensation	Adaptive Capacity
Spearman's rho	Executive Compensation	1.000	.884**
		Sig. (2-tailed)	.000
		N	53
Adaptive Capacity		.884**	1.000
		Sig. (2-tailed)	.000
		N	53

\*\* . Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS v25: Output, 2020.

Table 1 reveals that a very strong and positive significant relationship exists between executive financial compensation and adaptive capacity with a ( $\rho = 0.884$ ) and a  $PV = 0.000$  which is less than 0.05. In other words positive relationship exists between the variables, thus, the provision of financial compensation to executives will provide adaptive capacity for the DMBs in Rivers State. The degree to which executive financial compensation influences adaptive capacity is further shown in the below table 2:

**Table 2: the degree of effect of executive financial compensation on adaptive capacity**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.884 <sup>a</sup>	.781	.802	.38160

a. Predictors: (Constant), Executive Financial Compensation

Source: SPSS v25: Output, 2020

Table 2 above reveals the degree to which executive financial compensation influences adaptive capacity with R-val.= 0.884 which implies a very strong relationship while the  $R^2=0.781$  implies that executive financial compensation explain 78.1% variation in

DMBs adaptive capacity while the remaining 21.9% could be due to the influence of other factors not included in this study. The relationship is further tested applying t-statistics as shown in Table 3 below:

**Table 3: T-value result on executive financial compensation and adaptive capacity**

Coefficients <sup>a</sup>		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	.756	.539		11.531	.000
	Executive Financial Compensation	.701	.472	.630	8.057	.000

a. Dependent Variable: Adaptive Capacity

Source: SPSS v25: Output, 2020

From Table 1, the PV = 0.000 which is less than 0.05 and Table 3 shows  $\beta = 0.701$ ;  $t\text{-cal.} = 8.057 > t\text{-crit.} = 1.96$  at  $0.000 < 0.05\%$  which means that the relationship between executive financial compensation and adaptive capacity is statistically significant. We therefore reject the null stated hypothesis and accept the alternate hypothesis, thus there is significant relationship between executive financial compensation and adaptive capacity of DMBs in Rivers State, Nigeria.

**The Strength of the Relationship between Executive Financial Compensation and Situation Awareness**

**Table 4: Correlation between executive financial compensation and situation awareness**

		Executive Financial Compensation	Situation Awareness
Spearman's rho	Executive Compensation	1.000	.926**
		Sig. (2-tailed)	.000
		N	53
Situation Awareness		.926**	1.000
		Sig. (2-tailed)	.000
		N	53

\*\* Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS v25: Output, 2020.

Table 4 reveals that a very strong and positive significant relationship exist between executive financial compensation and situation awareness with a ( $\rho = 0.926$ ) and a PV = 0.000 which is less than 0.05. In other words positive relationship exists between the variables, thus, the provision of financial compensation to executives will lead to situation awareness of the business environment of the DMBs in Rivers State. The degree to which executive financial compensation influences situation awareness is further shown in the below table 5:

**Table 5: the degree of effect of executive financial compensation on situation awareness**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.926 <sup>a</sup>	.857	.839	.45023

a. Predictors: (Constant), Executive Financial Compensation

Source: SPSS v25: Output, 2020

Table 5 above reveals the degree to which executive financial compensation influences situation awareness with R-val.= 0.926 which implies a very strong relationship while the  $R^2=0.857$  implies that executive financial compensation explain 85.7% variation in DMBs situation awareness while the remaining 14.3% could be due to the influence of other factors not included in this study. The relationship is further tested applying t-statistics as shown in Table 6 below:

**Table 6: T-value result on executive financial compensation and situation awareness**

Coefficients <sup>a</sup>		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	.834	.711		8.729	.000
	Executive Financial Compensation	.790	.362	.557	5.906	.000

a. Dependent Variable: Situational Awareness

Source: SPSS v25: Output, 2020

From Table 4, the PV = 0.000 which is less than 0.05 and Table 6 shows  $\beta = 0.790$ ;  $t\text{-cal.} = 5.906 > t\text{-crit.} = 1.96$  at  $0.000 < 0.05\%$  which means that the relationship between executive financial compensation and situation awareness is statistically significant. We therefore reject the null stated hypothesis and accept the alternate hypothesis, thus there is significant relationship between executive financial compensation and situation awareness of DMBs in Rivers State, Nigeria.

**The Strength of the Relationship between Executive Financial Compensation and Innovation**

**Table 7: Correlation between executive financial compensation and innovation**

	Executive Financial Compensation	Innovation
Spearman's rho	.914**	.914**
Executive Financial Compensation	1.000	.914**
	Sig. (2-tailed)	.000
	N	53
Innovation	.914**	1.000
	Sig. (2-tailed)	.000
	N	53

\*\* Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS v25: Output, 2020.

Table 7 reveals that a very strong and positive significant relationship exist between executive financial compensation and innovation with a ( $\rho = 0.914$ ) and a PV = 0.000 which is less than 0.05. In other words positive relationship exists between the variables, thus, the provision of financial compensation to executives will motivate the executives to be innovative. The degree to which executive financial compensation influences innovation is further shown in the below table 8:

**Table 8: the degree of effect of executive financial compensation on innovation**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.914 <sup>a</sup>	.835	.828	.48115

a. Predictors: (Constant), Executive Financial Compensation

Source: SPSS v25: Output, 2020

Table 8 above reveals the degree to which executive financial compensation influences executive innovation with  $R\text{-val.} = 0.914$  which implies a very strong relationship while the  $R^2 = 0.835$  implies that executive financial compensation explain 83.5% variation in DMBs innovation capability while the remaining 16.5% could be due to the influence of other factors not included in this study. The relationship is further tested applying t-statistics as shown in Table 9 below:

**Table 9: T-value result on executive financial compensation and innovation**

Coefficients <sup>a</sup>		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	.795	.689		13.807	.000
	Executive Financial Compensation	.662	.513	.610	9.046	.000

a. Dependent Variable: Innovation

Source: SPSS v25: Output, 2020

From Table 7, the PV = 0.000 which is less than 0.05 and Table 9 shows  $\beta = 0.662$ ;  $t\text{-cal.} = 9.046 > t\text{-crit.} = 1.96$  at  $0.000 < 0.05\%$  which means that the relationship between executive financial compensation and innovation is statistically significant. We therefore reject the null stated hypothesis and accept the alternate hypothesis, thus there is significant relationship between executive financial compensation and innovation of DMBs in Rivers State, Nigeria.

### VIII. DISCUSSION OF FINDINGS

Based on the data analyzed, executive financial compensation has positive and significant relationship with organizational resilience vis-à-vis adaptive capacity, situational awareness and innovation. Sound compensation system is a hallmark of organizations success and prosperity. The success and stability of organization is measured with pay package provided to its employees including the executives. This is because, employees as well as executives' willingness to stay on the job largely depends on compensation packages of the organization (Armstrong, 2003). In other to ensure executive optimal performance and retention, organizations need to consider a variety of appropriate ways to rewarding them so as to achieve the desired results (Falola, Ibidunni & Olokundun, 2014). Furthermore, executives as part of human resources in the organization facilitate seamless adaptation of organizations in everyday challenges and in a world of dynamic business environment. The presence of effective executive with requisite skills and knowledge was particularly highlighted by Beerman (2011) as a critical contributor to adaptive capacity. Thus, effective financial compensation will go a long way in providing motivation to the executives in trying to constantly modernize and integrate with partners, suppliers and customers to keep up with uncertain business environment and quickly reacting to customer demand, market opportunities and external threats.

Additionally, Tzu and Chung (2007) expressed that financial compensation given to the executives are used to improve their operational efficiency thereby motivating them to work harder in order to receive a high amount of future compensations depending on the productivity of the organization. This generally motivates executives to perform better. This can

provide the executives the drive to provide the relationship necessary to facilitate the survival of the organization in its environment before, during and after crisis or challenges. More so, effective financial compensation provides executives the enthusiasm to manage organizational change through proper relationship with followers and encouraging them to innovate and to prepare for crisis (Goucher, 2007). Consequently, an ideal financial compensation system will positively impact on the efficiency and results produced by executives. It will encourage the executives to perform better and achieve the standards fixed, enhance the process of job evaluation, help in setting up an ideal job evaluation and the set standards would be more realistic and achievable.

Furthermore, financial compensations drive workers morale and the contribution of the rewards has existed in organizations especially in accordance with performance evaluation (Appelbaum, Schroeder, Cain & Mitroff, 2011). All businesses organizations use salary, bonuses or other types of compensation to motivate and encourage high-level performance of their workforce including their executives which can provide a dynamic orientation to the situation at hand in the organization as well provide the opportunity to reflect not only the past, present and future, but the potential features of the situation. In motivating high executive performance, money is the fundamental inducement; no other motivation technique has been applied widely than pay due to its influential value (Tzu & Chung, 2007). In the same vein, Kalim (2010) observed that money is a vital factor which affects employees' motivation. It is worthy to note that no human on earth does something if he or she lacks the motivation to doing it; he or she does anything as a result of either direct or indirect motivation, thus the motivation provided by financial compensation can provide the executives the ability to be at alert of what is happening around the organization, have understanding of what that information means to the organization now and in the future, anticipate opportunities and possible threats, disturbances and the ability to correctly identify potential crisis and their likely effects on the organization. Many organizations see financial compensation as a mediator to attract talented workers (executives), motivate and increase the retention rate of their workers to stay with the organization (Ahmad, Toh & Bujang, 2013). Also, Riggio (2013) stated clearly that workers are motivated by money and material gains. This means that with fair

and equitable financial compensation, executives are more likely to stay with the organization and gather the impetus to be aware of the happening around the organization and track events as they gradually unfold and makes appropriate decision that will affect the organization.

Innovation is crucial to organizational survival and growth in any industries especially in times of disruption. Innovation is important in the value-creating process of organizations and is a key determinant for firm growth (Lev, Nissim & Thomas, 2008). Given the importance of innovation to the long-run success of business organizations, and given that executives reside at the strategic apexes of their organizations and make critical resource allocations pertaining to investments in new products and technologies, financially compensating the executives is a powerful mechanism for inducing them to pursue more valuable innovations (Balkin, Markman, & Gomez-Mejia, 2000). With regards to innovation, Manso (2011) expressed that the executives are essential in guiding the organization to an optimal level of innovation in line with the organization's ultimate task of maximizing stakeholders' interest and in other to motivate innovation the organization should rely on compensation schemes. The main innovators in an organization are executives that contribute through their everyday work to the innovation capabilities of the organization (Lerner & Wulf, 2007), thus good financial compensation will go a long way in motivating the executives towards bringing innovative ideas to the organization. Consequently, Ederer and Manso (2013) articulated that executives with good financial compensation are more likely to explore new options and discover new business strategies. In the same vein, Holmstrom (1989) suggests that the design of executive compensation is a significant determinant of the innovation produced by an organization.

## IX. CONCLUSION

Based on our findings, we therefore conclude that executive financial compensation positively and significantly affects organizational resilience vis-à-vis adaptive capacity, situation awareness and innovation of DMBs in Rivers State, Nigeria. Consequently, organizations of all types and sizes especially the DMBs may strengthen their resilience by engaging in a good, effective and efficient executive financial compensation. More so, sound executive financial compensation means having an environment that gives just and equitable compensation to executives for their works which serves as a means to motivating them to work harder to building an organization that will be able to withstand environmental changes.

## X. RECOMMENDATION

1. DMBs that want to attain resilience should ensure their financial compensation plans include policies that provide comprehensible executives' compensation management.
2. DMBs should apply effective and efficient executive financial compensation to motivate their executives so as to withstand environmental threats.

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# Enhancing Organizational Resilience Through Corporate Social Responsibility

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**Abstract-** To survive, persist and even thrive in the face of unexpected changes represents significant challenges for organizational decision-makers and have resulted in calls for understanding and developing mechanisms of coping with uncertainty. Thus, the aim of this paper is to examine the relationship between corporate social responsibility and organizational resilience of oil and gas firms in Rivers State, Nigeria. The predictor variable is corporate social responsibility which was used as a uni-dimensional variable while the criterion variable is organizational resilience which was used without measures. The study adopted a correlational and cross-sectional research design and uses questionnaire as the research instrument which was distributed to 50 top executives of ten selected oil and gas firms in Rivers State, Nigeria which comprises of five executives from each oil and gas firms. The data generated were analyzed through the use of Spearman's Rank Order Correlation Coefficient as well as t-statistics to test the relationship between the variables of the study through the use of Statistical Package for Social Sciences within a significance level of 0.05. The findings showed that corporate social responsibility has positive and significant effect on organizational resilience of oil and gas firms in Rivers State. We therefore recommend among others that oil and gas firms should balance and address the needs of different stakeholders in order to enhance their level of resilience during environmental changes.

**Index Terms-** Corporate Social Responsibility; Organizational Resilience

## I. INTRODUCTION

The business environment of all organizations including oil and gas firms has today become very turbulent and uncertain, thus, one of the major challenges today's business organizations are facing is to develop a new organizational form with the capacity to constantly respond and adapt to environmental changes. Countries globally as well as communities and business enterprises even individuals are all affected by environmental changes. Consequently, the need to incessantly align to changes in the environment has become so essential today than ever due to frequent changes in the business environment brought about by increased globalization. Today, a slight changes in the business environment of any country can have great impacts on the performance of other business organizations in other parts of the world due to the interconnectivity, dependability and

interrelatedness of the world business environment mostly enhanced by advanced technology. Hence, an event in one area can often have disastrous effects in another. Incidences like natural disasters, pandemic diseases such as the current covid 19 pandemic, and economic recession can all pose volatile and austere threat to the existence of any given business enterprise.

Therefore, it has become very obvious and glaring that no organization in today's business environment be it profit or non-profit oriented, local or global and large or small is immune to environmental changes. Thus, Hoopes and Kelley (2004) expressed that the amount of changes that have occurred in the business environment over the last two decades has increased tremendously. In this face of tremendous environmental changes, there is need for organization to be more resilient in their day to day operation in other to be able to attain their set goals and objectives. Organizational resilience has to do with the capability of an organization to bounce back from negative experiences by adapting to the business environment in a flexible manner using its available resources (Grote, 2009). It is a potential remedy to moving beyond survival to organizational prosperity and success in the face of challenging conditions and turbulences. Thus, Denhardt and Denhardt (2010) expressed that since resilience is the ability of business enterprise to recover from challenges to move beyond survival to organizational prosperity and success in the face of challenging conditions in a way that allows the business firm to be more flexible in adapting to future challenges, managers of all organization must find means to promote it at all times. In a bit to promoting the organizational capability of resilience, there is need for the organization to meet the needs of its stakeholders. This is very important as no organization exist in a vacuum; thus organization exist in an environment that lots of persons and institutions have stake as such their interest must be met and satisfied at all times for the organization to be resilient in its operation and generally prosper. In other words, organizations must of necessity engage more in corporate social responsibility.

The practice of corporate social responsibilities in the corporate world has brought a new shape to the social and economic setting throughout the globe (Kamrujjaman & Muhammad, 2015). This is because the business world is growing rapidly, demanding the organization's competence and public reputation in maintaining their business (Novrianty & Ely, 2015). Corporate social responsibility is the obligation which a firm has to satisfy the interest of its shareholders as well as to meet the needs of the society at large (Pearce & Robinson, 2011) which includes its customers, host community as well as government. It

reflects the organization's value which is based on the economic aspect, social aspect, and environmental aspect to ensure the sustainability of the organization. Thus, corporate social responsibility is a way organizations manage their businesses with a view to making positive and healthy impact on the society, through their economic, environmental and social activities. It is a business strategy meant to assist firms strike a balance between the need to achieve economic and financial objectives and the socio-environmental impact of their activities. To develop and enhance the performance of an organization does not only require it to meet only the need of its shareholders or investors but also the need of its host government and the entire society. This is because, the existence and impact of corporate activities does not only affect the organization but host of other institutions. Therefore, managers must not only focus on the organization's interests, but also consider the interests of parties outside the organization. More so, the survival of every business depends on the accomplishment of its objectives and according to Hilda, Hope and Nwoye (2015) there are two broad categories of business objectives expected to be accomplished vis-à-vis economic objectives and social objectives. While economic objectives are the targets to be accomplished in the marketing efforts of an organization towards enhancing its profitability, social objectives are associated with the aims of an organization towards satisfying the interest of its stakeholders. The capability to meet the interest of all stakeholders plays an important role in ensuring organizational resilience.

Furthermore, the oil and gas industry is one of the largest sectors in the world based on the monetary contribution estimated at \$3.3 trillion annually that is very essential to the global economic framework (Appiah-Adu & Amoako, 2016). Also, the oil and gas sector is a major driver of the Nigerian economy due to its contribution in the creation of employments as well as a major source of revenue of the Nigerian economy. However, in the last few months, a series of events and changes such as covid 19 pandemic has profoundly altered the operating environment in the oil sector changing the way they operate. Thus, firm in the oil and gas supply chain have gone from boom to bust. As a result, oil and gas companies are seeing business evaporate. Also, over the years the oil and gas sector have been accused of negligence of providing some basic social responsibility especially to their host communities. As a result, these companies suffer lots of setback that arises from community protest as well as lock down. There is therefore the need to study how the provision of social responsibility by oil and gas firms will impact on their organizational resilience in Rivers State. Thus, the purpose of the study is to determine the relationship between corporate social responsibility and organizational resilience of oil and gas firms in Rivers State, Nigeria. The research question is: what is the relationship between corporate social responsibility and organizational resilience of oil and gas firms in Rivers State, Nigeria? While the research hypothesis is that there is no significant relationship between corporate social responsibility and organizational resilience of oil and gas firms in Rivers State, Nigeria.

## II. LITERATURE REVIEW

### Theoretical Framework

This study is anchored on legitimacy theory which place emphasis on the continual endeavour of organizations to make sure they are seen to be operating and functioning in conformity within the society's norms they operate (Deegan, 2009). The theory further emphasize that there is an existence of social contract between business enterprise and the society in which it carries out its operation (Deegan & Samkin, 2009); this contract can be implicit or explicit as regards to societal expectations. The legal requirements by which a business organization operates is termed explicit while societal or community expectations is termed implicit. Generally, legitimacy theory focused on the relationship between the business organization and the community it operates within and the theory contends that business enterprise can only exist and survive if the society they operate in perceives them to be functioning within the values and norms that conforms to the value system of the society (Gray, 2010). Thus, business organizations must make sure good relationship exist between them and the society which they operate so as to maintain and sustain a good state of legitimacy by which the community permits the continuous existence of the organization even in times of disruptions and turbulences. This is because, no business enterprise exist in a vacuum; thus, its activities depends on the society. Therefore, the legitimacy level of the business enterprise is very essential to its continued survival.

### Corporate Social Responsibility

The business organization's environment has become encircled by different groups of persons and institutions who has stake in the organization as well as have sentient thought on how the business organizations could enhance their image publicly and help in developing and sustaining the society (Carroll & Shabana, 2010). Thus, this cautious awareness of these group of persons and institutions led to the creation of corporate social responsibility agitating that business organization should be responsible to the social and environmental consequences of their operations and not only to their economic activities. In other word, corporate social responsibility balanced shareholders and other stakeholders' needs. It thus, means that corporate social responsibility goes beyond the traditional obligation of satisfying the need of shareholders to other stakeholders to the organization. Over the years different scholars and managers have dedicated lots of thoughtfulness towards defining corporate social responsibility as a concept due to its complexity. In the words of Bani-khalid and Ahmed (2017) responsibility is a commitment or an obligation between two or more parties which is centered on mutual benefits. Combining the two words, Wartrick and Cochran (1985) earlier defined corporate social responsibility as a business organization's configuration of principles of social obligation, processes of social responsiveness, and policies, programs, and observable outcomes as they relate to the organization's societal relationships. It is a set of suitable behaviours exhibited towards different stakeholders of an organization which can be internally or externally as a result of the organization's sense of obligation towards the impact of its operations on the society in which it operates (Hohnen, 2007; Friedman & Miles, 2006). Also, McWilliams and Siegel (2001) observed that corporate social responsibility is a situation whereby firms engages in actions that further social good which is beyond the interest of the firm and that which is required by law. Therefore, social responsibility can be seen as the systematic

objective and intelligent concern shown by the organizational management towards the welfare of members of the society. It restrains individual and organization from destructive activities on humanity. It is the obligation of organizational decision makers to enact and implement managerial behaviours, which protect and improve the interest of the society and the organization that is being socially responsible (McWilliams & Siegel, 2001).

Corporate social responsibility also include incorporating social characteristics into products and manufacturing processes (by using environmentally-friendly technologies), adopting progressive human resources management practices (by promoting employee empowerment), achieving higher levels of environmental performance through recycling and reducing pollution (by adopting an aggressive stance towards reducing emissions), and advancing the goals of community organizations. It is becoming an increasingly important activity to businesses nationally and internationally. As globalization accelerates and large corporations serve as global providers, these corporations have progressively recognized the benefits of providing corporate social responsibility programs in their various location (Wasserman, 2003). This is because, the provision of social responsibility does not only affect the operations and the performance of the organization but also its survival capability. As such, Ehsan, Kaleen and Jabeem (2012) suggests that the first important goal of the organization is to fulfill its economic aims, thereafter its social aims. The economic responsibility of an organization is to ensure the production of goods and services desired by society and make profit out of it (Carroll, 1979). The economic responsibility has to do with profit maximization of the organization which according to Friedman (1970) is the primary and sole responsibility of any business organization. Thus, managers should only be responsible in enhancing the profitability of the organization through effective and efficient deployment of its resources as well as engaging in activities that will enhance its profits as long as the organization acts within the confined of laws or rules. On the other hand, social responsibility means being accountable for the social effects the organization has on people and institution even indirectly which include the organization's customers, suppliers, distributors, host community, government and other stakeholders. It is an organization's responsibility to make choices and take actions that will add value to the society at large as well as those of the organization (Hossain, Salat & Amin, 2005) by doing what is right, just and fair. The ability of an organization to do what is right, just and fair plays an important roles in enhancing the public image of the organization thereby increasing their market levels and subsequently increasing their performance.

### III. ORGANIZATIONAL RESILIENCE

Resilience is fundamentally a nascent characteristics connected with a business firm's capability to attain its goal(s) and objective(s) in the face of interference and turbulence through adaptive capacity, situation awareness as well as innovation. It is the ability of business enterprise to align or adapt its activities and operations to environmental changes in times of difficulty and challenges so as to achieve enhanced organizational performance and recover more swiftly to better performance level subsequent to dwindling performance through characteristics of mindfulness,

training and agility (Antunes & Mourao, 2011; Deevy, 1995). Thus, organizations build resilience capacity in order to lessen the effect of deleterious changes from its environment as well as the capacity to recuperate to an enhanced organizational performance after a performance decline. Organizational resilience is an essential if not critical element in the success of any organization. It is therefore, essential for managers to build organization's levels of resilience that will not only help to acclimatize with changes that might spring from the business environment by minimizing the level of disruption it might bring to the organization, but to see changes as a usual and normal ways of attaining set goals and objectives.

Furthermore, according to Robb (2000), a business organization with a resilient capability is able to maintain and enhance its competitive advantage over time by delivering excellent performance against set goals as well as effectually innovating and adapting to swift and uncertain changes from the business environment. It also exhibits certain broad characteristics, and is able to create structure and dissolve it when necessary, provide safety (though not necessarily security or stability) during times of change, manage the emotional consequences of continuous change through continuous learning, developing and growing. The frequent changes in the business environment vis-à-vis technological changes, economical changes, social and political changes has today makes it very challenging for any business enterprise to carry out their operation seamlessly. Thus, old methods of operation is gradually becoming outdated and quickly reducing the performance of the organization. Deevy (1995) expressed that this unstable and uncertain business environment needs managers to understand more deeply the inner dynamics of the organizations, hence, there is need to for business organizations to be more resilient such as time as this.

### IV. METHODOLOGY

Correlational vis-à-vis cross sectional survey research design was adopted in this study in order to determine the level of relationship that exist between corporate social responsibility and organizational resilience of selected oil firms in Rivers State, Nigeria. The independent variable is corporate social responsibility used as a uni-dimensional variable while the dependent variable is organizational resilience which was also used as a single variable without measures. More so, the study adopts questionnaire as the research instrument which consist of four respond choices with 5 Point Likert scales ranging from 1 to 5 indicating strongly disagree, disagree, indifference, agree and strongly agree respectively. Face and content validity was also used for the validity of the research instrument while the reliability of the research instrument indicates a Cronbach Alpha value higher than 0.7; specifically the values for corporate social responsibility = 0.941 while that of organizational resilience = 0.927. The population of this study was made up five (5) managers from strategic departments of ten (10) selected oil and gas firms operating in Rivers State, Nigeria vis-à-vis (human resource department, finance department, marketing department, operations department and public relations department). Therefore, the population of the study consists of 50 managers of the 5 identified departments of the ten (10) selected oil and gas

firms which were also used as the sample size. From the 50 questionnaire distributed, 47(94.00%) copies of questionnaire were retrieved while the remaining 3(6.00%) were not retrieved. More so, all the 47 questionnaire retrieved were used for data analysis. The retrieved data were analyzed through the use of Spearman's Rank Order Correlation Coefficient Statistical as well

as t-statistics to test the relationship between corporate social responsibility and organizational resilience with the aid of Statistical Package for Social Sciences (SPSS) Windows version 25 within a significance level of 0.05.

V. DATA ANALYSIS AND RESULTS

**The Strength of the Relationship between Corporate Social Responsibility and Organizational Resilience**

**Table 1: Correlation between corporate social responsibility and organizational resilience**

		Corporate Social Responsibility	Organizational Resilience	
Spearman's rho	Corporate Responsibility	Correlation Coefficient	1.000	
		Sig. (2-tailed)	.000	
		N	47	
	Organizational Resilience	Correlation Coefficient	.927**	1.000
		Sig. (2-tailed)	.000	.
		N	47	47

\*\* Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS v25: Output, 2020.

Table 1 reveals that a very strong and positive significant relationship exist between corporate social responsibility and organizational resilience with a (rho = 0.927) and a PV = 0.000 which is less than 0.05. Thus, when organizations engages in social responsibility, their organizational resilience will increase. The degree to which corporate social responsibility influences organizational resilience is further shown in the below table 2:

**Table 2: the degree of effect of corporate social responsibility on organizational resilience**

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.927 <sup>a</sup>	.859	.817	.50611

a. Predictors: (Constant), Corporate Social Responsibility

Source: SPSS v25: Output, 2020

Table 2 above reveals the degree to which corporate social responsibility influences organizational resilience with R-val.= 0.927 which implies a very strong relationship while the R<sup>2</sup>=0.859 implies that corporate social responsibility explain 85.9% variation in oil and gas firms' resilience while the remaining 14.1% could be due to the influence of other factors not included in this study. The relationship is further tested applying t-statistics as shown in Table 3 below:

**Table 3: T-value result on corporate social responsibility and organizational resilience**

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.879	.691		16.072	.000
	Corporate Social Responsibility	.811	.504	.682	9.738	.000

a. Dependent Variable: Organizational Resilience

Source: SPSS v25: Output, 2020

From Table 1, the PV = 0.000 which is less than 0.05 and Table 3 shows β= 0.811; t-cal. = 9.738 > t-crit. =1.96 at

0.000<0.05% which means that the relationship between corporate social responsibility and organizational resilience is statistically significant. We therefore reject the null stated hypothesis and accept the alternate hypothesis, thus there is significant relationship between corporate social responsibility and organizational resilience of oil and gas firms in Rivers State, Nigeria.

## VI. DISCUSSION OF FINDING

Having policies that integrate economic and social concerns into an organization's core strategy plays an essential role in building good reputation for such an organization needed for its survival. Thus, Ogrizek (2001) expressed that organizations who put into place an all-inclusive corporate social responsibility enjoys better market benefits and competitive advantages needed for better performance during turbulences. This is because a business enterprise with effective and efficient policies in regards to corporate responsibility often attract top talent and good public reputation which affects their capacity to bounce back from setbacks. Hence, Ehsan et al (2012) explained that in a time frame of three to five years, a business organization that have good corporate social responsibility would have better access to talented workforce, better reputation and lower capital constraints and in the long run, corporate social responsibility provides innovation and transformation during and after disruption or crisis. Through corporate social responsibility, it may be possible to not only overcome potential disruptions but transcend disruption into a better opportunities. The provisions of social responsibility therefore help organizations to enhance their situation awareness ability, reduce organizational vulnerabilities to systemic risk environments, adaptive capacity and reestablish value following the events of a disruption because organizations that are corporate social responsibility based have the interest of their stakeholders at heart. Meeting stakeholders' needs on the spot is essential in today's service economy. This, creates more pressure on organizations to assess situations quickly, decide what can be offered to stakeholders, defend what they have done, and move on to the next level. Resilient behaviours help organizations meet stakeholders needs on the spot, capture opportunities that may be otherwise be lost, and advert catastrophes by acting quickly and effectively in crisis situations (Madni & Jackson, 2009).

More so, when a business enterprise meet the expectations of its stakeholders, the organization is highly building a thriving trust that it can draw upon in times of crisis while on the contrary, if an organization does not deliver or meet the expectations of its stakeholders and something goes wrong in times of crisis, the capability of the organization's to bounce back might be affected. For organizations to be truly resilient, they must build enterprise-wide reputation competence and the entire organization needs to understand what stakeholders are thinking and when those attitudes change, they need to become proficient in meeting those changes which is the primary aim of corporate social responsibility (McWilliams & Siegel, 2001). Good public repute is a major outcome of corporate social responsibility that is very essential to attaining organizational resilience during crisis and turbulence. Resiliency is a seal for an organization if managed effectively and efficiently. Business organizations are often adjudged by how well they forestall changes or crisis and plan for

them and, when they eventually happen, how well they adapt to them is very essential which can be achieved by having an effective and efficient corporate social responsibility policies in place .

## VII. CONCLUSION

Based on the data analyzed, we therefore conclude that corporate social responsibility has positive and significance effect on organizational resilience of oil and gas firms in Rivers State, Nigeria. Thus, corporate social responsibility is a major driver of organizational resilience. Organizations of all types and sizes especially the oil and gas firms can strengthen their resilience by engaging in corporate social responsibility activities. There are different reasons an organization indulges in a socially responsible activities such as humane intentions, positive effect on employee motivation, retention and recruitment or customer-related motivations and so on but no matter what the reasons are, it is for a better corporate reputation which is very essential to organization resilience. Therefore, organizations especially the oil and gas firms should not trivialize corporate social responsibility.

## VIII. RECOMMENDATIONS

1. We recommend that oil and gas firms should balance and address the needs of different stakeholders in order to enhance their level of resilience during environmental changes.
2. We also recommend that oil and gas firms provide good working conditions and organizational support to motivate their employees so as they can give their best and go the extra mile to improving the organization's resilience.
3. More so, balancing and satisfying the host community need with the goal of the organization should be a major priority by the oil and gas firms if they want to continue to exist and prosper.

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# Incident Analyses of Helicopter Guimbal Cabri G2

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**Abstract-** Helicopters play important roles in transporting people and goods and were extensively used for observation and reconnaissance. The Helicopter Guimbal Cabri G2 is usually used for training and recreational purposes. In November 2020, there was an incident involving Cabri G2 in Malaysia. In fact there were several incidents around the world involving this type of helicopter and this paper delineated those incidents and analyses were performed to gain useful insights with regards to those incidents. This paper however did not cover 8 incidents (including the one in Malaysia) as they were still under investigation by respective authorities.

**Index Terms-** Aviation Incident, Aviation Accident, Crash Investigation, Helicopter

## I. INTRODUCTION

The aviation field is vast expanding with various types of helicopter are currently in the market. There exist helicopters that played roles as trainers and were also used for tourism purposes. These helicopters belong to the light aircraft category. According to Airbus Helicopters, light helicopters were usually utilized for surveillance, border patrols and others and light helicopters were usually cost effective and offered users the satisfaction of being “quiet” as compared to other helicopters [1].

The Guimbal Cabri G2 is a type of light helicopter that is mostly used for training and recreational purposes. The Cabri G2 is a helicopter with 3 primary blades and able to host 2 individuals [2]. The Cabri G2 has 2 seats which were certified as crash resistance where the seats are able to withstand a 5 meter free fall [2]. These characteristics had made the Cabri G2 a prominent choice among aviation enthusiasts.

If there were aviation incidents or accidents, relevant authorities would conduct investigations in order to identify causes of these incidents. This is for the purpose of rectifying the situations in order to increase the level of safety in aviation. The investigation usually does not apportion blame to any parties but was carried out to prevent similar incidents as outlined in Annex 13 of the International Civil Aviation Organization [3]. This paper also followed suit and did not apportioned blame to any parties and the analyses in this paper were based upon factual information provided by relevant aviation authorities.

In any incident investigation related to aviation, there are procedures to be followed and steps to be taken in order to have an investigation which is thorough and systematic. The procedural system allow investigators to dissect fully the incident and prevent biases toward certain parties [3]. It's a norm to

cord off the area of the incident to prevent any contamination seeping into the area being investigated.

There were many cases where incidents were caused by maintenance errors. One such case was the Japan Airlines Flight 123 where the incident occurred in 1985. In this incident, the vertical stabilizer of the aircraft was not properly installed onto the aircraft and this caused the stabilizer to disintegrate from the fuselage in mid flight and the uncontrollable aircraft crashed at a mountain in Japan [4]. It is thus important for aviation maintenance crew to be vigilant and attentive and able to follow stipulated procedures during maintenance processes.

Brien stated that aviation personnel that were stressed or fatigued had contributed to aviation incidents [4]. Those who are fatigued or stressed tend to make mistakes and tend to take shortcuts in order to not spend more time on work. This should be addressed as safety is the uttermost important in aviation.

It's imperative for aviation workers to be physically fit in order for them to perform well in their tasks or chores. Performing well would deter mistakes and hence retaining safety. According to Harris, those who are physically fit are able to concentrate much better and thus able to perform better at work [5]. Harris had conducted a study among 116 individuals and these individuals had performed physical activities and their levels of concentration were evaluated after these physical activities were performed [5].

Harridon had studied the crews of Aviation Search & Rescue and the results indicated that crews that were physically fit were able to judge appropriately the situations during flights and this had contributed to the efficiency of the Search & Rescue Missions [6]. According to Harridon, regular physical exercises would enhance the circulation of blood in individuals and this would subsequently enhance the brain capacity in making decision and judgement [6]. Hence those that are physically fit have the ability to make better judgement and this is needed during flight and during any aviation processes that involve safety.

## II. LITERATURE REVIEW

With the rise in aviation, various aircraft were manufactured in order to fulfill the needs. Light helicopters offer users affordable ways to train as pilots and to physically transverse from one point to another. However most light helicopters were not equipped with black boxes or Health and Usage Monitoring System (HUMS) which would aid in the improvement of safety and also aid in incident investigation. Peering the data of light helicopters, it's best to have HUMS install onto these helicopters but weight seems to be a hindrance.

Bechhoefer had proposed a new HUMS architecture that employs state of the art components that are suitable to be installed onto light helicopters where this new architecture offer weight reduction and also reduction in technical support [7].

The Guimbal Cabri G2 is a light helicopter that had gained certifications from several authorities from several countries such as Canada, United States of America, Europe, and others [2]. The Cabri G2 has a maximum gross weight of 700 kg and could fly to an altitude of 5000 feet with that maximum gross weight [2]. The pilot pedals of the Cabri G2 could be adjusted which offers comfort and ease of handling to pilots flying the Cabri G2 [2]. This in fact is an advantage to operators and pilots and perhaps the criteria for Cambri G2 to be chosen as trainers for student pilots.

In aviation safety is prominent and several methods were in placed to eradicate or avoid incidents. But somehow incidents do happen. It's the role of authorities to conduct investigation in relation to incidents. Latipulhayat stated that regulations were in existence in order for crews or aviation personnel to perform works in such a manner that safety would not be in risk and the works are performed correctly and efficiently [8].

Latipulhayat also mentioned that during incident investigation enormous amount of data would be collected and these data originated from various sources such as black box, maintenance records, eye witness accounts, and others [8]. The comprehensiveness of this is due to the fact that all avenues would be explored to pinpoint the exact nature of the incident or accident.

Aircraft maintenance if done properly would ensure that the aircraft is in good form and would fly efficiently without any incidents. This is always the primary purpose of any aviation organization, from airlines to military units. Atak stated that aviation organizations should find a balance between getting aircraft ready swiftly for flights and retaining safety [9]. There were cases where management requires airplanes to always be available for flights and this had created unwanted pressure towards technical crews where they were pushed beyond their capacity in order to get the aircraft ready. Hence Atak advised

airlines or any aviation organization to be prudent and realistic in their objectives and goals as it involves safety and lives of passengers [9].

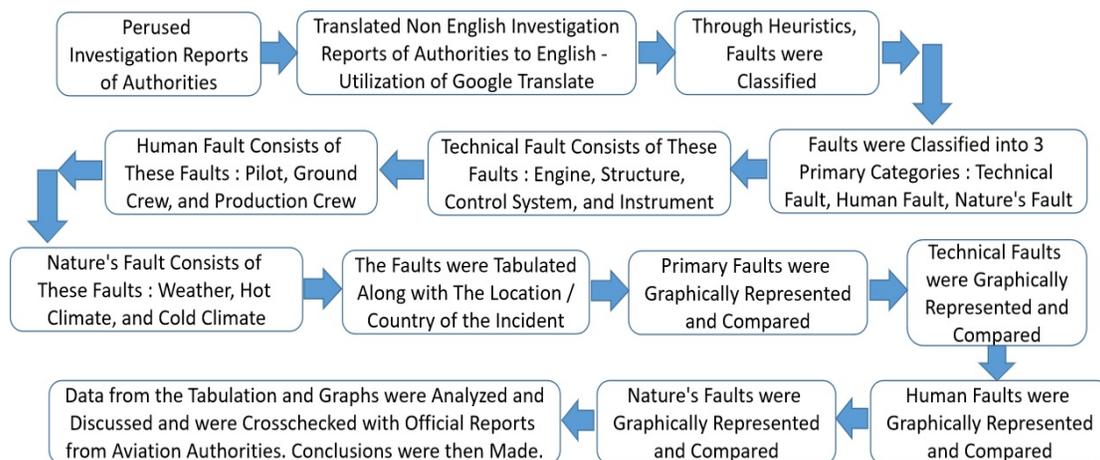
Samaranayake stipulated that aircraft maintenance is sometimes resource extensive where several resources need to be managed simultaneously and in an optimum manner [10]. There were times when resources needed to be shared and this created constraints. Samaranayake had studied problems that were in existence in aircraft maintenance organizations and had proposed Enterprise Resource Planning (ERP) as a tool to mitigate the current predicaments [10]. Again the purpose of mitigating predicaments is to gain high level of safety which is a requirement in aviation. And subsequently this would deter incidents and save lives.

To retain safety, it's imperative for aviation personnel to be physically fit as individuals that are physically fit have ingrained advantages compared to those that are not fit. Elmagd stated that those that have adequate level of physical fitness are able to be attentive at a much longer time [11]. Attentive is important in aviation where maintenance workers or pilots that are attentive are more vigilant of their ecosystems, situations, and surroundings and thus are able to make decisions which are correct.

Coulson had studied 201 individuals and the results indicated that those who had exercised or performed physical activities were able to perform well in their chores or jobs [12]. Coulson also stated that physical exercises had also shown to be effective in enhancing the moods of individuals and hence propelling them to be more proficient in their jobs [12]. This is clearly a good approach that could be used and perhaps already been used in some departments or sectors in the Aviation Field. Proficiency is the key towards safety and preventing incidents.

### III. METHODOLOGY

Figure 1 elucidated our approach in the investigation.



**Figure 1. The Methodology of Our Investigation**

Incident reports from aviation authorities were perused, read, and looked upon. Several of the reports were in the native languages and these non English reports were translated using

Google Translate. The incident faults that were outlined in the reports were classified using heuristics. The faults were classified into 3 main or primary categories which were Technical Fault,

Human Fault, and Nature's Fault. The Technical Fault was further classified into 4 categories which were Engine Fault, Structural Fault, Control System Fault, and Instrumentation Fault. The Human Fault was also further categorizes into 3 categories which were Pilot Fault, Ground Crew Fault, and Production Crew Fault. And lastly the Nature's Fault was classified into 3 classifications which were Weather, Hot Climate, and Cold Climate.

All of the faults were tabulated and the origins (countries) of the incidents were stated in the tabulation. All of the faults were also graphically represented for ease of analyses and all the faults were also compared with each other and with other external data such as data of light helicopters Dynali and HAL Cheetah. The comparisons gave us an overall view of the

standing of Guimbal Cabri G2 in relation with other light helicopters.

The data from the tabulation, graphs, and comparisons were crosschecked with reports from the aviation authorities. This aided the author's analyses where discreet details were etched to the analyses. Based upon the nature of the faults, recommendations were parlayed and conclusions were made.

#### IV. RESULTS

Table 1 portrays the tabulation of the incidents and gave descriptions of the incidents. Figures 2, 3, 4, and 5 show the faults or causes of the incidents.

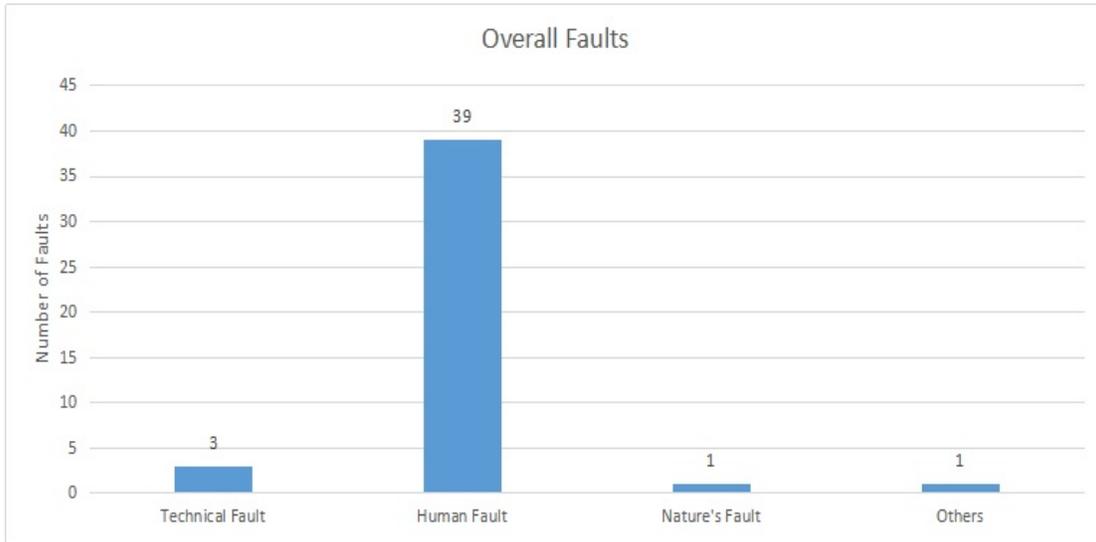
**Table 1. Tabulation of Incidents**

No	Cty	Technical Fault				Human Fault			Nature's Fault		
		Eng	Struc	Ctrl	Inst	Pilot	Grnd	Prod	Wthr	Hot	Cold
1	Ger					√					
2	Nth					√					
3	UK					√					
4	Swe	√									
5	Aus					√					
6	Aus					√					
7	Fra					√	√				
8	Swi	√									
9	Nz					√					
10	Ger					√					
11	Ger					√					
12	Ger						√				
13	Pol			√							
14	SA					√					
15	Fra					√					
16	US					√					
17	Nz					√	√				
18	SA					√					
19	Bra					√					
20	Nz					√					√
21	US					√					
22	Nz					√					
23	UK					√					
24	US					√					
25	Nz					√					
26	Cze					√					
27	Slv					√					
28	Swi										
29	UK					√					
30	US					√					
31	US					√					
32	Can					√					
33	Fra					√					
34	US					√					
35	US					√					
36	US					√					
37	Fra					√	√				
38	UK						√				

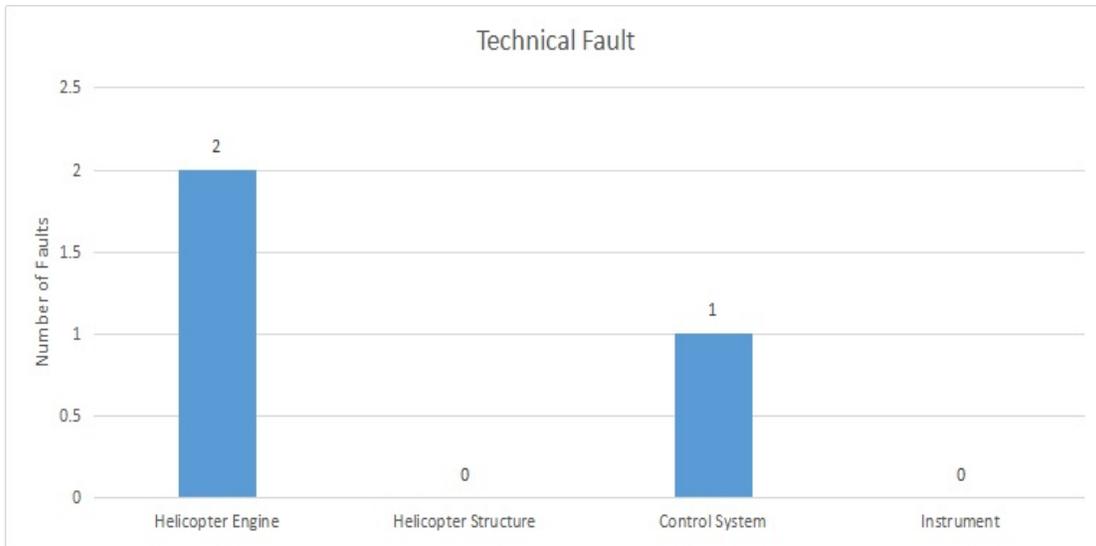
39	Fra					√					
40	US					√					

Legend used in Table 1 : Cty = Country, Eng = Helicopter Engine, Struc = Helicopter Structure, Ctrl = Control System, Inst = Instrument, Grnd = Ground Crew, Prod = Production Crew, Wthr = Weather

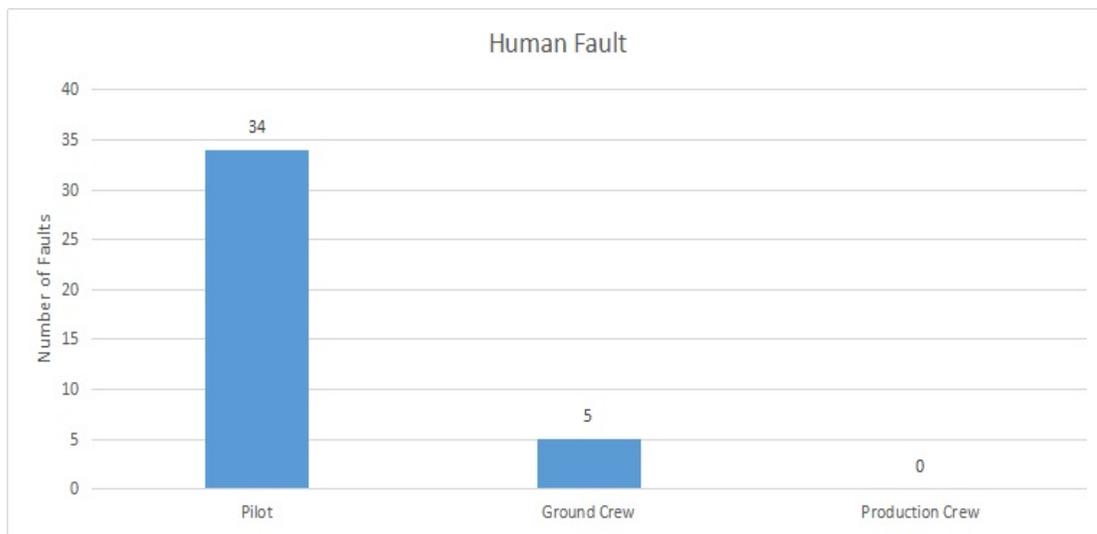
Legend of Countries in Table 1 : Ger = Germany, Nth = Netherlands, UK = United Kingdom, Swe = Sweden, Aus = Australia, Fra = France, Swi = Switzerland, Nz = New Zealand, Pol = Poland, SA = South Africa, US = United States of America, Bra = Brazil, Cze = Czech Republic, Slv = Slovakia, Can = Canada



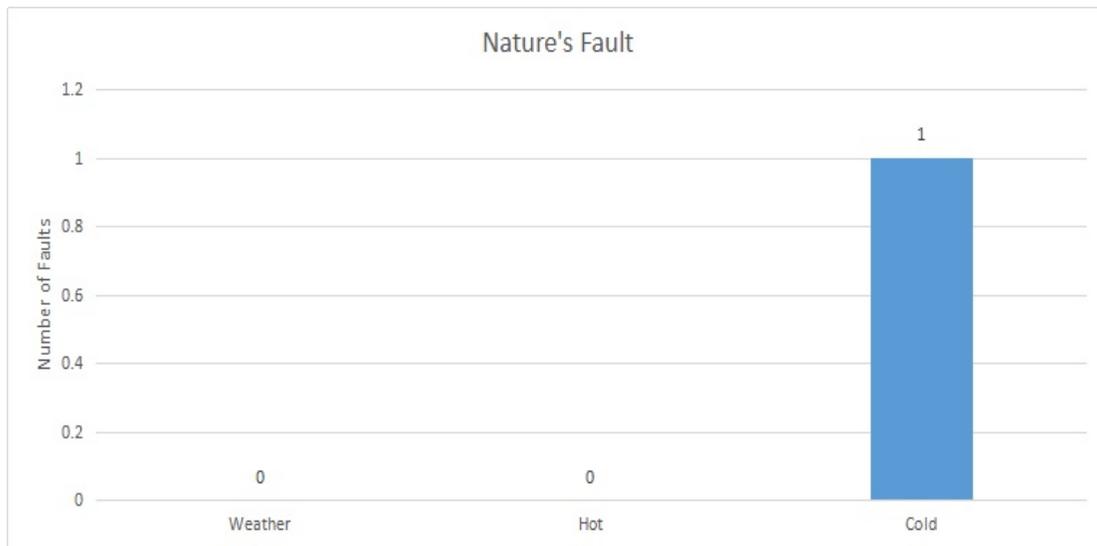
**Figure 2. The Holistic View of Faults**



**Figure 3. The Technical Fault**



**Figure 4. The Human Fault**



**Figure 5. The Nature's Fault**

## V. DISCUSSION

Peering Table 1, it can be seen that the causes or faults of the incidents were tabulated. Overall there were 40 incidents from the designated period chosen to be analyzed or scrutinized (from the year 2010 till 2020). For a span of 10 years, 40 incidents is considered an eye opener since in aviation safety is critical and is set at the highest standard.

Protocols and procedures clad the aviation industry in order to eradicate incidents or keep incidents at zero. The 10 years of data showed that each year there was an average of 4 incidents. The author had compared these data with another light helicopter of similar nature which is the Dynali and the Dynali had only 7 incidents for the span of 9 years (from the year 2011 till 2020) where the average incident per year was only 0.78 incidents [13]. The author had made another comparison with another light helicopter which is the HAL Cheetah. For a span of 10 years (from the year 2010 till 2020), the HAL Cheetah had only 13 incidents where the average incident per year was only

1.3 incidents [14]. The author was concerned with the average incidents per year of the Cabri G2 as other light helicopters had shown low average incidents annually.

In Figure 2 the holistic representations of the faults were shown. Overall there were 3 Technical Faults, 1 Nature's Fault, and 1 fault which was not quantified by Table 1. Human Fault represented a majority of the fault which is 39 faults (that is 88.64%). The 39 Human Faults contributed to 36 incidents (refer to Table 1). This is worrisome as humans were hugely attributed to reasons of the faults. This reinforced the notion that those that are physically fit were required in aviation as they have the aptitude to remain attentive, concentrate better, have better positional awareness, and others. According to Harridon, training which encompassed technical fields and others such as physical fitness were important in order to ensure flights were safe and mission completed successfully [15]. Harridon had studied crews of Search & Rescue and results had shown that those involved in physical fitness had high chances of delivering output and performing well [15].

The author had dissected further the Technical Fault and the discreet details were shown in Figure 3. The Technical Fault was divided into 4 sections. There were 2 Helicopter Engine Faults, 0 Helicopter Structure Fault, 1 Control System Fault, and 0 Instrument Fault. The majority of the Technical Fault was the Helicopter Engine Fault. Both of the incidents of the Helicopter Engine Faults showcased severe vibrations in the engine. It's recommended for the manufacturer to look upon these failures and implement improvements upon the design or actuate appropriate modifications upon the engine.

Figure 4 showed the components of Human Fault. There were 34 Pilot Faults, 5 Ground Crew Faults, and 0 Production Crew Fault. The majority of the Human Fault was Pilot Fault and the Pilot Fault contributed to 34 incidents. 34 out of the total 40 incidents were due to Pilot Fault which represented 85% of the incidents. This is really a concern. According to the Australian Transport Safety Bureau (ATSB) which investigated incident number 5 (refer to Table 1), pilots should be familiar with the handling characteristics of Cabri G2 and different types of helicopter require different handling maneuvers and touches [16]. The author had perused incident reports from different authorities of other countries with regards to the incidents stated in Table 1 and most of the reports indicated that pilots should have first hand knowledge of how to specifically control the Cabri G2. The Cabri G2 is different from other helicopters in terms of the application of intensity of physical inputs from the pilot towards the helicopter [17].

Figure 5 showed the dissection of Nature's Fault. There were 0 Weather Fault, 0 Hot Fault, and 1 Cold Fault. Peering Table 1, the Cold Fault had caused incident number 20. According to the Civil Aviation Authority of New Zealand, there was a mist built-up in the cockpit which had covered the windshield and subsequently obstructed the view of the pilot [18]. The helicopter struck a pole and crashed to the ground [18]. The author opinionated that in cold weather it's imperative for an anti fogging device be activated to prevent moisture or mist built-up in the cockpit. It would be in everyone's interest if the anti fogging device be installed in the cockpit.

Observing the overall data and analyses, it's clear that Pilot Faults had caused most of the incidents and this is a point that should be looked into in depth in terms of mitigating these faults and finding solutions to decrease Pilot Faults. Apart from rigid and continuous technical training, another aspect that should be taken into account is the physical fitness of pilots. Pilots that are physically fit are able to make better judgement, are much more attentive, and are able to concentrate more. According to a study done by Reigal, those that are physically fit are more attentive and able to make decisions better [19]. Reigal had studied 210 individuals and had indicated that concentration levels of those who were fit were much better than those who were not fit [19].

According to several reports by authorities, pilots involved in the incidents were not able to input adequate forces (legs and hands) to yaw and move the helicopter sufficiently [17]. Harridon had studied the physical fitness of personnel involved in Aviation and Harridon had came out with physical methods to aid personnel or pilots in controlling their physical inputs especially the utilization of their legs [20]. Harridon had proposed Partial Squats, Step-Ups, and Calf Raises where these physical exercises would collectively decrease the strains in the

legs of the aviation personnel and subsequently the reduction of strains would allow these individuals to control the movement of their legs in an efficient manner as minor pain or strain would not be an obstacle anymore [20]. Even if the pilots were not clad with strains within their legs, these physical exercises are beneficial as these exercises offer avenues to pilots to practice their controlling skills especially controlling the movement of their legs (from slow to moderate to fast and also from low intensity to high intensity). Another research by Harridon indicated that individuals which are unhealthy in terms of weight are prone to gain strains in their legs and this could hamper their abilities to efficiently control the yaw of the helicopter [21].

## VI. CONCLUSIONS

Analyses had been actuated with regards to the incidents of Helicopter Guimbal Cabri G2 where the analyses were based upon reports from relevant authorities that had investigated the causes behind the incidents. Analyses from this paper had shown that Pilot Fault had contributed to a majority of the incidents. This paper was not intended to apportion blame but to pinpoint causes of the incidents for the intention of alleviating safety and finding solutions to improve safety. The author had defined several ways and methods to increase safety in terms of improving the skills of pilots and maneuvering the helicopter in an efficient manner.

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# Effects of Earlier Mobilisation on Critically Ill Patients

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## ABSTRACT

**Introduction:** An intensive care unit (ICU) provides patients with advanced life support, where they stay from hours to months to stabilise and survive. Early mobilisation has proven to be a safe and viable technique that provides hemodynamic benefits, avoids the effects of immobility and contributes to the best physical and functional outcomes for patients. **Objective:** The aim of this study is to clarify the importance of early mobilisation (EM) in critically ill patients. **Material and Methods:** A systematic review of the literature by mobilizing the descriptors: "Critical patient", "Early mobilisation" and "Nursing ". Were selected databases imaginable, between 2014-2020, included for analysis seven articles. **Results and Discussion:** Results and discussion: In most studies it was found that the general form, this practice provides increased muscle strength, increased maximum inspiratory pressure, shorter duration of mechanical ventilation, shorter hospital stay and better quality of life. The seven studies identified recognized the importance of early mobilization as it can facilitate the functional rehabilitation of these patients by promoting increased muscle strength and greater participation in daily activities, but some studies also identified challenges that need to be addressed. **Conclusion:** Early mobilization contributes to improve the patient's functional capacity and quality of life, both in the hospital environment and in the post-discharge period. It has been shown that patients who are mobilized early in a safe and practical manner have advantages in the face of the disease. This behavior helps to reduce muscle weakness acquired through immobility in bed and enables faster functional recovery, shorter weaning and shorter hospital and intensive care stays.

**Keywords:** "Critical patient", "Early mobilisation" and "Nursing".

## I. INTRODUCTION

In recent decades, the number of patients admitted to intensive care units (ICUs) has increased. At the same time, the growing ability to support vital functions together with the effectiveness of new therapies has increased the survival rates of critically ill patients. In this context, a critically ill patient is a person whose life is threatened by the failure or imminent failure of one or more vital functions and whose survival depends on advanced means of monitoring, observation and therapy (Regulamento nº 124, de 18 de Fevereiro. Diário da República nº 35/11 - II Série. Ordem dos Enfermeiros. Lisboa, Portugal).

The patients loss of mobility in hospital has negative effects on several organ systems, including the respiratory, cardiovascular, skin, muscle and skeletal systems, as well as on patients in ICUs (Silva et al, 2010). Pulmonary complications such as atelectasis, hypoxemia, pulmonary embolism and pneumonia are among the most common and lead to longer retention times and higher mortality (Soares, et al, 2011). In the last two decades, progress has been made both in the field of critically ill patients and in the field of mechanical ventilation, which has led to an extension of the survival time of critically ill patients (Dantas et al., 2012; Terra et al., 2012). Lack of exercise in bed is associated with the development of musculoskeletal dysfunctions such as muscle weakness and osteoarticular deformities among other complications that limit the functionality and quality of life of these patients after discharge from hospital (Mattos, 2011). Such immobility in the critically ill patient is an important limitation that is associated with a loss of innervation and a decrease in muscle mass (Mattos, 2011). Such immobility in the critically ill patient is an important limitation that leads to a loss of innervation and a decrease in muscle mass (Feliciano, et. al., 2012). The start of rehabilitation of critically ill patients in intensive care units was a research topic and was considered an important part of a care plan. In the field of functional rehabilitation, EM of critically ill patients has been proposed as an important therapy to modify the risk of developing secondary diseases that affect their physical and functional morbidity, as these are associated with the loss of muscle strength leading to acquired weakness (Morris et al., 2011). EM in the intensive care unit aims to maintain or increase the muscle strength and physical function of the patient. It includes progressive therapeutic activities such as bedside mobility exercises, bedside sitting, transfer to a chair and walking (Mota e Silva, 2012, Rocha et al, 2012). A variety of therapeutic exercises that prevent muscle weakness and deformities and also reduce the use of aids during

hospitalisation. The harmful effects of bed rest and the benefits of early mobilisation have been recognised in hospital patients. When referring to "early", it refers to the concept that mobilisation activities begin immediately after the stabilisation of important physiological changes, rather than after the absence of mechanical ventilation or discharge from the ICU (Mota e Silva, 2012). According to Grap and McFetridge (2012), EM (also referred to as progressive mobility) describes a pattern of increasing activity that begins with passive mobilisation and extends to walking, which begins immediately after hemodynamic and respiratory stabilisation, usually within 24-48 hours of admission to the ICU. However, the EM of critically ill patients has several peculiarities inherent to the context of action and uses different activities depending on the individual needs of the patients.

One of the aims of patient mobilization is to provoke a respiratory and cardiovascular response in the individual, which is why it is essential to consider patient safety before starting treatment (Oliveira and Silveira, 2010). Knowledge of past and current clinical history shows how the patient's respiratory and cardiovascular reserve can be a limiting factor in activity and what signs and symptoms should be monitored during mobilization (Oliveira and Silveira, 2010). In search of the best available evidence to improve the quality of care, a systematic literature review was carried out to identify the impact of EM in the functional rehabilitation of patients admitted to intensive care units.

## II. MATERIALS AND METHODS

A systematic review of the literature is one of the research methods used in the practice of evidence-based research, and its purpose is to collect and summarize research findings on a particular topic in a systematic and orderly manner, thereby contributing to knowledge about the topic (Mendes et al., 2008; Benefield, 2003). The method used was based on the strategy PICO (acronym for patient, intervention, comparison and "outcomes"). In this way it maximizes the inclusion of relevant information in different databases, focusing on the research object and avoiding unnecessary searches (Santos, Pimenta e Nobre, 2007).

With strict attention to all the steps necessary for the application of this method, in the period between May and September 2020, a protocol has been developed to identify studies of interest for this work, consisting of a search in the search engines: Ebsco and B-ONline, and in the following databases: CINAHL Plus, PubMed/ MEDLINE, LILACS, Scielo, Web of Science, ScienceDirect and Repository of Scientific Open Access of Portugal.

A search strategy using the following descriptors was used to identify relevant studies: Critical Patient AND Early Mobilisation AND Nursing. After all these protocol requirements had been met, some articles that did not meet the requirements were discarded and a reductive process was methodically developed.

## III. RESULTS

It was selected for the study seven articles that follow in Table 1.

Table 1: Description of selected studies and main results of investigations

Study	Author(s)/ Year	Main Results
E1: "The Effects of Early Mobilization on Patients Requiring Extended Mechanical Ventilation Across Multiple ICUs"	Miguel Escalon, Ann Lichtenstein, Elliot Posner, Lisa Spielman, Andrew Delgado, Stephanie Kolakowsky-Hayner; 2020.	-It was verified that EM was evaluated in intensive care units based on the number of physiotherapy consultations, length of stay, individual treatment sessions using functional results and follow-up visits. -EM protocol in all intensive care units led to a significant increase in the number of physiotherapy consultations, a significant reduction in the number of intensive care units and the total length of stay, significantly shorter days for conducting physiotherapy and a significantly higher follow-up rate for physiotherapy. -It was concluded that the mobilization of people in an intensive care unit reduces the length of stay and hospital costs. -With an interdisciplinary team that plans, implements and evaluates the individual phases of the program, a successful EM program can be implemented simultaneously in all intensive care units and bring about changes in patients requiring longer mechanical ventilation.
E2: "Early Mobilization Interventions in the Intensive Care Unit: Ongoing and Unpublished Randomized Trials"	Janane Maheswaran, Jake Fromowitz, Michael Goldfarb; 2020	-In this study the primary EM interventions were standard physiotherapeutic activities, cycling and electrical muscle stimulation. Only one study involved a nurse led by EM. The most common assessment tool was the 6-minute walk test. -Primary outcome measures were physiological, clinical, patient-centered and resource consumption in health care. Most of the studies included post ICU follow-up up to one year after hospitalization. -The results of this study have shown that EM has the potential to improve outcomes in intensive care, but current data on its effectiveness are limited. -The studies identified may provide further information on what modalities EM may be feasible and what short and long-term benefits may result. -This review has identified areas that can be further explored, such as looking at specific study populations and finding more innovative EM delivery methods. -Discovered studies will further the evidence base for the effectiveness of EM There is a need for studies that address specific patient groups that could benefit from EM, such as older adults and heart patients, and for novel EM delivery strategies, such as nurse-led EM.

<p>E3: "Early mobilization of critically ill patients in the intensive care unit: A systematic review and meta-analysis"</p>	<p>Lan Zhang, Weishu Hu, Zhiyou Cai, Jihong Liu, Jianmei Wu, Yangmin Deng, Keping Yu, Xiaohua Chen, Li Zhu, Jingxi Ma and Yan Qin; 2019</p>	<p>-In this studie was possible verify that EM decreased the incidence of ICU-acquired weakness at hospital discharge, increased the number of patients who were able to stand, increased the number of ventilator-free days, during hospitalization, increased the distance the patient was able to walk unassisted at hospital discharge, and increased the discharged-to-home rate. -The mortality (28-day, ICU and hospital) and adverse event rates were moderately increased by EM, but the differences were statistically non-significant. However, due to the substantial heterogeneity among the included studies, and the low quality of the evidence, the results of this study should be interpreted with caution. -It was possible to conclude that EM appears to decrease the incidence of acquired weakness in intensive care, improve the functional capacity and increase the number of ventilator-free days and the discharged-to-home rate for patients with a critical illness in the ICU setting.</p>
<p>E4: "Clinical attitudes and perceived barriers to early mobilization of critically ill patients in adult intensive care units"</p>	<p>Paula Caitano Fontela, Luiz Alberto Forgiarini, Gilberto Friedman, 2018</p>	<p>-It was verified favorable attitudes toward EM included recognition that its benefits for patients under mechanical ventilation exceed the risks for both patients and staff, that EM should be routinely performed via nursing and physical therapy protocols, and readiness to change the parameters of mechanical ventilation and reduce sedation to facilitate the EM of patients. -The main barriers mentioned were the unavailability of professionals and time to mobilize patients, excessive sedation, delirium, risk of musculoskeletal self-injury and excessive stress at work. -It could be concluded that the participants were aware of the benefits of EM and had a positive attitude towards its use. However, the actual performance of EM was perceived as challenging, mainly due to the lack of professionals and time, excessive sedation, delirium, risk of musculoskeletal self-harm and excessive stress at work.</p>
<p>E5: " Early Mobilization of Patients in Intensive Care: Organization, Communication and Safety Factors that Influence Translation into Clinical Practice"</p>	<p>Carol L. Hodgson, Elizabeth Capell, Claire J. Tipping; 2018</p>	<p>-It has been verified that there is currently a gap between ICU professionals who want to implement EM based on the current evidence and professionals who believe EM is an intervention that should be tested in a large patient-centered study to determine long-term outcomes. -Despite the publication of safety recommendations and clinical practice guidelines, the implementation of EM in the ICU remains a challenge, as limited information on safe levels of vasoactive support, persistent evidence of oversedation of mechanically ventilated patients and poor staffing levels limit the ability to implement EM. -Based on current evidence, EM is safe during mechanical ventilation, but conservative management of ICU patients leads to a culture of bed rest. Some of the driving forces for clinical decisions can be modified, with better adherence to sedation and mobilization protocols, clinical leadership, and increased staff resources and training. - However, EM should be tested in a patient-centered study with evaluation of long-term results before implementation.</p>
<p>E6: "Early mobilization: Why, what for and how?"</p>	<p>Miranda Rocha, B.P. Martinez, V.Z. Maldaner da Silva, L.A. Forgiarini Junior; (2017)</p>	<p>-EM strategies in intensive care units can lead to the prevention and reduction of polyneuropathy in critical patients, to an improvement in the quality of life, to a shortening of the intensive care and hospital stay and to lower mortality during hospitalization. -However, it is known that factors such as the protocol used, the population involved in the studies, the timing of the strategy, the severity of the patients and various barriers directly influence the results. -Although sometimes mobilization is not applied, programs that focus on specific populations, such as patients with weakness due to immobility and with preserved neuromuscular excitability, may have more positive effects from such treatment.</p>
<p>E7: "Early Mobilisation in ICU: From Concept to Reality - Four Steps to Change Patient Outcomes"</p>	<p>Jean-Michel Constantin; 2016</p>	<p>-Research shows that the short-term effects of EM on delirium and patient feeling, as a hope for a long-term improvement in quality of life, are sufficient encouragement for intensive care unit staff. -It also shows that team motivation is probably not an issue in the process of EM; team motivation is only the result of the process. -motivation could, however, be included in the first plan if fears, doubts and an insufficient workload were eliminated by a protocol that includes an algorithm for patient-centered care with an appropriate education program, which is part of the early comfort of using analgesia, minimal sedatives and maximum humane care.</p>

#### IV. DISCUSSION

From the analysis of the selected studies it can be concluded that early mobilization in critically ill patients is safely possible and can begin immediately after their physiological stabilization. According to the literature in all studies, prolonged immobilization of critically ill patients has negative effects on the musculoskeletal, cardiovascular and respiratory systems, skin and cognition (Mah et al, 2013, Parry et al, 2017).

The characteristic muscle weakness of the intensive care unit is caused by polyneuropathy and/or myopathy of the critically ill patient. Polyneuropathy is the result of axonal degeneration, which is caused by microvascular changes in the endoneuro and allows toxic factors to enter the nerve endings. The resulting edema can affect the energy supply to the axon after the axon has died. Myopathy, in turn, is caused by reduced synthesis and/or increased breakdown of muscle proteins, leading to muscle atrophy (Needham et al., 2010). In addition, immobility is able to change the muscle fibres from slow to rapid contraction, further reducing the patient's muscle resistance (Mota et al., 2012; Beach et al., 2017). Patients admitted to intensive care units are at high risk of muscle weakness and consequently functional disability (Koo et al., 2016; Anakwe et al., 2017). The prolonged immobility that these patients are confronted with causes several systemic complications, especially in the case of musculoskeletal complications. Bed restriction can lead to muscle weakness

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affecting both peripheral skeletal and respiratory muscles (Mota et al., 2012; Hermans et al., 2015; Machado et al., 2017). Facts confirmed by the E3 study, which concluded that early mobilisation reduces the incidence of acquired weakness in the ICU, shortens the days of invasive ventilation, increases the number of patients discharged and the number of patients acquiring faster walking ability. Immobility impairs the action of the respiratory muscles, reduces the diaphragm's ability to generate force and contributes to an increase in immobility, dyspnea and hypercapnia (Dantas et al., 2012; Ishida et al., 2017). Early mobilisation can reduce these adverse effects of prolonged bed rest, as exercise can increase patient functional recovery, self-perception of functional status and quadriceps strength at discharge from hospital if initiated early in patients with prolonged hospitalisation in intensive care (Burtin et al., 2009). In study E1, where the effects of early mobilisation were beneficial, these results were assessed on the basis of the number of rehabilitation consultations, length of stay and full follow-up visits. The introduction of a protocol for early mobilisation in intensive care units has reduced the length of stay and thus the cost of admission. This study suggest that a protocol should be implemented. These facts are present in all the studies, but Study E5 proposes an increase in human resources and the development of a specific protocol, which should be implemented and properly tested, and also in Study E6, which suggests that this procedure should be carried out routinely using protocols between nurses and physiotherapists.

In addition, Stiller (2007) reports that in critically ill patients, mobilisation can reduce the incidence of lung complications, speed recovery and shortened the duration of mechanical ventilation and hospital stays. This shows that both patient health and cost reduction can be optimised by early mobilisation. As shown in Study E1, where the effects of early mobilisation were beneficial, these results were assessed on the basis of the number of rehabilitation visits, length of stay and full follow-up. The introduction of a protocol for early mobilisation in the intensive care unit has made it possible to reduce the length of stay and therefore the cost of admission. You suggest that a protocol should be implemented.

In addition to the reduction in the length of stay in the ICU, the Soares study (et al., 2010) showed a 45% reduction in mortality (as referred to in study E3), a fact linked to the withdrawal of patients from bed, which, in conjunction with early mobilisation, was able to restore functional limitations and reduce dysfunctions and morbidity. Wang et al (2018) showed a 2% reduction in mortality, probably due to the fact that the intervention group received respiratory physiotherapy once a day in conjunction with other treatment, such as early mobilisation, and the control group was only supervised by other members of the ICU team, which normally included aspiration only. This fact can be found in all studies, especially in study E6, which refers critically ill patients who undergo early mobilisation, have greater muscle strength and fewer days of mechanical ventilation, and in one study which shows that the short-term effects are a sufficient incentive for early mobilisation in ICU patients.

Regarding delirium, Schweickert et al (2009) showed a two-day reduction in the intervention group through daily sedation interruption and early mobilization, compared to the control group, which underwent daily sedation interruption and standard care.

The gain in muscle strength was verified by Dantas et al. (2012) by comparing two groups, one of which underwent conventional physiotherapy with daily care five times a week, with the development depending on the patient's response, while the other underwent early mobilization, systematized twice a day, every day of the week, resulting not only in a gain in muscle strength in the quadriceps, but also in a gain in inspiratory muscle strength. These gains lead us to the conclusion that a broader view of the patient's functional recovery aspect is needed (Walsh et al., 2014). In some articles the observed results were compatible with the search. We also found that the presence of barriers such as sedation, physiological instability and hospital environment often prevents the implementation of the early mobilization protocol (Gomes et al., 2012). He refers to study E2, which recognizes the added value of early mobilization but notes that there are several factors that may limit this procedure, and study E5, which notes that this challenge of early mobilization is due to the specificities of the critically ill patient (vasoactive support, hypersedation, ventilation). As in Study E4, which states that the refreshment of the fact that early mobilization has several advantages is a major challenge, as it has been possible to verify the shortage of professionals, the lack of time for mobilization procedures and the increased risk of self injury. In addition to these factors, it also highlights the particularities of critically ill patients, often sedated and delirious. And also in study E6 which identifies as main barriers the lack of availability of professionals, the risk of self-injury, the challenge itself and the characteristics of the patient, often sedated and in delirium. On these grounds, haemodynamically unstable patients who require high doses of vasopressors are not fit to start or advance in the therapy (Abrams et al., 2014; Almeida et al., 2014). The same was the case for the results corresponding to haemodynamic stability, mentioned in seven studies, and the lack of use of vasoactive drugs, cited by four authors. As it refers study E5.

For it to be considered as a priority, EM, as a strategy to improve the rehabilitation outcomes of critically ill patients, it also involves a cultural change in the healthcare team towards a patient-centred care approach. To this end, the use practices should be reviewed, the obstacles and constraints in the multidisciplinary team identified, and the advantages arising from the adoption of a strategy requiring more interaction with the patients and more participation of the patients in their rehabilitation process should be understood. This facts corroborate with Study E7 that suggests that motivation of the health team can be related to doubts, workload and fears, as well as study E5 that reveals the division of ideas, for although clinical practice guidelines point to the multiple benefits of early mobilization, it is a challenge to implement them.

It was found that safety issues should be considered before mobilizing critically ill patients. From the analysis of the articles it was observed that it is possible to mobilize the patient safely and without serious complications, however, there are some barriers to be overcome, which is why there is a need for further studies on the subject.

## V.CONCLUSION

Concerning the results of the studies analysed, it can be noticed that patients undergoing early mobilization in a safe and viable manner have benefits in the face of the disease and its recovery. This conduct contributes to the reduction of muscle weakness acquired by immobility in bed, allowing a faster functional recovery, shorter weaning, and hospital and ICU stays, always safeguarding the patient's safety.

Early mobilization as therapeutic conduct has room in the rehabilitation and treatment of the critical patient ICU. Motor rehabilitation at ICU targets functional independence and improves the quality of life.

Complications from immobilization in ICU are numerous, unhealthy, and develop a reduction in functional fitness, which directly affects the quality of life of the individual, consequently increasing their stay in the hospital, and relates to worrying degrees of morbidity and mortality. However, protocols and human resources must be guaranteed so that this procedure can be properly performed.

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# Application Of Health Protocols In Adaptation New Habits (Case Study Of Sanitarian In Mamuju District, Indonesia)

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**Abstract** - Public discipline in enforcing health protocols is the main key in suppressing transmission of COVID-19. The discipline of applying the 3M health protocol, namely wearing masks, maintaining distance, and washing hands with soap. The purpose of this study was to describe the application of health protocols to sanitarian workers in Mamuju district. This research method is an observational study, with a descriptive design, the sample is a Sanitarian who is assigned to a health service facility in Mamuju District. The sampling method is carried out by accidental sampling of 19 people, information is obtained through a questionnaire on google form which is sent via social media WhatsApp. The results showed that using a mask before boarding a vehicle, always using a mask at work, still using a mask on the way home from work was 100%, carried a spare mask of 17 people (89.5%) and who did not bring 2 people (10.5%). Only 68.4% of them used a different mask when they came and came home. The implementation of the health protocol for washing hands with soap / hand sanitizer has 100% implemented the health protocol, namely going to work with a hand sanitizer. only use a hand sanitizer after handling money, wash your hands with soap and running water as much as possible, use a hand sanitizer after work, wash your hands with soap or hand sanitizer before entering the house. Keep a minimum distance from other people of 1 meter, if using public transportation, if driving using your own helmet, as much as 100%. Keeping a minimum distance from colleagues of 1 meter as much as 84.2%, not shaking hands when meeting colleagues or relations as much as 68.4%. In general, the application of health protocols using masks, washing hands with soap / hand sanitizer, maintaining distance when leaving for work, during work and when returning home by sanitarians is very high.

**Index Terms**- Health protocol, sanitarian, new habits, sanitarian

## I. INTRODUCTION

Behavior is defined as the action or actions of a person related to himself or others. The expected behavior change, especially in compliance with the Covid-19

preventive health protocol, which is often known as 3M, namely wearing masks, maintaining distance and avoiding crowds, and washing hands with soap (BNPB, 2020).

Health protocols are rules and regulations that must be followed by all parties. so that people can continue to carry out activities safely and also not endanger the health of others. (Ministry of Health, 2020) New Normal is a change in behavior to continue carrying out normal activities but by implementing health protocols with the aim of preventing the transmission of Covid-19. Indonesian Ministry of Health, (2020)

Decree of the Minister of Health (KMK) Number HK.01.07 / MENKES / 328/2020 concerning Guidelines for the Prevention and Control of Covid-19 in Office and Industrial Workplaces in supporting business continuity in a pandemic situation as a guide to welcoming a new normal life transition in the world of business and work. (Indonesian Ministry of Health, 2020). The role of the community in being able to break the chain of transmission of COVID-19 (risk of contracting and transmitting) must be done by implementing health protocols. (Ministry of Health, 2020)

Adherence to health protocols can be more effective in preventing transmission if done collectively and not alone. Several international journals state that washing hands with soap can reduce the risk of transmission by 35%. While wearing a cloth mask can reduce the risk of transmission by 45%, wearing a surgical mask can reduce the risk of transmission by 70%. (Maruli Sinambela, 2020)

The use of masks is part of a comprehensive series of preventive and control measures that can limit the spread of certain respiratory viral diseases, including COVID-19 (WHO, 2020). This is in accordance with the results of the study which concluded that the proportion of respondents who experienced ARI is greater for respondents who do not use masks (77.8%) compared to those who use masks (39.1%) (Rustika, 2018), There is a relationship between the use of masks and the incidence of ARI (Tri R. Pujiani, 2017), there is an influence between wearing habits. masks with the incidence of ARI. (Hasanah, 2019)

The behavior of maintaining hand hygiene by diligently washing hands and using hand sanitizers will prevent transmission and spread of Covid\_19 by hand (Statistics,

2020a), this is in accordance with the results of research that washing hands with soap that is practiced properly and correctly is the easiest and most effective way to prevent outbreaks of infectious diseases, such as Cholera, Hepatitis A, and ISPA. (Santoso Ujang Effendi, Rina Aprianti, 2019), Antiseptic hand sanitizers are effective in reducing the number of germs (Desiyanto & Djannah, 2013). Washing your hands using a hand sanitizer reduces the number of germs (Cordita, Raka Novadlu, Soleha, Tri Umiana, Mayasari, 2017). Another thing that was revealed in the study was that the compliance of nurses in washing hands was quite obedient (53.0%) (Jayu Catur Ruci, Titan Ligita, 2013). Maintaining distance is one of the main regulations in health protocols to prevent transmission of the Covid-19 virus, because maintaining a minimum distance of 1 meter can reduce the risk of transmission by up to 85%. (Majni, 2020) Sanitarians are a part of health workers who are at the forefront of providing promotive and preventive health services during the Covid-19 pandemic, so they must guard themselves and be protective in working by implementing health protocols, namely wearing masks, washing hands with soap / hand sanitizer, keep your distance and avoid crowds. This study aims to describe the application of health protocols to sanitarian workers in Mamuju district, West Sulawesi Province

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## II. RESEARCH METHODS

### Types of research

The type of research used is observational research, with a descriptive design.

### Location and Time of Research

This research is located in Mamuju District, West Sulawesi and was conducted in July - October 2020.

### Population and Sample

The population of this research is all sanitarians who work in service facilities health in Mamuju District is people 58 (Dinkes Mamuju, 2020). The sample in this study were sanitarians who served in health care facilities in Mamuju District. The sampling method was carried out by accidental sampling. The number of respondents in this study were 19 respondents.

### Data collection

The research data was collected through a questionnaire on google form which was sent via social media WhatsApp to sanitarians in Mamuju District.

### Processing and analysis of data

The results of this study are presented in the form of a descriptive table for the health protocol variables.

## III. RESEARCH RESULT

Table 1. Frequency Distribution according to Respondent Characteristics

Variable	Frequency	%	
Gender	Male	4	21.1
	Female	15	78.9
Total		19	100.0
Working period of	1 - 5 years	10	52.6
	6-10 years	5	26.3
	> 10 years	4	21.1
Total		19	100.0
education	Diploma III	14	73.7
	S1/DIV	5	26.3
Total		19	100.0
Age (years)	20 - 25	3	15.8
	26 - 30	8	42.1
	31- 35	4	21.1
	36 - 40	2	10.5
	> 40	2	10.5
Total		19	100.0

Distribution of respondents in table 1 based on gender illustrates that most of the respondents are female as many as 15 people (78.9%) and only 4 men (21.1%). Respondents based on education show that education S1 / DIV as many as 5 people (26.3%) and Diploma III as many as 14 people (73.7%).

In table 1, it can be seen that the respondents based on the working period mostly have a work period of 1-5 years as many as 10 people (52.6%) and a working period of more than 5 years as many as 9 people (47.4%), while the respondents according to the group 8 people aged 26-30 years (42.1%), followed by the 31- 35 years age group as many as 4 people (21.1%), 3 people aged 20-25 years (15.8%) and the age group 36 - 40 years and over 40 years respectively as many as 2 people (10.5%).

Table 2. Frequency distribution according to the action of using masks

Action	Answer	Total	%
Use a mask before getting on a vehicle	Yes	19	100.0
	No	0	0.0
When you go to work you bring a spare mask	Yes	17	89.5
	No	2	10.5
Always wear a mask at work	Yes	19	100.0
	No	0	0.0
Keep using a mask on the way home from work	Yes	19	100.0
	No	0	0.0
Use a different mask when coming and coming home from work	Yes	13	68.4
	No	6	31.6

Table 2 shows the respondents in implementing the health protocol using masks, it appears that the use of masks before boarding a vehicle is 19 people (100%), and carrying spare masks are 17 people (89.5%) and those who do not carry as many as 2 people (10.5%) ). Always use masks at work as many as 19 people (100%). There were 19 people (100%) still using masks on their way home from work, 13 people (68.4%) using different masks (68.4%) and 6 (31.6%) who did not use masks

Table. 3 Frequency Distribution According to the Action of Washing Hands with Soap

Action	Answer	Total	%
When leaving for work, bring a hand sanitizer	Yes	18	94.7
	No	1	5.3
if forced to hold money, do you use a hand sanitizer afterwards	Yes	19	100.0
	No	0	0.0
Wash hands immediately with soap and running water	Yes	19	100.0
	No	0	0.0
Use the hand sanitezer after work	Yes	19	100.0
	No	0	0.0
Washing hands with soap or hand sanitizer before entering the house	Yes	19	100.0
	No	0	0.0

From Table 3, the implementation of the health protocol for washing hands with soap shows that 18 people (94.7%) brought hand sanitizers to work and only 1 person (5.3%) did not carry hand sanitizers, using hand sanitizers after holding 19 cash. 19 people (100%), washed their hands with soap and running water (100%), 19 people used a handsanitezer after work (100%), 19 people washed their hands with soap or hand sanitizer before entering the house (100% ).

Table 4. Frequency distribution according to the act of maintaining distance

Action	Answer	Total	%
If using public transportation, keep a minimum distance from other people of 1 mete	Yes	19	100.0
	No	0	0.0
If driving using your own helmet	Yes	19	100.0
	No	0	0.0
Try not to frequently touch shared facilities / equipment	Yes	19	100.0
	No	0	0.0
Maintain a minimum distance from colleagues of 1 meter	Yes	16	84.2
	No	3	15.8
Shake hands when meeting colleagues or relatives	Yes	6	31.6
	No	13	68.4

Table 4 illustrates the application of health protocols in terms of keeping a distance showing that keeping a distance from other people at least 1 meter when using public transportation is 19 people (100%), 19 people (100%) use their own helmet, Try not to touch often Facilities / equipment shared by 19 people (100%). Maintain a distance from colleagues of at least 1 meter as many as 16 people (84.2%) and 3 people (15.8%) who do not keep their distance, Shake hands when meeting colleagues or relations as many as 6 people (31.6%) and 13 people (68.4%) who did not shake hands

#### IV. DISCUSSION

##### Put on a mask

The results showed that the implementation of health protocols on the behavioral aspects of using masks on sanitarians generally complied with the health protocols described in table 2, namely using masks before riding a vehicle as many as 19 people (100%), the same thing was revealed that 96.06% of respondents who using ojol / opang admits that drivers wear masks (Statistics, 2020b), most people (95.4%) consider wearing masks when traveling as

important (Pinasti, 2020), as many as 95.8% of Wonosobo people have good behavior., form The behaviors shown include obedience in using masks when outside the home (Purnamasari & Raharyani, 2020), actions on officers using masks when leaving for work, which is high, namely 99.4% and carrying a spare mask of 89.6% (Akbar et al. , 2020), 70.3% of respondents have good skills regarding the prevention of COVID-19, consistency of wearing masks. (Utami et al., 20 20)

The application of other health protocols related to wearing masks in this study is to always use masks at work as many as 19 people (100%), still use masks on the way home from work as many as 19 people (100%), indicating that most people obey using masks, namely 46 respondents (74.19%) (Devi Pramita Sari & Nabila Sholihah 'Atiqoh, 2020), That only 23.33% of people use masks (Siahaineinia & Bakara, 2020)

Thirteen people (68.4%) used different masks when they came and came home from work, and 6 people (31.6%) did not use masks. The same thing was concluded in previous research that 70.6% used different masks when they came and came home from work (Saeni et al., 2020), 94.35% of respondents admitted that their work environment had applied masks (Statistics, 2020b). This is in line with WHO, which stated that the use of masks is part of a comprehensive series of prevention and control measures that can limit the spread of certain respiratory viral diseases, including COVID-19. Masks can be used either to protect a healthy person (worn to protect oneself in contact with an infected person) or to control sources (worn by an infected person to prevent further transmission). (WHO, 2020).

This study also illustrates that 17 people (89.5%) carried spare masks when they went to the office and 2 (10.5%) did not bring along as many as 2 people (10.5%). wash and change their masks regularly after being used for traveling during the Corona virus pandemic. (Pinasti, 2020)

Wash your hands with soap / hand sanitizer

The results showed that the application of health protocols in the aspect of health protocols to wash hands with soap illustrated that 18 people (94.7%) brought hand sanitizers when leaving for work and only 1 person (5.3%) did not carry hand sanitizers. A different thing from previous research shows that only 14.2% of people always carry hand sanitizers when traveling (Pinasti, 2020)

Washing hands with soap and running water as many as 19 people (100%), this is in line with what it is said that washing hands is a new behavior and must be done at all times after activities to prevent corona virus transmission. As many as 80.20% of respondents stated that they often wash their hands for 20 seconds with soap, 82.56% of respondents admit that their work environment has implemented hand washing / using a hand sanitizer. (Statistics, 2020a); In contrast to other studies, as many as 56.9% of people have kept their hands clean by washing their hands with soap and running water. (Pinasti, 2020), compliance with washing hands with soap is only 50.46% (Demsia Simbolon, Darwis, Andra Saferi Wijaya, Hermansyah, Lusi Andriani, Andeka, MoH Gazali, 2020), only 26.67% of respondents wash their hands with

soap at Sukaramai Market , Medan North Sumatra (Siahaineinia & Bakara, 2020)

Using a hand sanitizer after work, hand sanitizer after holding money, is in line with the survey results on the level of compliance of respondents during the past week, especially when outside the house using 77.71% hand sanitizer / disinfectant, washing hands with soap for 20 seconds as much as 75.38% and Hand washing in the workplace as much as 82.56% (Statistics, 2020b). Washing their hands with soap or hand sanitizer before entering the house was 19 people (100%), this is in line with a previous study of 96.9% who washed their hands before entering the house (Saeni et al., 2020)

Keep the distance

From the results of the study, it is illustrated that the application of health protocols in terms of maintaining distance shows that keeping a distance from other people at least 1 meter when using public transportation is 19 people (100%), this is different from what 43.15% of respondents who use public transportation / mikrolet admitted that most of the passengers kept their distance (Statistics, 2020b)

The application of other health protocols in this study illustrates that when driving using their own helmet as many as 19 people (100%), this is different from what is depicted that 30.80% of respondents who use ojol / opang admit that they use their own helmet (Statistics, 2020b).

Maintaining a distance from colleagues of at least 1 meter as many as 16 people (84.2%) and 3 people (15.8%) who did not keep their distance, the results of the survey on the level of compliance of respondents during the last week kept a minimum distance of 1 meter as much as 73.54%. Avoiding crowds 76.69% (Statistics, 2020b), 72.62% of respondents admit that the environment where they work has implemented compulsory distance maintenance (Statistics, 2020a), 11.5% of the public think that maintaining a minimum distance of 1 meter is not really necessary, even as many as 3.8% of people think this is not necessary (Pinasti, 2020), good behavior related to social distancing (93.3%) (Yanti et al., 2020).

In contrast to previous research, 11.5% of the public were not sure about the application of social distancing or physical distancing, while 0.8% of the people considered it unnecessary to carry out social distancing or physical distancing during the Corona virus pandemic period (Pinasti, 2020), the proportion of physical behavior good distancing of 55.9% (Syadidurrahmah et al., 2020), Always, keep 54.29% distance (Balitbangkes Kemenkes RI, 2020)

Other variables measured in this study were 6 people (31.6%) and 13 (68.4%) who did not shake hands when meeting colleagues or relations. This is in line with the conclusion that 81.85%, avoiding handshakes when meeting (Statistics, 2020b)

## V. CONCLUSION

In this study, it can be concluded that in general the application of health protocols using masks, washing hands with soap / hand sanitizer, maintaining distance when leaving for work, during work and when returning home by sanitarians is very high.

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# Sustainability of Zimbabwe's Platinum Mining Sector

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**Abstract-** Sustainability of platinum Group Metals exploitation in Zimbabwe continues to be a cause for concern due to a number of factors. One therefore takes a look at factors necessary for optimum incremental beneficial mining. Mining business confidence gives better prospects for mining business growth. Prospects of mining profitability, under pinned by an enabling sustained terming of mining costs, stability in investment flows and reduced exports constraints.

Access to cheap capital, stability and dependability of fiscal policies, improved economic enablers such as electricity, transport and water, and indeed coherence and consistence of relevant mining policies. Contribution of the PGMs sector to national GDP continues to grow. Creation of decent work and general employment remains high. This paper extrapolates performance issues in the PGMs sector and proffers possible remedies to these constraints to unlock the potential Zimbabwe can enjoy. The paper further proposes linkages, both upstream and downstream in the PGMs sector ensuring that exploitation of this finite resource can translate to development of other sectors of the economy.

Exogenous and endogenous factors influencing, not only the commitment to supporting the national mining vision but additional socio political and socio-economic questions requiring strategic response in our quest for full blown PGMs exploitation. Of major concern and of strategic response is the uncertainty surrounding policies on mining title, royalties and licensing and administration. To conclude the paper shall provide direction on PGMs mining growth, profitability, investments, markets, employment and skills, as well as the country risk profile.

The PGMs sector response to a number of interested stakeholders whose interests vary. These include the shareholders, management, employees, suppliers, government and investors. What is the size of the PGMs cake in Zimbabwe? Who gets what? Who is the largest beneficiary? Does it make economic sense for the investors to continue to grow their investment? What are potential constraints? What is the ownership pattern of the resource? How does it compare with global best practice?

**Index Terms-** platinum group metals, government policy, royalties, taxation, value chains, licensing transparency

## I. INTRODUCTION

Zimbabwe's mining regime has traditionally undergone debilitating self-inflicted challenges, and has threatened the viability of the entire sector. These challenges range from adverse mining operating conditions as a result of bad mining policies, weakened value chains, low levels of economic sector linkages and a general negative impact of global economic conditions.

Mining, as an industry, is a capital-intensive industry and requires huge capital investments to sustainably exploit the mining resource. Attracting domestic direct investment in this sector is a difficult because the local economic capacity is unable to bankroll large mining projects. This leaves the country to hunt for external investors capable of committing long term money into the sector. Historically, Zimbabwe has been an envy of the world because of the wide range of quality mineral endowments in Gold, diamonds, chrome, coal, copper lithium, nickel and platinum group metals. Successful Exploitation of these minerals depends on a number of exogenous and endogenous factors. These include a currency conundrum whose effect over the years has increased the cost of mining, crippling power shortages, unavailability of external lines of credit and offshore funding, politicised labour regime and disparaging mining, fiscal and monetary policy regime. The sustainability of mining in Zimbabwe in general and the platinum group metals in particular is therefore under spotlight, requiring in-depth evaluation.

## II. BACKGROUND TO PLATINUM MINING IN ZIMBABWE

Platinum group metals exist in the Great Dyke of Zimbabwe and form the world's second largest deposit only to South Africa. Historically the Great Dyke is home to some of the biggest mineral deposits some of which exist in the same rock formations as platinum, Gold, silver, asbestos, chromium and Nickel. It stretches from Northern Zimbabwe through the central parts to the southern parts of Zimbabwe. Its spans to approximately 550kms.

According to Hughes, C. (1970). Lateral Cryptic Variation in the Great Dyke of Rhodesia, the great dyke was first described in 1867 by a surveyor named Karl Mauch with no information on the existence of Platinum till around 1920s. Stribny, B., Wellmer, F., Burgath, K. et al in their article Unconventional PGE occurrences and PGE mineralization in the Great Dyke, metallogenic and economic aspects, the great dyke became a strategic mineral economic resource, holding base metals and PGMs of various concentrations including copper and cobalt. Geographical spread of the Great Dyke covers areas such as, Darwendale, Lalapanzi, Makwiro, Mutorashanga Mvurwi expanding to Wedza, Shurugwi and Zvishavane. Early exploitation of gold, chrome and chromite dominated early mining in this area. The coming in of BHP Minerals, an Australian investor around the Makwiro Area opened up organised exploitation of PGMs in Zimbabwe. Due to complex geological and macroeconomic factors BHP disinvested to pave way for South African Based impala platinum. Exploitation of PGMs in oxidised surface ores, potential existence of approximately

400metric tonnes of ore makes business sense for platinum producers to sink in excess of 5billion dollars investment over the last decade. Anglo-American in joint venture arrangements with both Aquarius and Impala Platinum have taken advantage of the easy accessibility of this resource setting up mines in Selous, Ngezi, Shurugwi and Zvishavane.

According to the 22<sup>nd</sup> Annual Investing in Africa Mining Indaba investment guide of 2017, there are four complexes holding PGMs in Zimbabwe. The biggest is Hartley Geological Complex mined by Zimplats, holding approximately 85% of the resource. Mimosa and Unki share the remainder, with prospects of another Russian Investor, Karo Resources, potentially locating a \$4.2billion investment in the Darwendale area.

### III. RESOURCE NATIONALISATION AND VALUE CHAIN ANALYSIS IN THE PLATINUM SECTOR

The paradox of resource endowments in Africa against stinking poverty exposes Africa state leadership. Obsession with state ownership of all strategic mining assets continues to derail effective sustainability of exploitation of these resources because states in general and Zimbabwe government in particular lacks an accountable framework to eradicate opportunism and theft. Nationalisation of mineral resources has led to a resource curse in most African countries. D R Congo has persistently undergone incessant conflicts. Angola, among other highly endowed countries, remain a least developed country. Zambia is swimming in debt and continues to seek debt forgiveness against a backdrop of copper endowments of monumental proportions.

Major Players in the PGMs sector include Zimplats, Mimosa and Unki mines. A few new Russian and Chinese players have also entered the terrain intending to operating Karo Resources and Global mining respectively. All these assets are privately owned save for the new players whose ownership is still to be disclosed. For full scale economic transformation of Zimbabwe, the role of government must clearly be defined. It is to create an enabling environment for private businesses to thrive. According to Gumede 2015, Zimbabwe would benefit immensely if she moves from economic transformation to economic development. Economic development will fast track accrual of benefits to support employment creation, housing, healthcare, local enterprise development, social relation and indeed a developed infrastructure. According to Walter Rodney 1973, the rationale of Europe under developing Africa was to exploit mineral resources to serve Europe's industrialisation. It is therefore imperative that the national conversation in Africa in general and Zimbabwe in particular, changes from broad based ownership of mining assets to systematic and sustainable exploitation for economic development.

Zimbabwe boasts of being one of the top five produces of PGMs which locates the country at a unique position to exploit platinum global value chains. According to Kapinsky @al 2002, value chain is a process of converting primary products from their production stages to value added products ensuring that these products reach the desired markets and exploiting the value chain benefits at every stage of the product development. Zimbabwe ranks second from south Africa in PGMs endowment with high levels of proven and probable reserves with minimum life of mine of 20 years. PGMs include palladium, rhodium, iridium, osmium

and ruthenium. They are applied new technological industries among other commercial ventures.

Whilst Zimbabwe has enjoyed proceeds of organised gold and chrome mining over the years, and has witnessed the formation of Mining towns such as Mhangura, Cam and Mine Motor Kadoma, Hwange, Kwekwe, and Shangani among others, opportunities for locating the country as an African technological hub remain high. The sustainability of PGMs exploitation leads to creation of new industries in automotive, mobile telephony, health care especially cancer therapy and personal hygiene, clothing and textiles, and jewellery among other uses.

According to Anglo-American Cooperation, "A sustainable business is purposeful, competitive, resilient and agile –it's a business that thrives through both economic and social cycles" Zimbabwe needs to define its comparative advantage to competitively locate itself in global value chains in the above potential industrialisation opportunities. Trade-offs for lucrative markets, technology and relevant skills are an option to ensure local development of economies of scale in chosen PGMs industries. Foregoing gold mining, for example and exchanging all gold deposits for developing local capacity to drive global platinum value chains is a crucial medium to long term economic strategy worth evaluating. Nationalisation of the resource naturally destroys all innovation in attaining smart exploitation of the PGMs because public or state driven businesses are generally slow in decision making, bureaucratic in implementation and inefficient in cost containment. Technological Innovation and digitalisation are crucial components in the future of exploitation of mining endowments.

### IV. LICENCING TRANSPARENCY IN PGMs MINING SUSTAINABILITY

Licensing and regulations associated with setting up and operating a mining business boosts appetitive for long term investments into the sector. A number of questions must be answered particularly when it comes to state facilitation of mining licencing. What is the licencing period? How many licences does one require? Which state entities are responsible for issuing out mining licencing? Is the process of acquiring mining licencing simple enough to facilitate speedy acquisition of the mining licence? How dispersed are the licencing authorities? What are the basic requirements for one to qualify for mining licence? What are the associated costs of licencing?

These questions, if all satisfactorily answered present the ease of doing business in Zimbabwe. State departments responsible for licencing vary from mining title ownership, environmental management, safety and health, use of dangerous chemical and substances, marketing and mining operating license at local authority level. Requirements of licencing and the process to comply with all the pre-requisites to obtain some of the licences are sometimes cumbersome and repetitive causing undue delays, frustrations, fatigue, and increased costs.

Investors by nature are easily intimidated if the investment compliance environment is complicated particularly on access to critical information to facilitate mining business set up. For example, the environmental management act enforces environment impact assessments. The impact assessments are carried out by experts who engage in a broad stakeholder

consultative process to avoid future conflict between the business and these stakeholders and create a collective environmental management compliance. According to the Chamber of mines, an investor receives an environment impact assessment certificate which is renewed annually. The revised policy requires the investor to pay 1.2% of the total project cost down from 10% prior to 2017. The Chamber of Mines of Zimbabwe (COMZ) specified that *“The Environmental Impact Assessment (EIA) fee at 0,8% to 1,2% of project cost with a cap of US\$2 million remains high and is discouraging execution of investment projects in the mining industry. In order to promote capital inflows into the mining sector, the chamber recommends the reduction of EIA fees to a rate of 0,5% of project cost with an upper limit of US\$10 000, in line with regional best practice,”* The consequence of this requirement is that the investor may be constrained in cashflows as they are expected to outlay compliance costs ahead of the project establishment, on its own, a significant budget which include the required EIA professional fees. Further, all local authorities are expected to license all businesses in their local areas again. PGMs mining, as a business, derive their social license to operate by ensuring they embrace, not only the local authority licensing requirements, but accept informal social engagements with the local community structures. Whilst the costs associated with the formal or informal engagement with local community leadership are minimal, local authority processes are generally a repetition of the EIA process. It is therefore an unnecessary compliance process which should be integrated into the EIA process for simplicity.

Use of substances such as explosives, processing plant chemicals and mining residue management require separate licencing. Mining uses significant amounts of water. Water management legislation requires mining companies to obtain water management licencing. One therefore expects that all these licensing responsibilities be carried out under one roof by a single government agency.

Whilst the effort by Zimbabwe Government to create ZIDA is commendable, the institution has maintained its inherent traditional inefficiencies symptomatic of the parent agencies, the one stop investment centre, Zimtrade and Zimbabwe special economic zones authority. According to Tralac, (Trade Law Centre of South Africa) *“the Zimbabwe Investment Development Agency Act [Chapter 14:37] (ZIDA Act) (1.98 MB), ZIDA Act, deals with the promotion, entry, facilitation and protection of investment in Zimbabwe. The Act was introduced as part of the government’s efforts to streamline investment laws and create a business-friendly environment attractive to both local and foreign investors”* the world bank group through IFC advises that Sub-national political entities, whether states, provinces, regional governments or municipalities, play a central role in fostering a sound business climate. The consequences of ineffective, excessive or, in some instances, inappropriate regulation generally have adverse effects on investment and economic development. Promotion of a simplified but sophisticated investment environment presents a clear pedestal for business innovation, certainty and coherence particularly in PGMs mining because the sector is not only sophisticated highly capital intensive. Creation of an appropriate well-regulated investment climate naturally attracts long-term money which in itself is a development prerogative for positive economic outcomes.

The IFC further underscored the need for integrity in instituting simplified business climate processes and procedures through eliminating impediments in investment regulation and licensing. Corruption, vice and institutionalised graft are offshoots of constraints associated with complying with bad laws, guidelines and procedures.

Issuing a mining licences “entitle the holder to prospect, peg and register claims in terms of the Act. An exclusive prospecting order confers exclusive rights to prospect for specified minerals in any identified location within Zimbabwe” ICLG 2018. Expropriation of platinum-bearing mine concession originally owned by Zimplats and offered to Karo Resources, a project expected to create a \$4.2-billion mine, has further negatively affected, Zimbabwe’s property rights record. Whilst Zimplats had no choice but to agree to cede approximately 24 000 ha of the company’s land to the state, the transaction has been misunderstood to be evidence of the state renegeing on earlier investment agreements entered into by investors.

Licensing therefore plays a crucial role in sustainability of PGMs exploitation in Zimbabwe. Insulating the licensing regime from the vagaries of political manipulation, enforcement of populist policy decisions which may affect existing agreements and ill- thought regulatory changes will deal a fatal blow to future investment potential particularly in cases of wholesome reversals of agreements previously entered into between the state and external investors.

#### V. THE MINING EXPLORATION FOR SUSTAINABLE MINING

A compelling PGMs mining investment depends on the availability of the mining resource, availability of skills to extract the resource and more importantly the return on investment. Whilst the above is a necessary condition for arriving at a decision to invest, a conducive macro-economic environment in broad terms, is a catalyst to making a decision to establish a mining venture. The gestation of a mining project is long term and long-term investments by nature require long term money. policy clarity is a necessity and sufficient to enhance attracting investment into the PGMs sector.

Property rights are equal central to give certainty to ownership of mining assets targeted and must be observed as precondition to attract capital in mining exploration. Mining exploration budgets are called sunk budgets. Zimbabwe currently exploits four known platinum ore deposits all found in the great dyke. Ownership of mining assets called claims, special mining grants and mining leases are recognised in the mines and minerals act in Zimbabwe.

Zimbabwe is currently under explored. General negative perception that Zimbabwe has an awkward mining title management system, which is characterised by difficulties in applying the system, old and easily manipulatable, militates against the ability of the country to attract both internal and external exploration money. Lethargy and resistance to computerise mining title management system is misunderstood to be harbouring institutionalised corruption, hence the continued existence of mining title conflicts beyond the PGMs sector. Discovery of any minerals has largely been from old workings which has been a culmination of the existence of historical geological information rather than virgin land with no known

exploration history. Advanced exploration techniques will shape the future of exploration work in Zimbabwe particularly where private exploration companies are engaged.

Conditions sufficient for attracting the most reputable exploration firms include the harmonisation of the role of the state in the exploration process. The risk appetite and averseness for exploration financing depends largely on the country risk profile particularly with high value metals such as platinum. Exploration phase is the mineral discovery phase with potential to generate

relative value. It takes average 10-15years to explore, discover, engage in a prestart up feasibility assessment and engage in full scale mining. Exploration policy incentives whether they are legal, fiscal, regulatory and monetary take into account potential huge losses associated with this process.

**The policy consistency, coherence and complementarity**

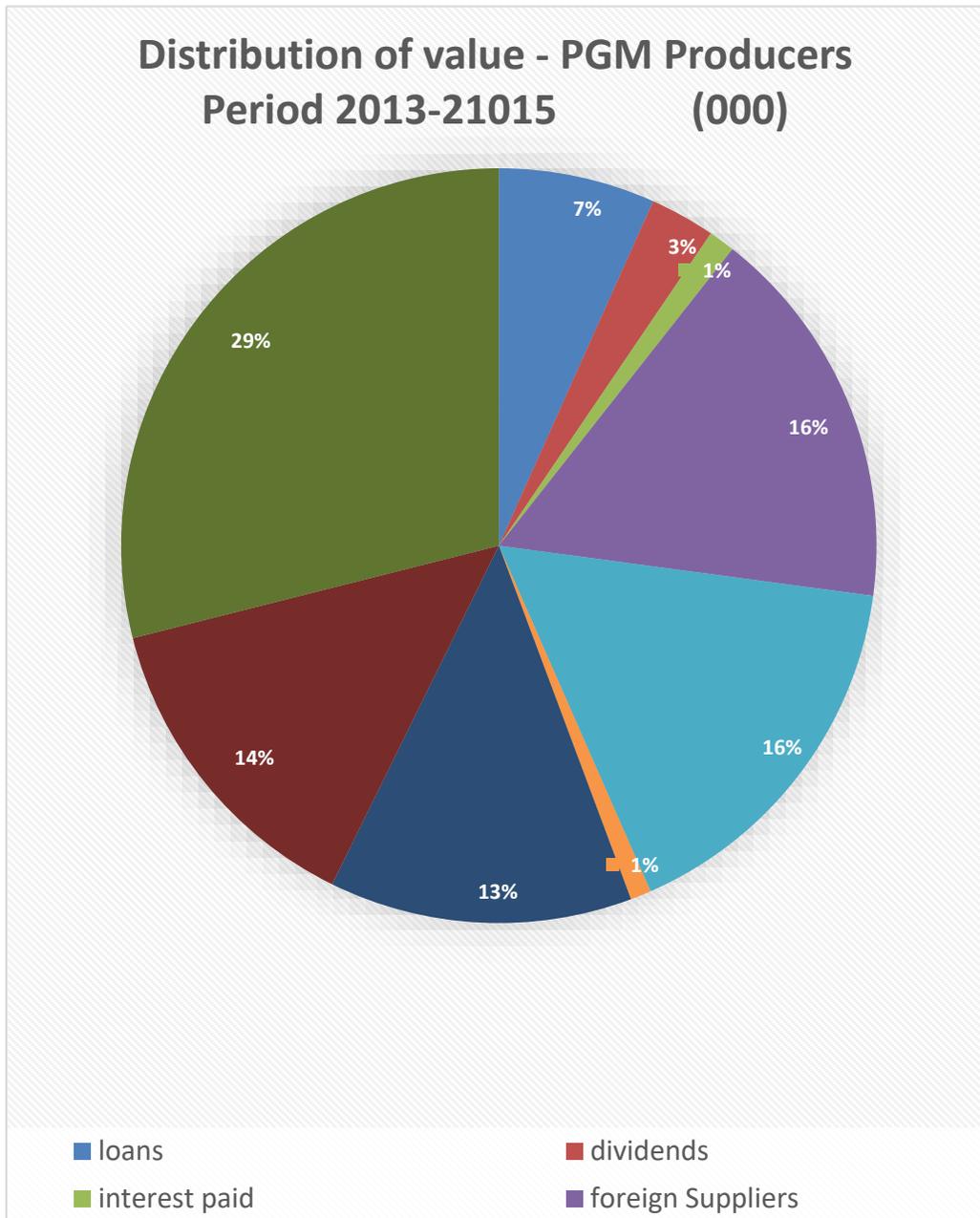
*Distribution of PGMs Value*

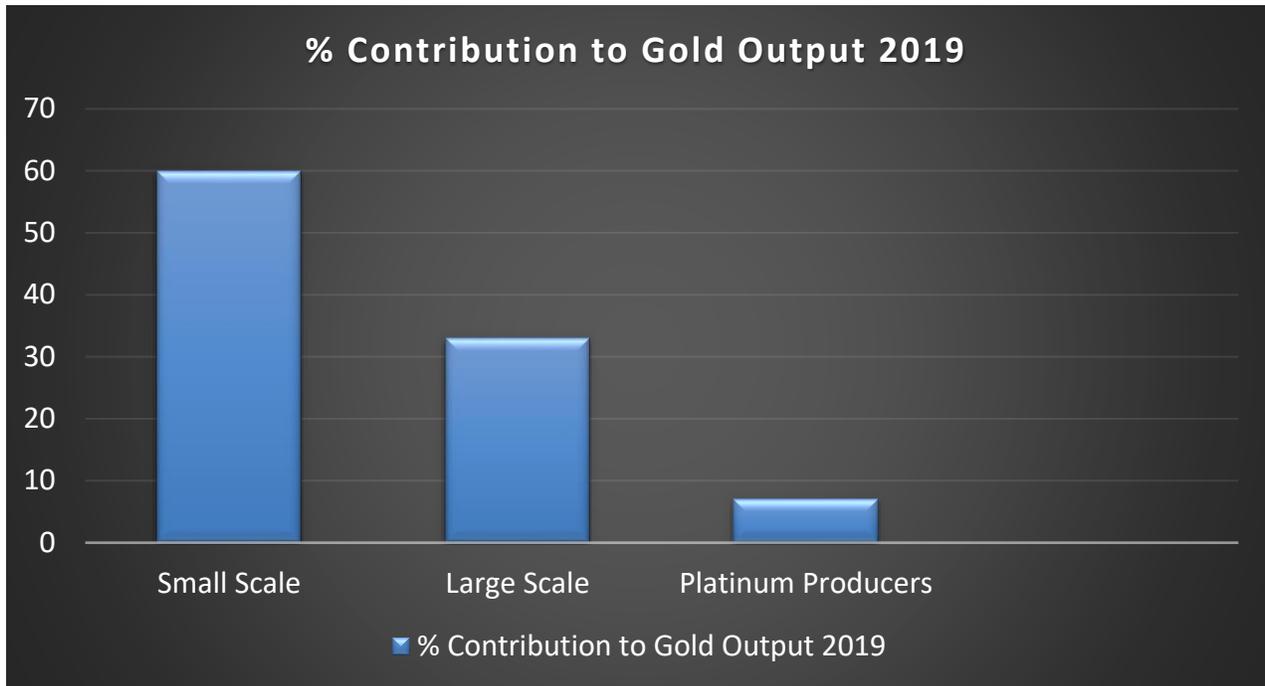
**Table 1**

<b>3 Year Period to 30 June 2015</b>	<b>(0000)</b>
Export proceeds	2 713 360
<b>Payments</b>	
Local Suppliers	893 401
Employees	425 270
Government – duty, royalties and taxes	400325
CSR & Community Trust	27 462
Capital Expenditure – Local	503 084
Foreign Suppliers	509 627
Interest Paid	34 693
Loan Repayment	206 881
Dividends	86 000
<b>Platinum Production and shared benefits (2012-2015)</b>	<b>3,086,743</b>

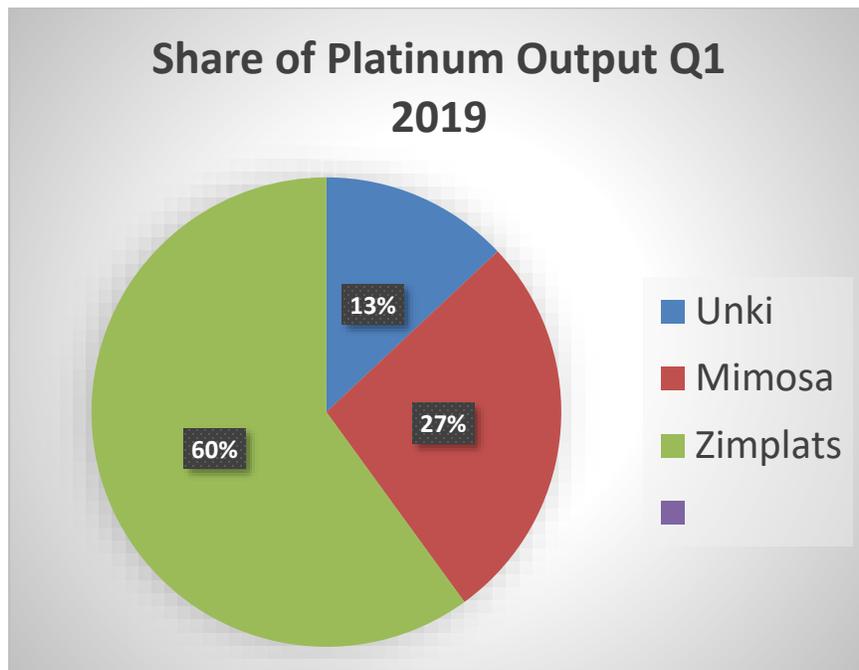
Source: Zimbabwe Platinum Producers Association

Figure 1





**Diagram 1**  
**Source: Chamber of Mines Q1 Journal**



**Source: Chamber of Mines Journal**

The prominence of artisanal mining demonstrates catastrophic failure of Zimbabwe’s mining policy. None of the studied public policy theories best suit Zimbabwe’s policy development architecture, the unintended consequences of which are the obtaining high company mortality rate of organised gold producers, capital flight, disinvestments and reduced capacity utilisation among the few surviving mining companies. Simply put, public policy making postulates the construction of a set of processes, procedures and systems to enhance optimal

management of public assets. Policy making invites multiplicity of interests and according to the garbage- can theory these interests cut across inside and outside government. The systems theory of public policy making further includes the involvement of individuals, special interest groups, and countries depending on the problem at hand.

Policy dialogue between existing mining operators, according to the chamber of mines, remains “suboptimal” Emerging issues affecting existing mining investments include a

complicate legislative regime, more complicated fiscal and monetary regime, and an even more complicated foreign exchange management regime. Mining operators are uncompetitive, with very low opportunities to access low-cost capital and coupled with uncertainty on continued ownership of existing mining title. Volatilities of exchange rates against major currencies, punitive surrender requirements and the blanket enforcement of the 2% electronic money transfer tax are part of a basket of complexes of policies the PGMs sector is grappling to conform to.

Therefore, the role of government policy in sustainable mining in Zimbabwe is to give direction to citizens, corporate or individual, providing them with leadership in optimum exploitation of platinum resources and their by-products. The basket of preferred policies must be complementary, coherent and consistent. Fiscal and monetary policies by nature give impetus to mining and exploration policies, resulting in creation of competitive mining environment that attracts the best and globally reputable extractors.

Sustainable mining thrives where mining returns are good. Reporting and collating of mining returns are a collective responsibility of the mining companies and various government and quasi government arms in Zimbabwe. These include monetary authorities regulated by the Reserve bank act, Fiscal authority overseen by the finance act and a multiplicity of regulators such as mines and minerals cooperation of Zimbabwe (MMCZ), Environmental Management Agencies (EMA) and the parent ministry borne by the mines and minerals act. Whilst the national aspiration in exploiting PGMs in Zimbabwe is to create sustainable mining for the benefit the country, operations of all state entities involved in the sustainability of PGMs mining run contrary. Fragrant disregard of the laws and policies consequentially disastrous particularly when the intention is to develop a comprehensive PGMs sector development plan.

Figure 1 above shows the distribution of value of PGMs from the year 2012 to 2015. A brief analysis of the given statistics shows that a combined 83% of the total value is accumulating to the state, local suppliers' government, communities and employees. The PGMs value proposition is accruing to Zimbabwe. Declared dividend for the period under review is a paltry 3% of the 3billion dollars. Local suppliers received approximately 45% of the value. 27% of the value is external comprising of loans repayments and loan interests, foreign suppliers as well as declared dividend to those share holders who may be resident outside Zimbabwe. The PGMs sector also contributes significantly to the annual national Gold Output as indicate in diagram 1. Sustainability matrix in the PGMs sector, therefore should aspire to:

1. **Contribute to Broad infrastructure development** – social cohesion related infrastructure responding the justification of obtaining their social licences to operate in the relevant communities. Infrastructure empowers local communities. Food security, education and human security are a natural benefit accruing form infrastructure development. PGMs are a finite resource. Ensuring that the proceeds accruing from exploitation of this resource directly contributes to creation of dedicated energy and power, water bodies, roads and rail among other critical infrastructure needs is strategically important.

2. **Industrialisation** – creation of new industries, local enterprise development, forward and backward linkages, sustainable economic enabler supply side related industries and support of community-based projects.
3. **Human capital Development and employment Creation** – the availability of dedicated mining skills, development of framework to support PGMs sectors and its linkages such as engineering, human resources, exploration, processing and marketing, as well as creation of formal employment nationwide.
4. **Create value for the investors** – investors are motivated to increase investment capacity is the return on the investment is attractive. A combination of progressive public policy mix and recruitment of globally reputable mining operators leads to development of mining towns nationwide. The growth of Zvishavane, Shurugwi and Ngezi are cases in point.
5. **Contribution to government fiscus** – progressive economies survive on rationale taxation of economic players. Expropriative and exploitative policies scare away good investors. Governments are not competitors to economic players but fluid facilitators of economic activity results of which are a wider base to collect direct and indirect taxes. Where policies are conduits to erode investor value, discourage honest work, reward corruption and theft and create institutionalised economic inefficiencies, the result is investor flight.

### **The mineral beneficiation, value addition and industrialisation**

Zimbabwe, like many countries in Africa does not derive benefit from manufactured mining exports. All mining exports are exported as primary products. In the case of PGMs, all three mines operate underground mines, extracting over and above the PGMs, gold, platinum, palladium, rhodium nickel copper, iridium and ruthenium.

Zimbabwe has no installed capacity for mineral beneficiation save for a three-stage processing. Platinum mines extract the rock and convey it as bulky ore to the process plant where it undergoes crushing and granulation to pulp. This pulp underscores further milling and smelting, in the case of Zimplats and Unki, to mate. The mate is the combination of all the above-mentioned minerals ready for export. According to Anglo American Cooperation, Major PGM mining integrates mining, refining and therefore maintain considerable processing assets that produce both refined PGMs and by-products. Zimbabwe's existing infrastructure can Mine, Concentrate, and Smelt. Refining and Fabrication facilities do not exist hence the export of mate.

For sustainability of the PGMs sector, Zimbabwe has exceptional opportunity to, not only create conditions for the growth of existing PGMs but design a deliberate framework to attract bigger investors in the sector. Refining and fabrication to produce final products depends on economies of scale. To Move the country towards full beneficiation of PGMs:

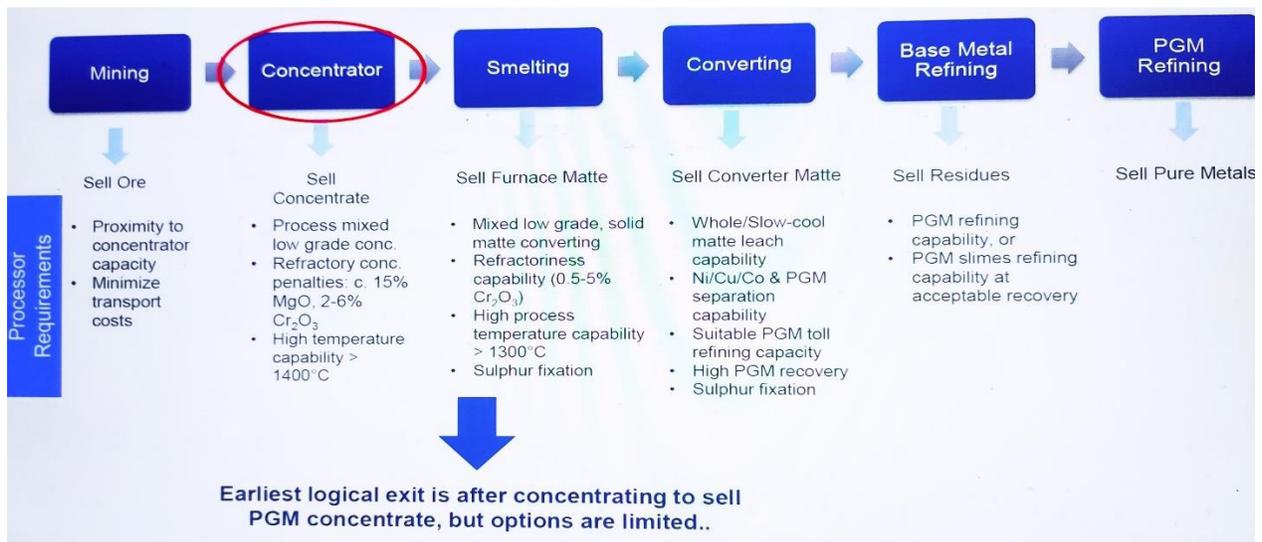
1. Role clarity is critical. Mining companies need capacity to increase rock extraction and processing as indicated

in figure 2 below. This capacity justifies development of refining and fabrication capacity.

2. Government must deliberately engage stakeholders in mining, finance, investments, potential markets to secure necessary guidance on how to establish inward to outward platinum group metals value chains. Establishing special economic zones aimed at attracting investment into automobile industries, healthcare delivery, technologies among other global value chains. Genuine stakeholder consultations and necessary assurances and commitments to rule of law, property rights, profits repatriation may assist in regaining lost trust and confidence from economic players.
3. Specialisation maybe a recommended starting point in view of potential integration with Zimbabwe's tradition markets in the EU and America. Whilst the opportunities are wide selection of a few areas of specialisation demonstrates organisational capacity for the country to pursue coordinated industrialisation.
4. A robust ease of doing business package to support PGMS industrialisation is necessary with a view to

establish centres of excellency particularly in local areas where the mining is undertaken.

5. Availability of statutory incentives, guarantees and indeed realigning taxation and royalties with global best practice may incentivise potential investors to consider Zimbabwe as a stable base to stablish industries.
6. Government to encourage linkages and partnerships between local Zimbabweans and potential foreign investors to ensure knowledge and skills exchange.
7. Define a consistent frame work to package government of Zimbabwe intention to achieve a 12-billion-dollar mining industry by 2030. This will call the government to unlearn a number of current uneconomic decisions they have pursued of late such suffocating businesses of the much-needed foreign exchange through crippling policies on foreign currency retention, liquidation and surrender. Deliberate effort to fix mining industry capacity constrains, a huge gap in mining industry infrastructure particularly power shortages may assist in turning around the mining sector beyond 2021.
- 8.



### The rationale of royalties and taxation

Globally, mining sector realignment has been a necessity particularly when global best practice turned to fixing royalties and taxation regimes as a low hanging fruit. Mining policies and regulations have modelled mining taxation as a remedy to ensuring mining sector contribution to national economic growth particularly in large scale mining. Some countries have gone further to implement fiscal decentralisation of mining. Local governments are empowered to levy some taxes while central government also enforce other taxes.

Royalties are a form of government tax generally agreed between the government and the mining investor. There are varied royalty categories and those applicable in the platinum mining sector take into account the fiscal needs of the government, communities and local government departments. The economics of platinum mining provides a basis for calculation of the royalties' thresholds. The interest of the investor, sustainability

plans and indeed the lessons learnt from global best practice are taken into consideration.

PGMs sector in Zimbabwe remains affected by the uncertainty surrounding royalties and taxation particularly as the national resource ownership conversation has undergone widespread misinterpretation. The geopolitical terrain continues to suffocate strategic planning of the PGMs sector because national politics' obsession with ownership of all productive assets continues to grow. The adage that owning 50% of an elephant is far better than owning 100% of a rat has found no space in strategic mining economics in Zimbabwe.

Concerns of opaqueness and lack of transparency in management of royalties and related fiscal taxation of mining assets in Zimbabwe explains low levels of long-term investment in the sector particularly in the last decade. Whilst Russia and China have since expressed interest in the sector, there is general lethargy and dragging of feet in fully establishing themselves.

**Fiscal Methods and Their Amenability to Fiscal Decentralization**

Tax type	National Govt	Provincial Govt	Local Govt
Incomes or profit based taxes	Applicable	Partially Applicable	Not Applicable
Import duty	Applicable	Not Applicable	Not Applicable
Export duty	Applicable	Not Applicable	Not Applicable
Royalty (profit-based type)	Applicable	Partially Applicable	Not Applicable
Royalty (ad valorem type)	Applicable	Applicable	Partially Applicable
Royalty tax (unit type)	Applicable	Applicable	Applicable
Royalty tax collected nationally and % distributed	Applicable	Applicable	Applicable
Licensing fees	Applicable	Applicable	Applicable
Surface rental or land use fees	Applicable	Applicable	Applicable
Withholding taxes on loan interest, dividends, services	Applicable	Not Applicable	Not Applicable
VAT on goods and services	Applicable	Partially Applicable	Not Applicable
Sales & excise tax	Applicable	Partially Applicable	Partially Applicable
Stamp duty	Applicable	Applicable	Applicable
Property tax (on book or assessed value)	Applicable	Applicable	Applicable
Payroll based taxes	Partially Applicable	Partially Applicable	Not Applicable
Surtaxes	Applicable	Applicable	Applicable
User fees	Applicable	Applicable	Applicable

Source: The World Bank Group Mining Department

Incomes and profit-based taxes are more user friendly to apply and legislate, therefore is commonly used taxation method. The method hardly gives credence to the provincial and local governments requirements for revenue collection but allow the central government to perform an allocative function. According to Prof Professor James M. Otto setting the tax rate, and setting the rules for determining the taxable income base will be subject to the determined tax rate. He further argues that the tax is best suited to implementation at the national level because of the complexity in balancing taxable revenues and allowed deductible costs.

The sustainable and optimum royalties and taxation model for Zimbabwe in the PGMs sector would take into account:

1. The national aspiration of growing the sector to 12billion dollars
2. The empowerment of communities and deregulation of state authority
3. Local procurement and local enterprise development
4. Creation of all forms of infrastructure
5. Global Value chain development and industrial linkages

It therefore requires that Zimbabwe drastically reduces royalties and considers Royalty ad valorem type tax. Further, a flat, low rate of Incomes or profit based taxes be instituted including scarping of any forms of export duties. Incentive value creation, the empowerment of communities, Local procurement and local enterprise development. Creation of all forms of infrastructure that enhances social cohesion, facilitates creation of Global Value chains and industrial linkages.

**The state ownership question?**

The Zimbabwe story of state ownership of productive assets leave an after taste. In the mining sector alone, the state owns the biggest mining portfolio in gold, diamonds, coal, iron and steel among others. Whilst the ownership on paper is attractive, these assets are the worst performing.

*Under complete information the early contribution by Barone (1908) proved the equivalence between the two ownership modes. More recently, Sappington and Stiglitz (1987) extended the equivalence result under asymmetric information. However, the setting and the stringent assumptions under which the result holds, which include the possibility to enforce complete contracts, are hardly met in real world cases. This make the theoretical framework of limited practical relevance in the case of developing countries, where privatization and regulation opportunities are far from meeting these stringent conditions, since contracting opportunities may be severely limited, many events, risks and choices can hardly be ex ante fully anticipated, so that are not likely to be described and then enforced in contracts. Accordingly, practical approaches should be developed to take into account of informational and incentive issues, especially in the area of implementation. Yet, little work has been done beyond the normative assumptions, neglecting the relevant implementation issues.*

Source: Vagliasindi (2007)

**The broad indigenisation and economic empowerment**

Promulgation of the indigenisation and economic empowerment act, driven by political interest incorporated aspects of equity ceding by foreign companies to facilitate equity ownership by locals in those foreign owned companies and community participation through community share ownership schemes.

According to Herbert Smith Freehills LLP - James Watson, Rebecca Major and Jerome Hamilton, A statutory instrument was published in the Zimbabwean Government Gazette on 25 March 2011 (the "Statutory Instrument"). The Statutory Instrument's main provision is to compel mining companies with a net asset

value of or above US\$1.00 (rather than companies with an asset value of or above US\$500,000 as set out in the Regulations) operating in the country to:

- (i) submit indigenisation implementation plans to the Minister within 45 days of the Statutory Instrument's gazettal, i.e., 9 May 2011 and
- (ii) dispose of 51% of their shares to indigenous Zimbabweans by 25 September 2011.

An indigenisation and economic empowerment fund were created purportedly to assist indigenous Zimbabweans to acquire equity in foreign owned companies. The statutory instrument was not only opaque, vague and unreasonable at law but exposed the government to legal challenges that would derail the entire program. Where statutory instruments are used, their integrity is questioned because they are executive promulgations made without parliament approval. The whole program was reversed by 2017 as the costs of further implementation were outweighed by the benefits of discontinuing it.

## VI. THE CORPORATE GOVERNANCE AND ACCOUNTABILITY INQUIRY

Demand for quality corporate governance in both public and private companies cannot be over emphasized. Institutional investors take great care in assessing quality of boards running with key national assets globally ensuring that those fund managers and investment giants provide critical investment guidance. Sustainability of Zimbabwe Platinum mining sector is guaranteed when:

- Investors are certain and confident on corporate culture, strength and independence of national institutions and indeed the dependability of investment policy regime.
- Law makers acknowledge that Mining investment requires long term money and is capital intensive. The integrity of legal and regulatory principles and systems has a knock-on effect on ability of investors to forward cast their future earnings and return on investment.
- Corporate governance enforcement safeguards robust performance of company boards, ensuring that their oversight role is not interfered with, accommodates diversity, provide for reasonable executive compensation, knowledge and skills exchange and enhance sustainable growth of the investor's portfolio

According to Impala platinum, Sound corporate governance is a critical foundation for protecting stakeholder value and achieving the group's strategic growth objectives. The company's governance universe demonstrates how the pillars of value are governed through their four governance segments, which are the board, finance, risk, and social and sustainability in support of the organisation's strategy and purpose. The elements in each segment are governed with appropriate processes, systems and resources to ensure the company demonstrate the desired governance outcomes. Impala Platinum is one of the critical and strategic players in PGMs exploitation in both Zimbabwe and South Africa.

Does Zimbabwe provide an optimum environment for sufficient demonstration of correct corporate governance and accountability? Promulgation and implementation of the indigenisation and economic empowerment legislation laid bare the suspicion that Zimbabwe is incapable of creating robust structures of corporate governance. Whilst one would argue that there are two key processes which were undertaken to give effect and credence to this aspect, none of the two has been implemented in later and spirit. The parastatals corporate governance legislation and the Zimcode fall short of the necessary and sufficient requirements for enforcement of good corporate governance practices.

A Case between the Zimbabwe government and Zimbabwe Platinum Mines wherein Zimplats lost part of its resource to Karo Resources continues to put question to the integrity of the Zimbabwean government particularly where respecting and honouring agreements is concerned. Commit to transparency. Dr. Nicole Bieske, Head of Program - Mining for Sustainable Development, Transparency International, *Governments should set clear, transparent and effective rules and criteria for mining approvals processes; and they should enable the public to access this information. Companies should be transparent about their operations, including their subsidiaries, joint venture partners and where they operate. They should also disclose their project rights and obligations, including contracts, licenses, and environmental and social impact and management plans.* Potential for conflict of interest between government employees, political institutions and mine operators must be eradicated.

Governments and Companies should continuously function with integrity ensuring set legal and regulatory frameworks are adhered to.

### *The PGMs mining best practice*

Mining Policy Framework (2003) identified as best practice for exercising good governance of the mining sector and promoting the generation and equitable sharing of benefits in a manner that will contribute to sustainable development. These best practices are divided into six key pillars: the legal and policy framework; financial benefit optimization; socioeconomic benefit optimization; environmental management; mine closure and the post-mining transition; and artisanal and small-scale mining. PGM have strived to show good practise over the years in most countries through corporate programmes that cover the following areas Supply chain development, Employment, Local business development, Regional development, Infrastructure

South Africa is the world's largest producer of platinum, processing 110mt in 2018. The country's reserves of platinum group metals (PGMs) stand at 63,000mt. The significance of the Platinum mining industry to the economy of South Africa is reasonably well acknowledged. PGMS in South Africa has played a vital role in the evolution of the economy positioning South Africa in the world. The South African PGM mining has undergone a noteworthy transformation from largely exporting raw minerals to the establishment of value-addition facilities (mineral processing and manufacturing). This transition has partly resulted in the construction of a number of large-scale resource-based investment projects, such as Columbus Stainless Steel, Saldanha Steel, Lion Ferro-chrome smelter and others. This demonstrates the country's state of readiness for value addition.

PGM in South Africa have elevated local suppliers to reduce imports and created development zones in South Africa and have reduced reliance from mining through local and economic development. The PGM have invested in infrastructure especially construction of roads and water purification facilities for their mines.

Through forward and backward linkages, mineral resources present great potentials to sustainable economic growth and development (Mahonye and Mandishara, 2015). Given the above, South Africa exploits their resources for higher growth rates, technological transfer, and poverty alleviation, as well as to increase the level of per capita welfare. The South African manufacturing industry, which is now a major contributor to national income, owes its origin to the needs of the mining industry.

PGM mining have drew people out of the agricultural sector into commerce. It also facilitated the establishment and expansion of towns, thus creating new and easier markets for agricultural products, construction of railways and roads, and so forth. The higher concentration of people in such areas together with an improved transport system facilitated the establishment of various factories, banks, banking facilities, schools, libraries, hospitals, theatres, and many other services. Mining therefore stimulates the agricultural, manufacturing, and even tertiary sectors.

Russia is the second-largest producer of platinum in the world, with a 2018 production of 21mt. The country's reserves of PGMs are 3,900mt (U.S. Geological Survey.) The Russian economy has developed better than expected in recent years and the prospects for the coming years are rated as generally good due to its leading role in the mining of platinum group metals. The PGM is highly consolidated. The Strategic Investments Law, which regulates access of foreign investors to the mining industry, gives privileges to Russian companies that play key roles in the sector and restricts foreign firms from developing large, or 'strategic' deposits.

In Russia PGM companies are investing a great deal of resources in exploration and production facilities and also looking at recycling processes and procedures to ensure the continued future supply of these essential metals.

Canada takes the fourth spot in the list of global platinum recovery, with a production of 9.5mt last year. A significant part of platinum mined in the North American country is a by-product of nickel mining. The country's reserves of PGMs are 310mt. Canada exports the majority of its output to the US.

Mining generates the much-needed revenue and raw materials required for industrial development (International

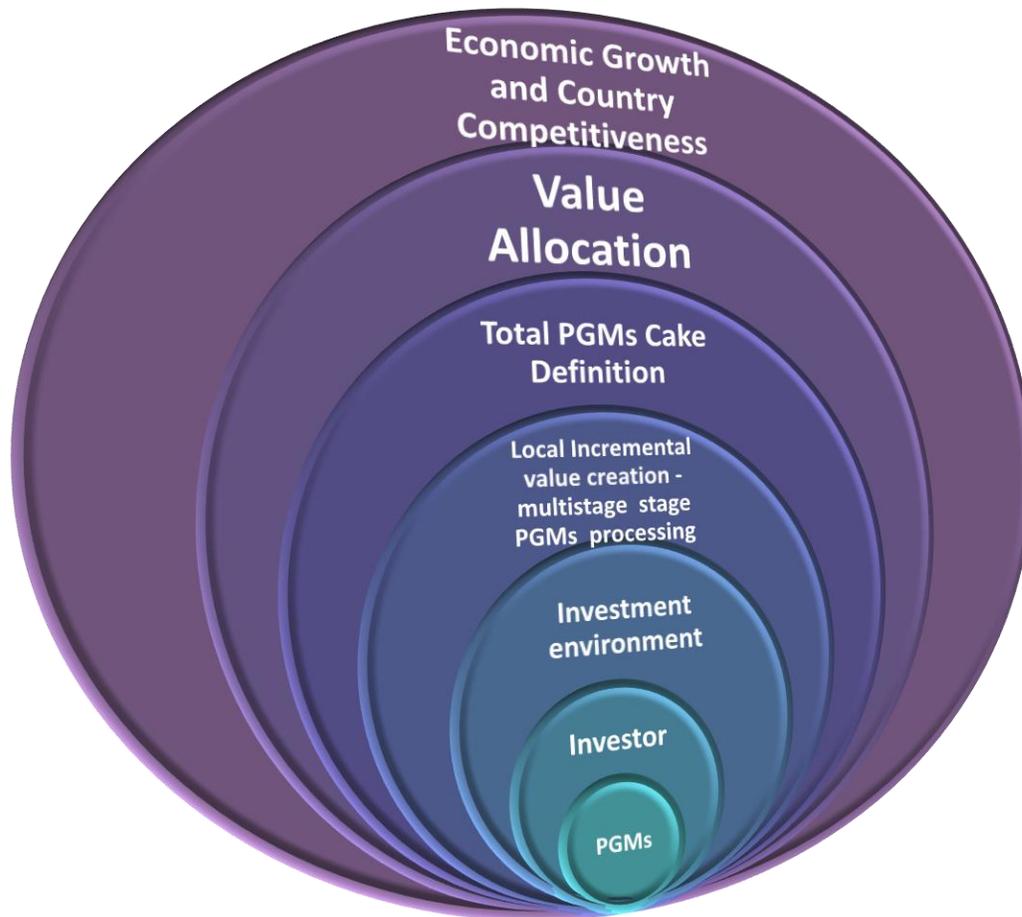
Council on Mining and Metals (ICMM), 2014). PGM mining generates the much-required capital to develop other key sectors of the economy, thus helping to address the problems of unemployment, poverty, and inequality in Canada

The US is the fifth largest platinum producer in the world, with a production of 3.6mt in 2018. The country owns two platinum producing mines including the Stillwater Mine, located in Nye, Montana, and the East Boulder Mine, which is located by Big Timber, Montana. Modernisation of the PGM industry in America is helping in ensuring global competitiveness and future sustainability. Through collaborative partnerships between PGMs and other stakeholders, United States of America has managed to shape an industry that is safer, more sustainable and efficient, and better harmonised with the needs of communities and of society as a whole.

## VII. OPTIMUM PGMs SUSTAINABILITY MODEL FOR ZIMBABWE

Creation of optimum macroeconomic conditions, eradication of political and other risks and engendering a robust mining framework is the panacea to developing sustainable PGMs mining. The illustration below demonstrates the potential the country currently possesses for full scale development of the PGMs sector. This illustration gives comfort to all the benefactors and beneficiaries of the value accruing from optimum exploitation of the PGMs in Zimbabwe. It adequately captures all interests associated with the existence of the PGMs in Zimbabwe. Role clarity is therefore critical in ensuring ease of exploitation of the resource. The PGMs sector can grow from the current 3-3.5-billion-dollar industry to 20billion dollars only if we avoid losing value along the entire value chain. The state need not obsess itself with owning any of the resources but create optimum conditions for retaining all the value and proceeds of the exploitation of the resource in Zimbabwe through value addition and beneficiation, dedicated infrastructure development, industrialisation, linkages and local enterprise development as well as value chain development.

Whilst the current value distribution of the PGMs is in excess of 80%, the proposed model will broaden the expected output from the current 3billion dollars. Derivatives from value accumulation of beneficiation and industrialisation will provide a multiplier effect at every stage of beneficiation. Feeder and support industries are created with potential to harness expertise, innovation and skills to enhance downstream and upstream support industries.



### VIII. CONCLUSION

This paper establishes that there is a direct correlation between an equitable investment environment and sustainability of PGMs mining in Zimbabwe. The more favourable the conditions for profitability the bigger the PGMs cake. Global best practice sustains the notion that national stakeholders derive their interest in supporting the growth of PGMs sector broadly for their selfish reasons. These include the need for infrastructure development, value chain creation, employment and skills development, poverty reduction, business linkages and industrialisation.

The paper also buttresses the position that there is a nexus between rationale government policy and PGMs mining growth in Zimbabwe. Bad government policy shuts out not only globally reputable PGMs extractors, but derail opportunity for backward and forward linkages, on its own an important process for value addition and beneficiation. The dichotomy however remains, whilst the country locates itself as the second largest holder of PGMs worldwide only form South Africa, Zimbabwe misses a unique opportunity to increase PGMs exploitation, grow the PGMs sector and create industries associated with the final products. The country only processes to matte which demonstrates that Zimbabwe is unable to directly benefit from all by products of the PGMs value chain. Zimbabwe therefore must recalibrate its

PGMs exploitation matrix to enhance its chances of driving platinum global value chains from Zimbabwe and ensure the country becomes global best practice in sustainable platinum mining and processing.

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# Dominant Regulatory Factor of Shoreline Erosion Process: The Case of Western Coastal Sector in Sri Lanka

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**Abstract-** Shoreline erosion process regulate by several factors which derive from interior of the earth, atmosphere, hydrosphere, lithosphere and biosphere. Gravitational force of the moon is also a considerable factor that determine the shoreline erosion rate. Thus, natural forces, process and dynamism belong to endogenic, exogenic, extraterrestrial along with anthropogenic origin control the recession and accretion level of the shoreline and denudation process of the coast. Literature and ground truth data reveals that shoreline erosion cycle is complex process which influence all kinds of dynamism, actions and processes belong to geo-system. The clear picture of this is still mystery. However, it can be conclude when referring geological and geomorphological history of Sri Lanka, the natural forces and process that regulate the shoreline erosion in Western coast (study area) are constant. The current study surfaces the fact that the anthropogenic (Human activities) influence with slow rise of sea level have become leading factors that determine the coastal erosion process in particularly in the West coast of Sri Lanka. Reduction of beach sediment supply and constructing hard structures to protect properties from shoreline erosion along beaches from where sediment comes have become dominant factors that regulate the erosion rate in the study area.

**Index Terms-** Coast erosion process, Regulatory factors of coastal landforms, Denudation of shoreline,

## I. INTRODUCTION

Shoreline erosion can be identified as the constant, relentless and visible land mass denudation process that cause to wearing away the surface of the earth (Amarasinghe, 2004). Waves caused by wind are the main erosion agent of the formation of coastal landforms. When the fetch is long enough to developed powerful waves and a major global wind path cross the coast line, shoreline erosion process is more dynamic and perpetual. South West and Western coastal sectors of Sri Lanka faces for huge Indian Ocean fetch and South Asian Monsoon wind path. Temporal and special span of appearing and disappearing coastal landforms of such coasts are very short. Livelihoods and lifestyles of these coast collapse suddenly. This has surfaced as a disaster. Such kind of disastrous situation hit the Western coastal sector in Sri Lanka from recent past (CCD, 1997). It is general truth that fetch does not change suddenly. Wind systems that effect to generate waves can be changed gradually or take some time to witness significant change. Without changing these two factors, many coastal zones of Sri Lanka which had been beach or land area around thousand year history wearing away within few days or few weeks. This means other factors than fetch and wind system influence as dominant factor/s to regulate shoreline erosion process. Main and broad objective of this study is to engage to investigate on this matter.

Sri Lanka is a small island of 65610 sq.km land area. Yet the population density is six or seven times higher than many developed countries. Population density, urban land area, industrialized area and other land areas that contribute national GDP are significantly higher in the coastal zone in Sri Lanka than other parts of the country. Approximately 1620km long coastline including shoreline of bays and inlets but excluding lagoons is belong to this country (CCCRMD, 2018). Such valuable land is eroding rapidly creating vast array of socio-economic, environmental, cultural and political issues. According to the calculation of CCD in 1986 and 2006 the intensity of shoreline erosion vary from 0.0 -3.0m/yr (Amarasinghe, 2020). This figure will increase up to 7m/yr in 2050 and 22m/yr in 2100 (Bakker, 2018). Ground reality of the disaster of coastal erosion is more serious than literature reported. At the same time, spending enormous amount of money to build hard structures to control shoreline erosion have become a starting point to accelerate erosion in long stood wide beaches in adjacent coastal sectors. Therefore, main objective of this paper set as to find what the dominant factors of shoreline erosion are. Result of this study may help to understand the main cause that influence to accelerate erosion particularly in West coast of Sri Lanka.

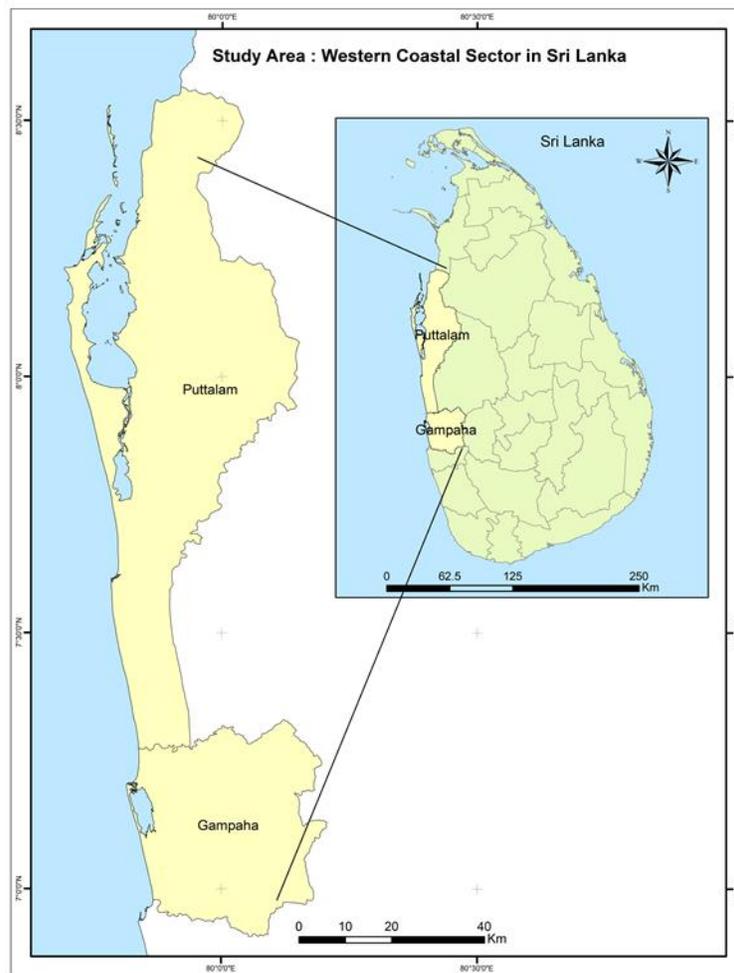
## II. METHOD AND MATERIALS

Existing knowledge on the shoreline denudation process and related physical process of the four geospheres of the earth was reviewing with the help of available digital and printed literature. Literature survey was the main secondary data collection method applied in this study. Analyzing satellite images and questionnaire survey were applied to collect relevant primary data. Conceptual data analyze method and basic cartographic techniques were employed to analyze raw data. Flowcharts, maps images and tables were used as results presentation techniques in this study.

### **Study Area: West Coastal Sector of Sri Lanka**

West coast as designated by the then Coast Conservation Department of Sri Lanka in 1986 comprised with shorelines belong to two administrative districts of Sri Lanka named Gampha and Puttlam (Fig. 01). Length of West coast is 340kms and 21% of the total length of coastline belong to Sri Lanka (CCD, 1986).

Figure- 01



According to the CCD (1986), net erosion of this coast varies from 0.2 – 1.0m per year. This figure is higher rate when comparing to national figure, 0.2- 0.35 m/yr as mentioned in the same report in 1986. Yet, the erosion rate is higher than this figure when comparing with the erosion rate for the period of 2015- 2020.

West coast is made up with old beaches and sand dunes belong to Holocene and Pleistocene periods of Cainozoic geological era (Cooray, P.G. 1983). That means the age of this coastal sector is just 0.01 to 2.0 million years. Raised beaches and dune deposits, older alluvium, laterite, nodular ironstones and submarine canyons cuts belong to Pleistocene periods can be seen in coastal stretch belong to Puttalam district. Drowning continental shelf during the post glacial sea level rise, younger raised beaches and dune deposits, beach rocks, recent alluvium and lagoons belong to Holocene period can be seen within the coastline belong to Gampaha district (Swan, B. 1983).

West coast is comprised with wide beaches and wide continental shelf. Beach profile consist with low gradient slope compared to South Western coastal sector of Sri Lanka. Therefore, waves crest are almost to shoreline alignment. Density of population, urban area, industrial areas are also low when comparing to South and South Western coastal sectors of Sri Lanka (CCCRMD, 2018).

### III. Discussion and Results

It is a general truth that land mass denudation process leads to gradation the earth surface. Gradation is accomplished by degradation and aggradation process (Spencer, E.W.1983). These processes can be seen in the shore in a single occasion at two different places or in one place at two different times. Weathering, erosion, transportation and deposition of rocks materials are the main influencing four geomorphic processes that determine the nature of the shoreline degradation and aggradation intensity (Leopold, Wolmand and Miller, 1964). Weathering of bed rocks, erosion of weathered rocks, dunes and beach, transportation of eroded sediments by the near shore wave action and deposition sediment load are the main results associated with the geomorphic process related to land mass denudation process of the shore (Huggett, 2011). This reveals that number factors that determine the actions, reactions, dynamism, interactions and infractions related to “geomorphic cycle” involve as regulating factors of the shoreline erosion process (Haggett, 1979). Knowledge of these factors can be traced by reviewing literary works relating to the subject of Geomorphology. For instances, concepts of Davisian Cycle of Erosion, Marine Dissection Theory of Sir Charles Lyell (1846), Cycle of Marine Erosion of D.W. Johnson (1919) and classical works of Aristotle (384-322 B.C.) and Leanodo Da Vinci (1452 -1519 B.C.) can be given( Amarasinghe, 2004). Reviewing and analyze these literary works and incorporate ground truth realities would pave the way to identify the responsible factor that regulate the shoreline erosion process. This infusion would help to identify the most influential and key factor/s that regulate the shoreline erosion process of the Western Coastal Sector of Sri Lanka. Findings of this study may help immensely to solve the array of problems associated with shoreline erosion process in the Island of Sri Lanka as well as other countries.

As mentioned above, shoreline erosion is a complex geomorphic process which involves number of forces, processes and formations of relief features of the coast (Huggett, 2011). Formation of coastal landforms are the product of different types of chemical and physical actions, reactions, interactions and infractions relate with “geomorphic cycle of shoreline erosion” (Haggett, 1979). All these process and dynamism relate directly or indirectly with the forces and processes of atmosphere, hydrosphere, lithosphere and biosphere. This shows that shoreline erosion process is a natural process which consists with number of regulatory factors that control the forces, processes and dynamism of the shoreline erosion derived from whole geo-system (King, 1972; Swan, 1965).

Almost all anthropogenic activities of coastal zone as well as interior of river basins which supply sediments to coast influence to alter shoreline erosion process (Hinrichsen, 1994). Impacts of all these factors may appear directly, indirectly or reciprocally. Magnitude and the level of intensity may be vary from temporally and spatially. Recurrence intervals of some of these factors is seasonal, annual or few years. Therefore, when considering the appearing and activation period of time, regulatory factors of shoreline erosion can also be categorized into two as short term and long term factors (Amarasinghe, 2001).

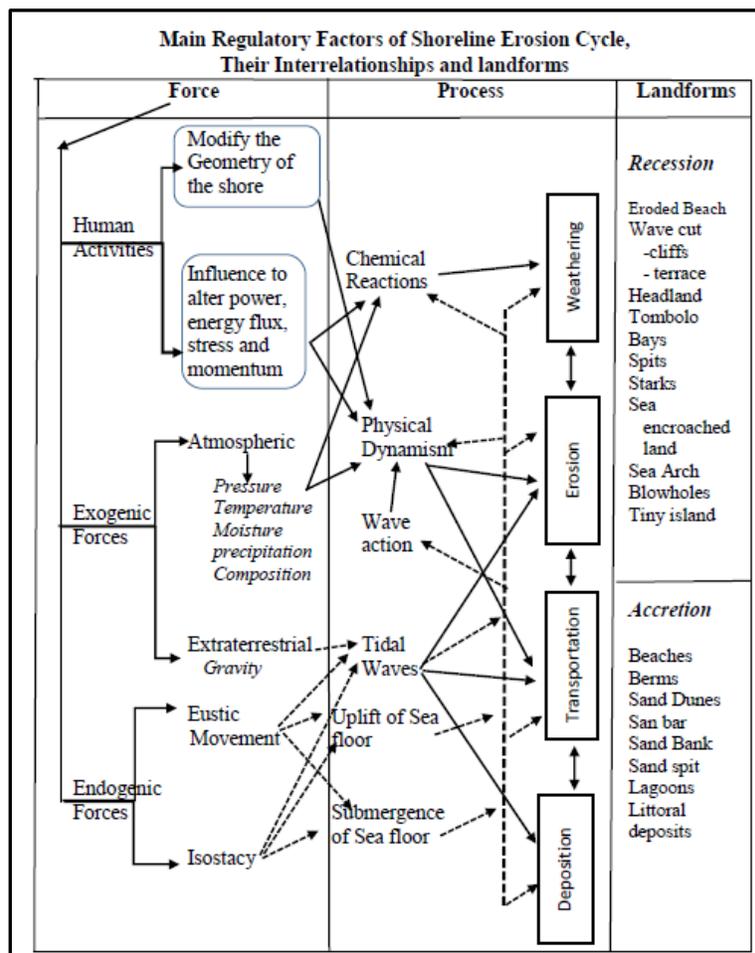
### **Regulatory Factor of the Shoreline Erosion Process and Their Interactions**

Shoreline undergoes relentless attack by the sea waves. Waves supply the required force to activate geomorphic process of the shoreline to wearing away shoreline and to produce various types of coastal landforms. Geomorphic process of the coast is driven by three types of forces; Endogenic, exogenic and human activities (Fig. 02). Endogenic or geological forces can be divided into two as eustatic and isostatic forces. The isostatic equilibrium influence to uplift or submerge the near shore sea floor level resulting eustatic sea level change. Forces associated with the exogenic are divided into two as atmospheric and extraterrestrial forces. Atmosphere influences to change sea level and to modify the wave climate of the sea. Wave climate or sea waves are the main agent of the shoreline erosion process. Nature of the tidal waves which causes for short term rejuvenation process of the shoreline erosion depends mainly on the extraterrestrial forces (Spencer, E.W.1983). In many cases, human activities concentrated in and around the coastal zone

influence to accelerate the geomorphic cycles of the shore. Accumulative effects of all these forces determine the intensity of the shoreline erosion cycle (Huggett, 2011). Long term, short term or sudden changes of the geomorphic forces of shore influence to change dynamism of the denudation process of the shore and formation of coastal landforms. In general, short term and sudden changes of the landform formation process of the shoreline create disastrous situations. Number of coastal nation including Sri Lanka are experiencing such malevolence effects at present.

Formation a recession (eroding) or an accretion (forming a depositional shore) shoreline is an outcome of a land mass denudation process of the shore. Shoreline accretion is a result of the shoreline erosion process. As mentioned earlier, the shoreline erosion process is a product of the interplay of the all kind of natural forces that can be seen in the atmosphere, hydrosphere, lithosphere and biosphere. All the forces of the geo-systems act to find their equilibrium within their own system and with other system. All these complex actions and reaction may be surfaced as visible actions or result. Yet, there are other activities such as chemical reaction may not be traced by the naked eyes. However, human activities can accelerate or modify all these natural process which lead to evolve relief features of the coast. It is clear that shoreline erosion factors act together or overlap each other (Hushain, 1989). When considering the views of King (1972) and Hushaian (1989), the factors that regulate the coastal erosion can again be divided into two main groups as short term and long-term factors. Brief accounts of these two category are as follows.

Fig. 02.



### **Regulating Factors of Shoreline Erosion: Short Term**

Changes of shoreline can be observed even by second by second, hourly to yearly as the waves of the near shore change relentlessly (Amarasinghe, 2002 and 2004). Changes of wave reaching pattern to shore, seasonal wind patterns and sediment budget of the shore are the main factors that cause to change shoreline erosion process within short period of time (Swan, 1983). Gravitational force of the moon (nature of tides) and morphological characteristics or geometry of the respective shore also effect to change the intensity of shoreline erosion process within the short period of time. Geometry of the shore profile can change providing room to reach powerful waves to hit the shore face when reduction the river sediment supply or removal sand from the beach in large scale. This effect to destroy the existing geometric equilibrium of the shore profile suddenly. Human activities such as removal of near shore vegetation cover and destruction the coral reefs also may further cause to alter the relief features of the coastline (Fig. 03). All these factors have named as “Influential factors” of shoreline erosion process (Swan, 1983).

Concept of shoreline erosion cycle concerns mainly on erosional and depositional process. These two processes cause to produce erosional and depositional landforms of the shore. And also, these landforms are the direct and visible results of this process. It is clear that the processes connecting with erosion and deposition have an undeviating relationship with weathering rocks and transportation the sediments of the coast. Therefore, all these four process: weathering, erosion, transportation and deposition have to be considered as the main parts of the land mass denudation process of the shore. As a whole, this process in generally used synonymously with coastal erosion, sea erosion and wave erosion. At the same time, “shoreline erosion” implies to describe erosional and depositional processes as well as to designate the recession and accretion process and their resulting landforms. This explanation shows that the denudation process of the shoreline is complex and relates with dynamic phenomenon associates with ecosystem that consist with hydrosphere, biosphere, lithosphere and atmosphere (Fig.04).

### **Regulating factors of Shoreline Erosion: Long Term**

As mentioned above, regulatory factors of shoreline erosion can be divided into three (Fig. 02) as follows;

1. Endogenic processes; eustatic change of sea floor, isostatic equilibrium
2. Exogenic processes; changes of the atmospheric dynamism due to changing atmospheric composition and energy balance.
3. Human activities influenced to change the geometry and geomorphic processes of the shoreline.

Fig. 03

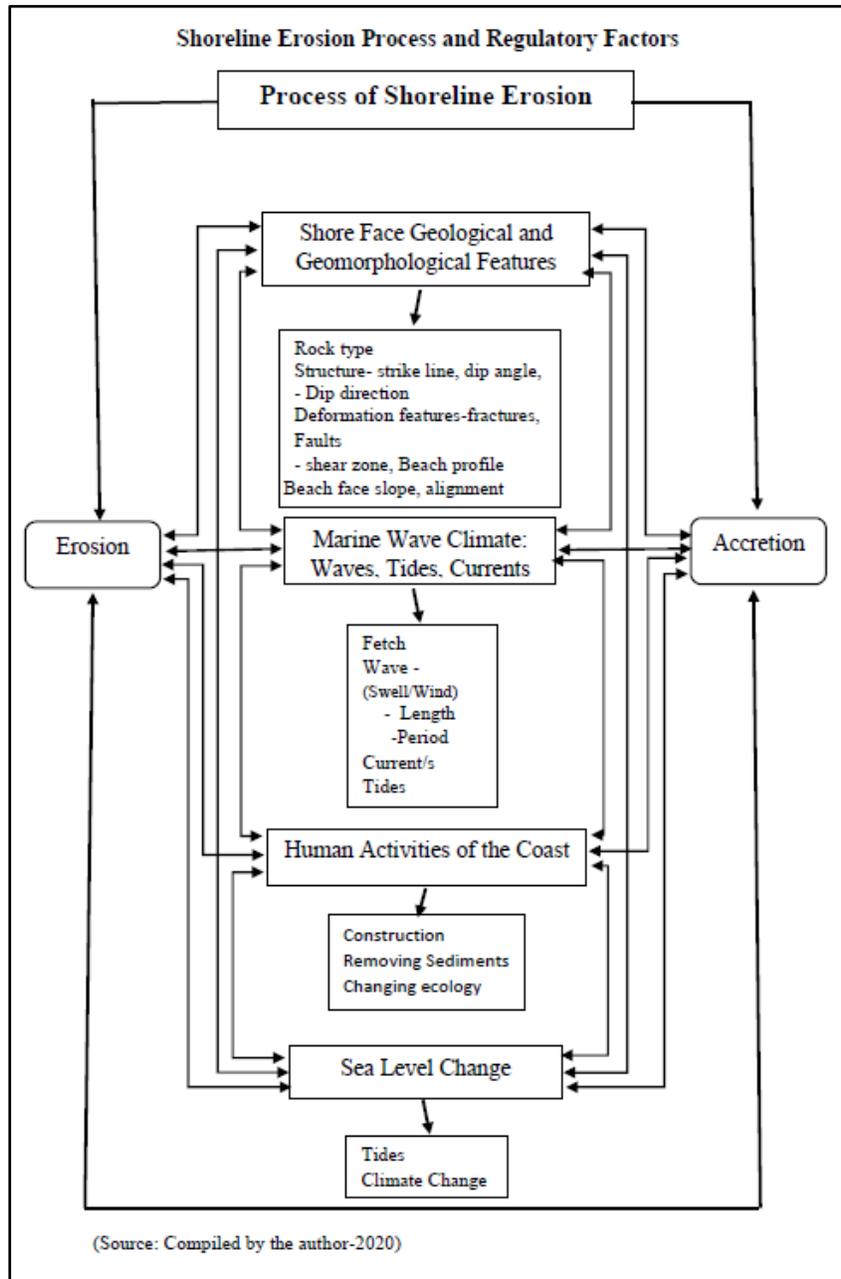
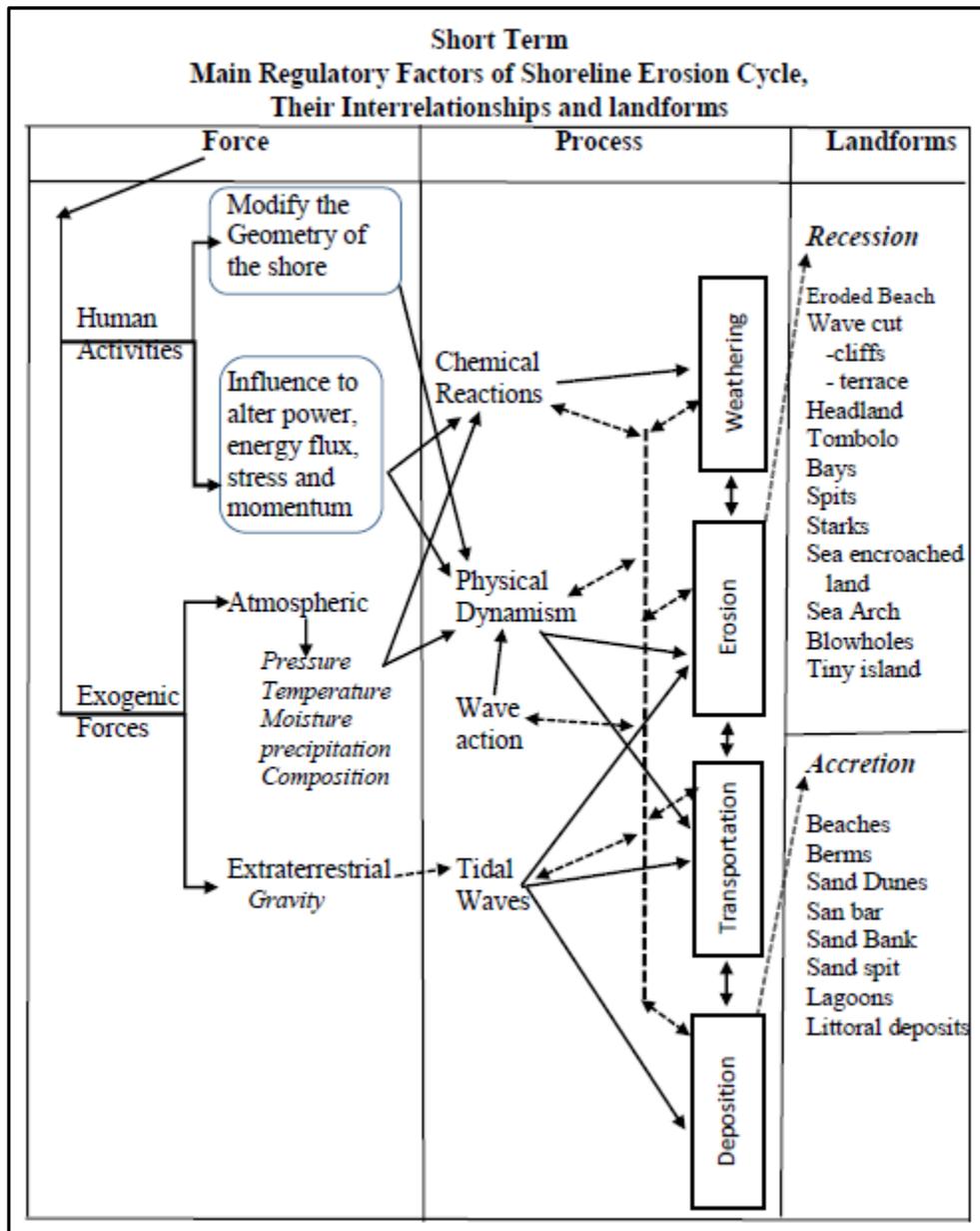


Fig. 04



Among these factors, significant change of the Mean Sea Level (MSL) and near shore geometric equilibrium can be categorized as the main two factors that regulate the shoreline erosion process in long run. Rise of the MSL has been recognized as the main impact and the causative factor that led to accelerate shoreline erosion in long term in Sri Lanka (Katupotha, 1992). However, exact evidences of endogenic process that influence to rise sea level is still to be recovered. And also the influence of the changes of the geological activities of the interior of the earth crust is a slow process when comparing with the intensity of current shoreline erosion rate in Sri Lanka. However, real-world situation that measures using instruments have proved that the sea level is rising due to the effects of “climate change” (IPCC,2014). Climate change will certainly be a key responsible factors that regulate the increasing shoreline erosion process in Asian region including Sri Lanka (CCD, 1986, IPCC, 2007, 2013).

According to the Inter-Governmental Panel of Climate Change (IPCC), coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas (*very high confidence*). By the 2080s, many millions more people than today are projected to experience floods every year due to sea level rise. The numbers affected will be largest in the densely populated and low-lying mega deltas of Asia and small islands are especially vulnerable (*very high confidence*) (IPCC, 2007 and ,2014)

Increases in sea level are consistent with global warming . Global average sea level rose at an average rate of 1.7 [1.5 to 1.9] mm per year between 1901 to 2010, 2.0 [1.7 to 2.3]mm per year between 1971 to 2010 and 3.2 [2.8 to 3.6]mm per year between 1993 to 2010 (IPCC: 2013:Climate Change 2013). It is clear that sea level is rising continuously. There are arguments over the exact figure of change. However, sea level rise and the affecting cause for sea level change are admitted by relevant scientists without any doubt at present (Pernetta, 1994). There are many other factors too that can cause to change shoreline in long time span lies ten to hundred years in Sri Lanka. Such factors can be listed as follows,

- a. Sea level rise
- b. Coastal subsidence due to tectonic events
- c. Climatic changes (changing of the storm intensities, shift of the dominant storm directions affecting the approach angle of waves; variation of precipitation and the river regimes and discharges)
- d. Increased vegetation cover over the river watersheds due to climatic changes (causing decreased soil erosion and sediment supplied to the coast);
- e. Sediment sinks (presence of offshore canyons, movement to great depths at steep slopes, wind transport of sand to inland areas)
- f. Changing of river courses and mouths in deltas

Anthropogenic causes of long term coastal erosion are more or less parallel to the natural causes. These are:

- a. Decreasing sediment supply by rivers to the coastal physiographic unit (cutting of the sediment transport by damming the rivers, sand and gravel mining along the river beds, decreasing the sediment transport efficiency by lowering water discharges due to increased fresh water use or due to river works such as bank and bed erosion control)
- b. Erosion control works and forestation in coastal and riverine watersheds.
- c. Decreasing the volume of sand in the physiographic unit (sand mining from the beach and dunes, offshore sand mining).
- d. Alteration of the usual pattern of coastal currents and the associated sediment transport along and across the shoreline, due to man-made coastal structures and urban development too close to the shoreline.
- e. Anthropogenic changes made to river courses and mouths in deltas.
- f. Maintenance dredging of approach channels and estuarine inlets.
- g. Land subsidence due to anthropogenic effects.

Construction dam such as protection wall, groins or revetments without understanding the shoreline process, sand mining, coastal structures and urban development close to the shoreline are cited as the factors that have triggered and accelerated coastal erosion (Olsen and Hale, 994, CCD, 1986, Clark, 1996). Other than these activities, construction of reservoirs to store river run off, extensive

soil erosion conservation methods of watershed and river banks, river sand and gravel mining along the river bed, illegal sand mining from the beach, and construction of coastal structures by property owners have been identified as the main reasons for increasing erosion rates in shorelines in many countries too. It has already identified that the reduction of sediment (sand) of the shoreline due to human activities as one the main factor that increase the shoreline erosion in particularly the South Western coastal zone in Sri Lanka ( CCD,1986; Maddumabandara, 1989, 1991 ; Amarasingeh, 2004).

## Results

Identified factors that increase the shoreline erosion of the study area were classified mainly into two as natural and anthropogenic factors.

Seven main anthropogenic factors that accelerate the coastal erosion of the West coast were identified as follows;

1. Increasing the volume of sand mining: river, beach and offshore
2. Reducing the sediment transport to the sea coast by constructing dams across the rivers
3. Decreasing the sediment transport efficiency by lowering runoff due to increased usage of inland water
4. Shoreline and inland erosion control works and forestation in coastal areas and watersheds.
5. Decreasing volume of sand in South shoreline which supplies sediments to SW shoreline.
6. Alteration of the usual pattern of coastal currents and the associated sediment transport pattern along and across the shoreline by the construction of groins, revetments, other structures and development works close to the shoreline.
7. Changes made to river courses and mouths in deltas by fishing activities to clear the approach channels and estuarine inlets

The natural factors that regulate the coastal erosion in the study area can be divided mainly into two as short and long terms as follows,

- Abrupt change of wave climate –Wind wave, Swell and Currents
- Non return of sediments from off shore
- Problem of coral bleaching
- Decreasing the extent of wetland and mangroves
- Reducing bio-diversity and bio-production of the coastal zone
- Lowering of rainfall in the river catchment areas and decreasing the run off of rivers in the SW region

## Conclusion

It is apparent that many factors that regulate the shoreline erosion process of West coast of Sri Lanka are stable. Fetch, geological features of the shore and endogenic forces around Sri Lankan coast are not change in resent past. Yet, the shoreline erosion is increasing rapidly. That means, except factors mentioned above are responsible to shoreline erosion process of the study area. However, reduction of sediment budget can cause to change shore face profile and geometry of beach. This would effect to increase the slope angle of the shore profile enabling high waves to hit shoreline. Such situation can erode beach and shoreline and increase the power of turbulence current enabling to disturb long shore drift. This would break the sediment supply to adjacent front coast of the long shore drift direction. West coastal sector is a comprised with wide beach. This beach had an equilibrium shoreline erosion

process up to 2015. Human activities of this coast are not help to trigger the shoreline erosion. Yet the shoreline is eroding significantly from recent past.

When considering the geomorphic process of shoreline erosion in West coast of Sri Lanka, two main factors can be identified as dominant factors that regulate the shoreline erosion as,

1. Constructing hard structures such as groins, revetments and water breakers to protect private and public properties from the process of shoreline erosion along the adjacent shoreline from where beach sediment provide to study area.
2. Reduction of sediment supply into the shore by constructing houses, commercial buildings and other structures along the shore and extensive river and beach sand mining

Other than these two factors, sea level rise that is associated with the process of Climate Change may accelerate the rate of the shoreline erosion in the West coast..

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# A Retrospective observational study on dietary factors influencing Urolithiasis

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**Abstract-** Urolithiasis is defined as the multi factorial disorder which involves the process of forming stones anywhere in the urinary tract (kidney, ureter, and bladder). Out of many factors diet plays a major role in forming urolithiasis. If left untreated it can lead to severe complications. Dietary and life style modifications can make a change.

**Methodology:** This study is a retrospective observational study and the data is collected from patients who are diagnosed with urolithiasis in a tertiary care hospital which includes 160 patients and their data is collected using food frequency questionnaire form which is validated by the senior urologist.

**Results:** Among the 160 patients, 103 patients were males and 57 females. The participants were belonged to the age group of 19 to 88 (p value <0.001). As per our study the major risk factors are high intake of oxalate rich food, high animal protein diet, less fluid intake and more salt intake will increase the risk of urolithiasis. It was found that less fluid intake and high salt intake will influence the risk of urolithiasis (p<0.0001). Moreover the patients with urolithiasis consume high oxalate rich food and more animal protein intake (68.25%).

**Conclusion:** The results show that there is a clear association between dietary factors and urolithiasis occurrence in males and females. From our study we conclude that less fluid intake, high oxalate foods, and high animal protein diet, high dietary salt will influence the formation of urolithiasis.

**Index Terms-** Kidney stones, Dietary risk factors, Urinary tract stones, Less fluid intake, Personalized diet plan.

## I. INTRODUCTION

Urolithiasis is defined as the process of forming stones in the kidney, bladder and urethra (urinary tract).<sup>[1]</sup> The overall probability of forming calculi differ in various parts of the world and is estimated as 1-5% in Asia, 5-9% in Europe, 13% in North America and the recurrence rate of renal stones about 75% in 20 years span. It occurs both in men and women but the risk is generally high in men and is becoming more common in young women.<sup>[2]</sup>

## II. TYPES OF CALCULI

Most commonly occurred renal calculi are: Calcium oxalate, uric acid, Struvite and cystine stones. Risk factors of

calcium oxalate stones include dehydration, hypercalciuria, hyperuricosuria.<sup>[3]</sup> Risk factors of uric acid stones include consumption of meat, chicken and sea food these increases uric acid production thus leads to uric acid stones.<sup>[4]</sup> Risk factors of Struvite stones are of from infections. The most common being *Proteus mirabilis* and less common pathogens include *Klebsiella pneumoniae*.<sup>[5]</sup> and cystine stones occurred due to a genetic disorder. which is an autosomal recessive disorder caused by a defect in the rBAT gene on chromosome 2 resulting in impaired renal tubular absorption of cysteine or leaking cysteine into urine.<sup>[6]</sup>

## III. CLINICAL PRESENTATIONS:

### Symptoms based on sites:

**Renal calculi:** Loin pain, vomiting.

**Ureteric calculi:** groin pain, fever, chills, and dysuria.

**Bladder calculi:** Supra-pubic pain, dysuria, haematuria and may also present with UTI Symptoms (nocturia, urgency, nausea).

## IV. RISK FACTORS:

Risk factors are of mainly hereditary, (Idiopathic hypercalciuria, hyperoxalosis, cystinuria: Dent's disease), disease related (Medullary sponge kidney, Poly cystic kidney disease, (10% develop stones,), renal tubular acidosis) dietary (high sodium diet, oxalate rich foods, animal protein, high protein weight loss diet), dehydration (low urine volume), stress, heat, water loss, sweating, and some drugs like furosemide, Indinavir, allopurinol etc.<sup>[7]</sup>

## V. AIM

The aim of the study was to assess the dietary factors influencing urolithiasis.

### 5.1 Objectives:

- To identify and evaluate the occurrence of urolithiasis in the out patients and In-patients in a tertiary care hospital. The data is collected from patients who were diagnosed with urolithiasis at tertiary care Hospital.
- To collect the data using food frequency questionnaire form which includes their dietary habits which results in occurrence of urolithiasis.
- To Counsel the patients regarding their life style modifications to prevent the recurrence of urolithiasis.

## 5.2 Study design:

The current study is a retrospective observational study performed by using food frequency questionnaire form for the assessment of dietary factors influencing urolithiasis.

## 5.3 Study site:

The study was carried out in tertiary care hospital of Guntur district, Andhra Pradesh, INDIA.

## 5.4 Study Period:

The retrospective observational study was conducted over a period of six months from October 2019 to March 2020.

## 5.5 Study Population & Sampling:

Sample of 160 subjects were taken in our study, knowledge of the cause of a disease is one of the most important factors in the control of the disease, 'Urolithiasis is occurred majorly due to lack of awareness on the dietary habits

## 5.6 Study Criteria :

Inclusion criteria:

1. Population who are in between 19 years to 89 years and are willing to participate.

2. Both male and female patients of both Outpatients and Inpatients are included.

Exclusion criteria:

1. The patients below 19yrs and above 89yrs.
2. The patients who were non respondent to the study.
3. The pregnant ladies, lactating women and post menopausal women.
4. The patients using calcium supplements and vitamin-d and vit-c supplements
5. The patients having metabolic disorders i.e hyperparathyroidism, gout, hypercalciuria.

## 5.7 Results & discussion:

A total of 160 patients were included in the study. Among them 103 are males and 57 are females. The age group which are more prone to urolithiasis are of from 49-58. The mean age was found to be 48.24. The data collected was significant with a p value <0.0001 at 0.05 level of significance and the standard deviation is 10.68. Figure 1 represents the distribution of male and females. Among the total population

Fig 1 Distribution of male and females

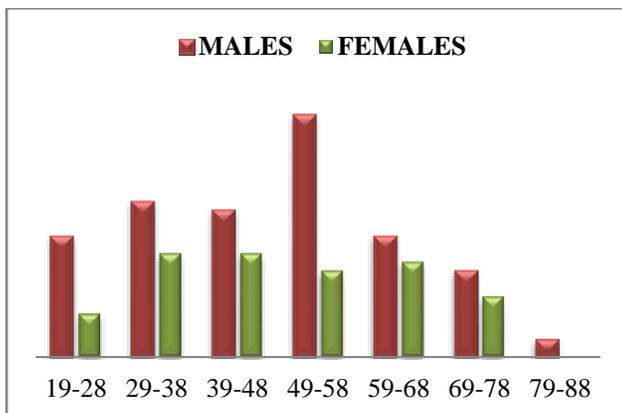
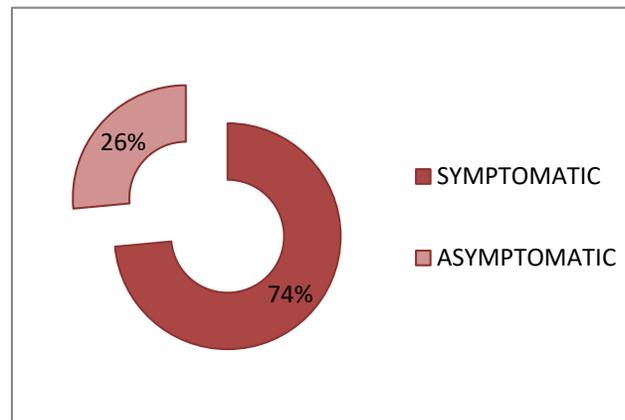


Fig 1 represents the distribution of males and females. Among the ages 19-88 males are of more diagnosed with urolithiasis compared to females. There is a significant relationship with p value <0.001 with a 0.05 level of significance and the standard deviation was found to be 10.69 and Fig 2

Fig 2 clinical presentations



represents clinical presentations. Symptomatic includes patients with loin pain, groin pain and flank pain haematuria, dysuria. In our study 76% are symptomatic, About 26% are asymptomatic, includes patients with no symptoms and unaware of calculi which is diagnosed in their ultra sound scan reports.

**Fig 3 Risk factors**

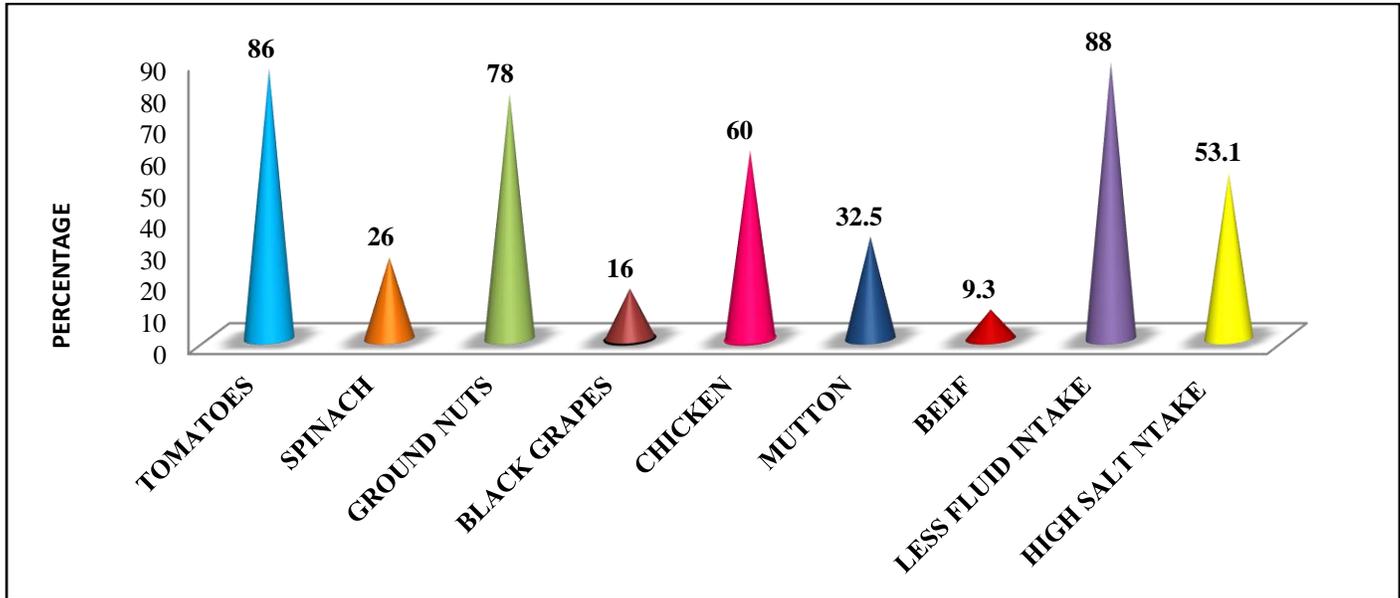
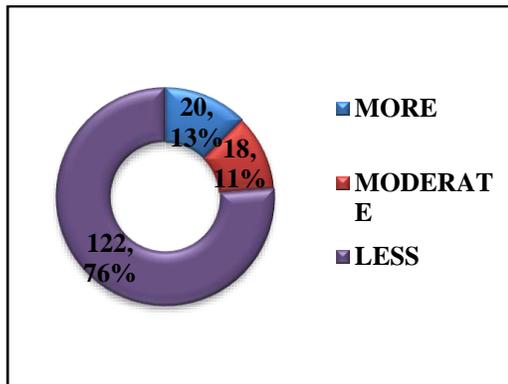


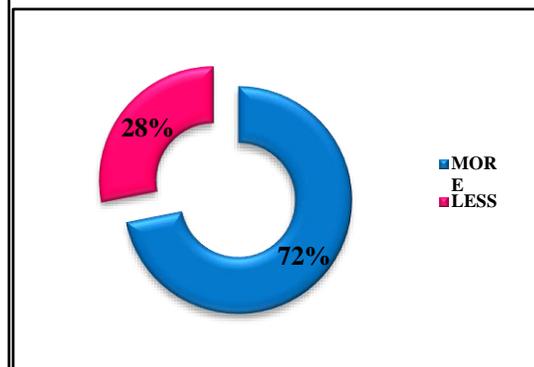
Fig 3 represents risk factors. In our study the major dietary risk factors of urolithiasis are high intake of oxalate rich foods, animal protein, less fluid intake, high dietary salt intake. The high

percentage of risk factors for each category in our study are less fluid intake:88%, tomatoes:86%, ground nuts:78%, chicken:60%, high salt intake: 53.1%, mutton: 32.5%, spinach: 26%, black grapes: 16%, beef: 9.3%.



**Fig 4 fluid intake**

Fig 4 represents the daily fluid intake About 76%(n=122) are taking less fluid intake (<2 litres) and 11%(n=18)are taking



**Fig 5 salt intake**

moderate fluid intake(2-3 litres) and 13%(n=20) are taking more fluid intake (4-5 litres).fig 5 represents salt intake 72% are of more and 28% are of less salt intake.

Demographic details	N=160
Age (mean)	48.24
Male (%)	103(64)
Females (%)	57(36)
Loin pain(%)	53.75
Groin pain(%)	13.75
Flank pain(%)	23.75
Asymptomatic(%)	26
Risk factors	
Protein rich foods (%)	68.25

**Table 1**

Table 1 represents the demographic details of patients and clinical symptoms and risk factors. Table 2 represents percentage risk of oxalate rich foods in our study. Of all tomatoes and ground nuts are of more percentage of risk.

## VI. DISCUSSION

In this study the major risk factors are high oxalate intake, high animal protein diet, less fluid intake, more salt intake. We analysed these foods in patients by asking their frequency of use in their daily routine. High oxalate intake is also known as hyperoxaluria. It is the condition triggered by using high intake of oxalate rich foods like tomatoes, spinach, potatoes, sweet potatoes, cashew nuts, black grapes, chocolates, beetroots, bran flakes. By taking these foods in more can cause production of more oxalates in the kidney; these free oxalates conjugate with the free calcium ions which are need to be re-absorbed in the kidney forming calcium-oxalate crystals. These calcium-oxalate crystals aggregate together and form calcium-oxalate stones. Which is the most commonest stones. Intake of calcium rich foods along with oxalate rich foods will be helpful in preventing the increase of size of calculi, as calcium and oxalate get metabolized and absorbed in the intestine. Next about high intake of animal protein which it leads to increased acid production (i.e methionine, cystine, urea, sulphuric acid) thus leads to increase in urinary  $P^H$  which leads to decreased calcium reabsorption further increase of calcium excretion leading to calculi..less fluid intake leads to lead to low urine output. When urine volume is low, the urine can theoretically be easily supersaturated with various solutes, such as calcium, oxalate, phosphorus, and uric acid. increased super saturation leads to crystallization thus forms the first step to stone formation. high intake of sodium leads to increase sodium load thus sodium reabsorption decreases followed by calcium reabsorption thus increases calcium excretion leading to stone formation.

## VII. STATISTICAL ANALYSIS

We used chi square test to analyse the significant relationship between protein and oxalate intake for protein and oxalate intake there is a significant relationship between protein intake and oxalate intake by p value ( $p < 0.0001$ ) and the chi square value is 7.395. Individuals with more protein intake are 41.04%

Oxalate rich foods	N=160 (%)
Tomatoes	85.62
Spinach	26.87
Potatoes	10
Beans	33.75
Ground nuts	78.75
Black grapes	16.87
Beetroots	11.87

**Table 2**

( $n=55$ ) and percentage of individuals with more oxalate intake are 58.96% ( $n=79$ ).and more salt and less fluid intake..For fluid and salt intake there is a significant relationship between salt intake and fluid intake by p value ( $p < 0.0001$ ) and the chi square value is 74.25 Individuals with less fluid intake are 73.05% ( $n=122$ ) and percentage of individuals with more salt intake are 75.16% ( $n=115$ ).

### Conflict of interest:

No conflict of interest

## VIII. CONCLUSION

Urolithiasis is a most common disease caused by multiple risk factors. Dietary risk factor is one of the noted problem in many urolithiasis patients We observed that treatment of calculi depends on stone size and anatomical position. From our study we conclude that less fluid intake, high oxalate foods, and high animal protein diet, high dietary salt will influence the formation of urolithiasis.

## IX. ACKNOWLEDGEMENT

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# Cyber Security Challenge in an Automobile

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**Abstract**—Automobiles such as smart cars have become tremendously complex, as they are allowing us to connect our phones to user interfaces of car and connect with external networks as well. Unfortunately, the interconnectivity of cars, embedded processors and systems developed in the vehicles have become targets of cybersecurity attacks making it the biggest challenge with respect to cooperative automotive industry. The real issue is caused when a spoofed message is injected in the internal network of the system compromising the security of the automobile. This paper will aim at providing a solution to secure the private information of each automobile by using cryptographic algorithm for authenticating the message. Upon successful failing of the cyber-attack a notification will be displayed to the User Interface (UI) of the automobile to keep the user aware of the situation.

**Keywords:** Automotive, Security Attacks, Advance Encryption Standard (AES)

## I. INTRODUCTION

Automobiles have evolved from transportation means to objects for a design consisting of individual, public and social spaces. With the rise of insightful transportation frameworks, the focal point of automobile design has moved from the structure of independent vehicles to the structure of consistent cross-vehicle transportation frameworks, typified by the integration of infrastructure, people, vehicles, urban areas and environment [14]. This combination of computer technology and automobile innovation has raised numerous issues about cyber-attacks in automobile playing a significant job in the development and utilization of automobile technologies.

Each activity in the vehicle can possibly be shared and reused which has stirred a continuous discussion about the amount of information sharing that must stay in the hands of an individual and what job automobile User Interfaces (UIs) play in this. A spoofed message containing virus or malware can be injected to the telematics unit of the automobile that communicate with the help of Controller Area Network (CAN), a vehicle bus that helps micro-controllers communicate with each other. This way the attacker can take control of the automobile as there is no message authentication system present on the CAN. It is significant, that our future vehicles and their supporting keen infrastructure, software and hardware foundations are designed to guarantee protection and security while fulfilling the need for extensibility, working normally under both normal and critical operating situations [1], [9].

An extensive literature review was done to identify the challenges of the automobile. The focal points of this exploration

are the cybersecurity dangers, which is the biggest challenge with respect to cooperative automated vehicles. Whenever the cyber-attack happens, it can possibly cause more harm than the cyber-attack occurred in the non-automated system in light of the fact that a driver will not be able to handle the malfunctioning attack if he/she is totally disconnected from driving. Cybersecurity aims to avert unapproved access to digital gadgets like PCs, cell phones, and laptops, wireless communication protocols and other wireless routers [1].

In order to minimize the knowledge gaps to maintain a high standard of future cyber-security in an autonomous vehicle [5] and to secure the private information of each automobile this paper will aim at providing two contributions. At first a symmetric, cryptographic algorithm will be implemented for authenticating the messages. Both the communicating devices will exchange a secret key before a secure communication is developed. The key size can be 128,192 or 256 bits and is encrypted in rounds is depending on key size. The main goal will be to make the spoofed messages and cyber-attacks detectable and waste them before they damage the security of the system. Secondly, upon successfully rejecting the cyber-attack a notification will be displayed on the UI of the automobile to keep the user aware of the situation. This added feature will give a sense of safety to the user.

The remaining structure of paper is organized as follows. Background is discussed in Section II, while related work is described in Section III of the paper. Section IV presents the proposed solution, and Section V evaluates the proposed solution. Section VI constitutes the Conclusion.

## II. BACKGROUND

The advancement of new technologies such as Artificial Intelligence, IoT and cloud technologies, new innovation in the autonomous vehicle industry is demanded. The main focus is to improve the security while driving, reducing the human error, speech recognition for Human-Machine Integration (HMI) and the reliability of vehicles containing On-Board Diagnostic (OBD) systems.

The interconnectivity of these devices leads to some potential vulnerabilities, threats and security risk to networks as well. These networks also include sensor networks, financial networks and traffic control features. A cyber-attack can start with controlled technology tools that are embedded in AVs such as electrical window controls, which are now controlled by Engine Control Units (ECUs) as embedded systems. Some cyber-attacks involve the use of malware like

computer viruses, worms, Trojan horses, spyware and adware; there are also denial-of-service attacks, phishing, and man-in-the-middle attacks [1]. Control Area Network (CAN) attacks happen when an attacker targets the control bag system, warning lights and electric window lifts. As embedded systems are software-oriented so the security should be taken as compulsory. System should know which threat is safety failure and security attack after identifying so the system should react accordingly [7].

Computational strategies cause a potential of vulnerabilities and threats when used in the different connected autonomous vehicles. A revolutionary change in technologies requires many computing resources in order to achieve a successful mechanism for automobile systems [8].

Fig 1. shows an attack on even a single Electronic Control Unit (ECU) can corrupt the whole system since ECUs are connected with external interfaces and communicate through Controller Area Network (CAN).

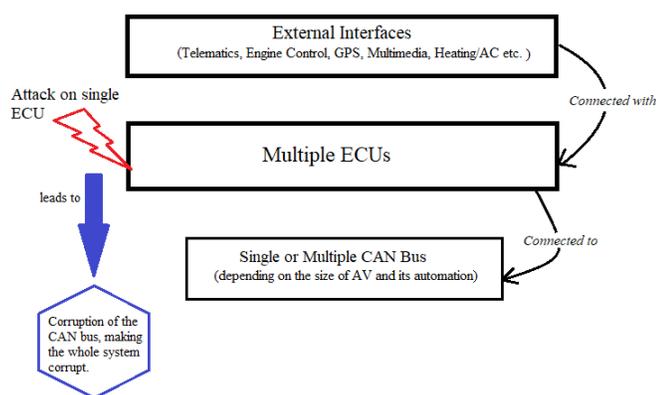


Fig. 1: AV system framework.

Securing the product quality first has always remained important in software development activities, whereas focusing on the cyberattack on information and running vehicles is less important in the traditional industry. Many companies are now following ISO 26262 and Automotive SPICE for the safe operations of vehicles and controlling processes as well.

### III. LITERATURE REVIEW

Communication is not merely limited to communication between cars (vehicle-to-vehicle (V2V)), nor to communication between cars and the infrastructure (vehicle-to-infrastructure (V2I)) in fact autonomous vehicles now communicate with each other and share information about the environment. The environment information is collected entirely from on-board sensors without any active communication with other vehicles or the infrastructure. Fig 2 shows possible communication security issues within a vehicle, vehicle to vehicle (V2V) and intelligent vehicle communication with infrastructures. The possibility of a cyber-attack increase with the increase in the degree of automation of a vehicle [12], [14].



Fig. 2: Security issues in communication

A fully autonomous system needs to ensure to bring the vehicle to a safe state whenever some critical hazard happens. The fusion system can help in order to identify the expected attacks but when there are only two sources of information with respect to vehicle state and one they are compromised due to cyber attack, then in this situation, the system will not be able to identify which one is valid.

Another challenge that was identified was spoofing of GPS systems used in vehicles where an attacker impersonates signals and provide the false locations. EMP attacks, medium threats and attack on the navigation system were also found. In [6] researchers with respect to autonomous interface challenges address some essential questions focusing on how the autonomous system will be able to know our daily routine schedule and act on it without even asking from us? A critical challenge arises with data sharing between connected cars. Though car to car connectivity helps in developing applications related to safety such as collision avoidance, it also provides loopholes for unauthorized access to personal data and activities occurred during driving.

In [11] a researcher found various potential vulnerabilities in Tire Pressure Monitoring System and Garcia found a vulnerability in a key-less entry system that allows cloning the remote control for unauthorized access of vehicle.

[2] explains that by attacking the sensors of the autonomous vehicle the attacker can create platform suicides and DOS attacks can be performed easily then. In [4] researchers have focused on Denial of Service DOS attack on networks. Some of the attacks found included Sybil attack in which multiple messages are sent through one node to another in order to leave the road, node impersonation and sending false information. To mitigate the attacks, a model is proposed by the researchers in [4] containing On-Board Unit (OBU) connected on vehicle nodes in order to make effective decisions when some cyber-attack occurs.

Groza and Murvay [3] explain a variety of techniques to secure the CAN bus from the cyber- attacks such as key sharing, cryptographic passwords and CAN authentication.

In [13], Researches have proposed a framework called Ve-

cure Fig.3, to protect the Control Area Network from spoofed messages injection attack and they evaluated it by using free scales automobile development board, in their research Denial of Service attack, where a large number of bogus messages are sent to the CAN were not considered since their primary goal was to inject a spoofed messages.

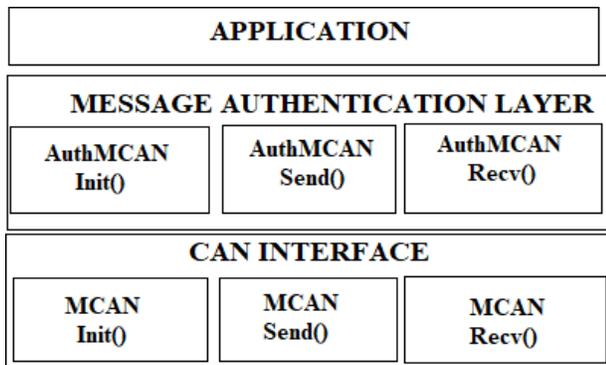


Fig. 3: Vecure Architecture [14]

Some researchers in [10], [8] proposed biometrics to secure the communication between AVs like Face Recognition and Iris Detection mechanisms but these techniques have several limitations.

A comparison Table I has been shown below stating the knowledge gaps found during the literature review of the already proposed solutions. The solutions are checked against a few defined parameters.

TABLE I: Comparison Table

Parameters	Fingerprinting Physical Signals	VeCure
Authentication System in CAN bus	Use of biometrics. No authentication on CAN.	Message authentication mechanism on CAN protocol.
Time management	Undefined	Online message processing overhead is only 50us.
Key sharing techniques	No keys required.	A secret symmetric key generated to authenticate each received message.
Notification to User	None	None

#### IV. PROPOSED SOLUTION

Automotive vehicles are vulnerable. Our data, location and confidential information can be access by any hackers who hacked our system. So our problem is to secure our data from cyber security attacks. To secure data from such attacks cryptography methods such as one time pad, diffie hellman

key exchange and blowfish etc. We are going to use Advance encryption standard (AES) algorithm for our problem statement. AES algorithm is a symmetric encryption algorithm. In cryptography, AES is a computer security standard defined by National Institute of Standards and Technology (NIST). In 1997, a competition was held by National Institute of Standard and Technology in order to choose the AES so that it should supersede the Data Encryption Standard (DES). Symmetric keys of different sizes are utilized with block of 128 bits of input data. The size of key can be 128,192 or 256 bits and number of rounds is dependent on key size. It uses 10,12,14 rounds with its number of size. The implementation of key pairing mechanisms and the rounds in ECU and CAN will keep the data and information confidential and protect the system from hackers. An abstract, systematic structure of the implementation using AES is depicted in Fig 4.

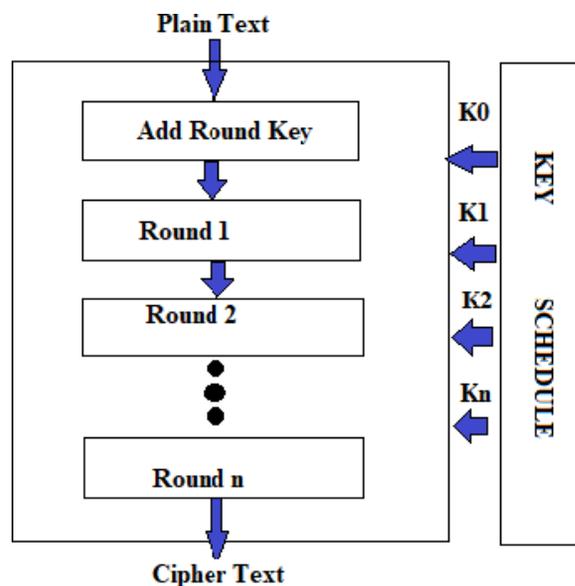


Fig. 4: AES Structure

The detailed description of this structure requires both the communicating devices to exchange a secret key before a secure communication is developed . A key encapsulation mechanism or a random number is generated by the receiver and sender devices or micro-controllers. Message authentication mechanism will check the received message for its key and compare it. If the keys are matched successfully, the message will be forwarded and displayed to the driver on the UI of the vehicle.

If an unauthorized devices or vehicle has sent a spammed message, the key will not match at the receiver's end. The CAN protocol will reject the message eventually. In such a case, a cautious notification will be displayed on the vehicle's UI to the driver, keeping him aware of the situation. This visualization of the circumstances has not yet been proposed in the earlier solutions.

Fig 5 shows the detailed structure of the solution.

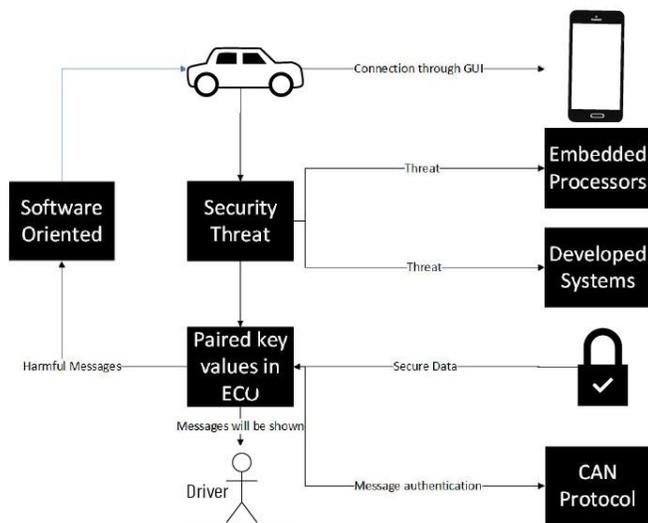


Fig. 5: Detailed Structure

In contrast to Asymmetric Algorithm, which are considered to be too slow for the time critical automobile CPS application, Advanced Encryption Algorithm being symmetric not only gives a highest performance in smaller data but also in large data as well.

### V. EVALUATION AND PROTOTYPE

In this section, we have evaluated our proposed technique. We tried to bridge the knowledge gap found in the earlier solutions as no visualization way was found previously which could give a sense of safety to the user. For this purpose, we have used Justinmind prototype tool to show how the notification of message will be displayed on the UI of automobile. Once the hacker tries to inject any hacked message, the message authentication mechanism on the CAN protocol will reject the keys and a caution message “You have been saved from Cyber Attack” will be popped on the UI as depicted in Fig 6. This message will aware the driver about the adversary and help him remain precautions.



Fig. 6: Caution message on UI of vehicle

Fig 7 shows a message on automobile’s UI to change the lane because of the traffic.



Fig. 7: Secured message on UI

For testing the algorithm, MATLAB has been used for simulating the result. To compare our proposed solution, a substitution cipher algorithm was taken to show the encrypted message sent to the automobile. In Fig 8, substitution cipher algorithms have encrypted our message “Please change the lane, traffic ahead” into encrypted message.

```

Command Window

phrase =

Please change the lane, traffic ahead

encrypted =

Ot6s 64, _s2B64E_64ts26U4E9s||u,4s_6sb
    
```

Fig. 8: Substitution cipher on Message

We simulate the result on MATLAB where a cipher text was created for all printed character. We have used pt for plain text or message and ct for cipher text. An index is assigned to every character of our message and then it is further encrypted.

```

ind(i)=strmatch(phrase(i) , pt, 'exact')
encrypted = char (ct (ind) )
    
```

In substitution cipher, a brute force attack can easily happen. An attacker can guess the message by sending different pass phrases. They can inject different spoofed messages in order to threaten the driver.

Fig 9 shows the code of our substitution cipher.

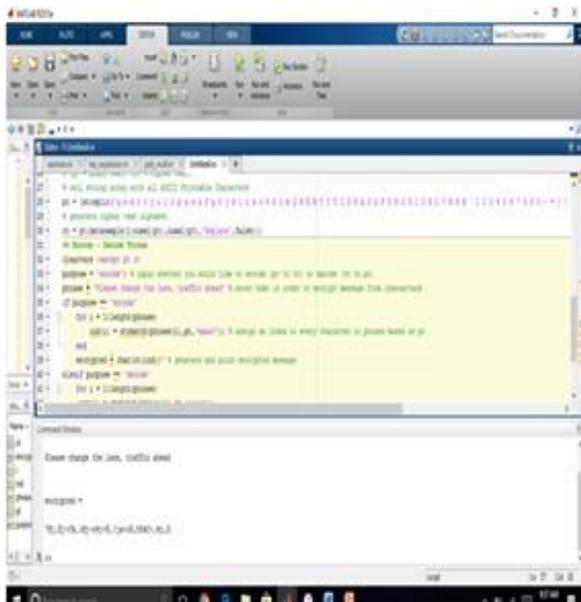


Fig. 9: Simulation of result on MATLAB

We used NetBeans to simulate the block cipher algorithm called AES-128. A message “Please change the lane, traffic ahead” will be encrypted by different round keys and XOR. AES-128 will create a threat free network by not only securing our information but also making it difficult for the attacker to decrypt the message. Fig 10 shows our encrypted message on net beans.

```
run:
Please change the lane, traffic ahead
VXPe+8wdpW8HC/+Emrc/moZAFEm+rrzenO8KpPPB6QbVdziEx/WvdN8OI/CVLd2b
BUILD SUCCESSFUL (total time: 14 seconds)
```

Fig. 10: Encrypted message

```
Source History
22 AESenc cipher = new AESenc();
23 System.out.println(AESenc.encrypt(data));
24
25
26
27 private static final String ALGO = "AES";
28 private static final byte[] keyValue =
29 new byte[]{'T', 'h', 'e', 's', 'e', 'a', 'r', 't', 'i', 'c', 'l', 'e', 's', 'a', 'r', 'e', 'w', 'r', 'i', 't', 't', 'e', 'n', 'i', 'n', 'a', 'n', 'e', 'n', 'c', 'r', 'y', 'p', 't', 'i', 'o', 'n'};
30
31 /**
32 * Encrypt a string with AES algorithm.
33 *
34 * @param data is a string
35 * @return the encrypted string
36 * @throws java.lang.Exception
37 */
38 public static String encrypt(String data) throws Exception {
39     Key key = generateKey();
40     Cipher c = Cipher.getInstance(ALGO);
41     c.init(Cipher.ENCRYPT_MODE, key);
42     byte[] encVal = c.doFinal(data.getBytes());
43     return Base64.getEncoder().encodeToString(encVal);
44 }
45 /**
```

Fig. 11: Encrypted message

A base64 in our code will implement the encoding for both upper and lowercase letter. A secret key class represents the

key providing independently. It is constructed through an array byte. Comparative to substitution method, our proposed algorithm stands out as a more secure one. During our implementation, the only drawback that we found was some delay in performance time of our proposed cryptographic algorithm. But a few seconds of delay can be compromised by the security of the network.

VI. CONCLUSION

In this paper we proposed the use of AES algorithm to secure the data theft and cyber attacks in the vehicles. The main idea of this solution is to implement a mechanism of message authentication using paired key values in the ECU which communicates with CAN protocol. Any harmful, hacked messages injected to an ECU or OBD-II port will be notified visually to the driver on the interface of the vehicle. This solution will help the driver recognize the attack and also take precautionary measures.

For future work, this solution can be used by the researchers for implementing this proposed model and test it according to the standards.

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# Youth Unemployment, Empowerment And Self Reliance In Nigeria: A Panacea For Self Employment

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**Abstract:** *There is high level of youth unemployment in Nigeria with many negative consequences or its attendant challenges such as security challenges or insecurity problem like kidnapping, armed robbery, violence, conflicts, armed banditry, insurgency, militancy and other socio-economic challenges like prostitution, drugs among many others. These myriad challenges have long retarded or inhibited the development of the Nigerian economy. As such, this paper examines the need for youth empowerment and self-reliance in order to propel self-employment among the youths in Nigeria. Findings from the paper reveal that there is high level or rate of youth unemployment in Nigeria couple with the limited number of job opportunities provided by the government so the only way out of such situation for the youth is empowerment and self-reliance so as to be self-employed. Conclusions were drawn and recommendations made. The paper therefore recommends among others that (i) Entrepreneurship should be taught as an activity (practical) and not just as an academic field or Entrepreneurship studies should be largely practical based to enable students acquire adequate skills and knowledge needed for self-employment, (ii) Appropriate conducive environment such as quality infrastructural facilities and start-up capacity should be provided to the youth by the government. In other words, Government should provide basic infrastructures such as regular power, good roads, communication etc for entrepreneurship to boost the Nigerian economy. The paper adopts qualitative method of data analysis, drawing from secondary sources.*

**Key Words:** *Youth, Youth Unemployment, Self-Reliance, Youth Empowerment, Entrepreneurship*

## INTRODUCTION

Unemployment is becoming a vicious disease in Nigeria. It has been estimated that over million Nigerians are jobless and this justify that Youth unemployment has been a decimal issue in Nigeria and has provoked a lot of researches. The rate of youth unemployment in the Nigeria recently has grown in geometrical progression. Indeed, problem of poverty and unemployment has for a long time been a cause of concern to the government. Youths in Nigeria suffer high unemployment due to lack of opportunities, physical and psychological challenges resulting from poverty. Some youths respond to these challenges by engaging in criminal or violent behaviour while others suffer from despair or depression.

Unemployment creates a wide range of social ills and young people are particularly susceptible to its damaging effects. Nigeria, like many other developing countries of the world is faced with a myriad of challenges such as unemployment and poverty with their attendant consequences such as low income, youth restiveness, social insecurity, kidnapping, frustration, idleness and drug addiction etc. In Nigeria, year by year, the number of unemployed graduates keep increasing as more graduates produced by the various higher institutions are made to join the long queue of other unemployed who have earlier graduated from school. Unemployment produces an unsettled labour force, and in urban areas, it may lead to overcrowding and all forms of crimes such as drug addiction, kidnapping, youth restiveness, armed robbery among many other crimes.

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Successive governments in Nigeria have at one time or the other created many intervention schemes to stem out poverty, unemployment and empower the youths and women in the country. In other words, to address the problems or challenges of youth unemployment and making the youth self-employed and self-reliant, the Nigerian government both at the federal and state levels have in the past and the present initiated and implemented several youth empowerment programmes tailored towards addressing the youth unemployment situation in Nigeria. In other words, the Federal Government of Nigeria in an effort to fight unemployment and create jobs for its teeming youths has at various times designed policies, programmes and established agencies such as: Family Economic Advancement Programme (FEAP), Nigerian Agricultural Bank (NAB) incorporated in 1973, renamed in 1987 to Nigerian Agricultural and Cooperative Bank (NACB and merged in 2000 the People's Bank of Nigeria (PBN) and took over the risk assets of Family Economic Advancement Programme (FEAP) to become Nigerian Agricultural Cooperative and Rural Development Bank Limited, (NACRDB) and was shortened to Bank of Agriculture (BOA). Agricultural programmes such as Youth Employment in Agriculture Programme (YEAP) aimed at reducing poverty and vulnerability, Directorate of Food, Road and Rural Infrastructure (DFRRI), Poverty Alleviation Programme (PAP), National Poverty Eradication Programme (NAPEP), National Directorate of Employment (NDE), Subsidy Reinvestment and Empowerment Programme (SURE-P), Economic Empowerment and Development strategy (NEEDS), N-Power, Youth Enterprise with Innovation in Nigeria (YouWin), Youth Empowerment and Development Initiative (YEDI), Niger-Delta Development Commission's (NDDC), North East Development Commission (NEDC), National Accelerated Food Production Programme (NAFPP), National Social Investment Programme (NSIP), University Entrepreneurship Development Programme (UNEDEP) to promote self-employment among the youth, right from higher institutions of learning among others.

The federal government of Nigeria in 2004 launched another poverty alleviation scheme at all three tiers of government packaged as National Economic Empowerment Development Strategy (NEEDS), the State Economic Empowerment Development Strategy (SEEDS) and Local Economic Empowerment Development Strategy (LEEDS), holistically, operated at all three levels respectively with the aim of eradicating poverty in Nigeria. Despite all the above attempts to alleviate poverty, it is still a mirage, and as a result, the international community felt it needs to act fast and the United Nations (UN) in 2005 launched the Millennium Development Goals (MDGs) as part of effort to accelerate the attainment of MDG's ahead of the 2015 targeted date . However, the programme could not achieve most of the set goals as most African countries could not meet the said target. Given the above challenges, the Sustainable Development Goals (SDGs) came into being aimed at ending poverty, protect the planet and ensure prosperity for all. Each goal has specific target to be achieved over the next 15 years.

These programmes are aimed at empowering the people particularly the youths and addressing various manifestations of unemployment and poverty. Meanwhile, under the present economic hardship that is currently being experienced in Nigeria, there are fears that the present programme (SDGs) might also go in the way of its predecessor that is, MDGs.

Besides, as the global economy slows down with signs that it is heading towards recession, there are chances that many more nations will face socio-economic crises that would require urgent attention. This means that without rapid economic growth to sustain the nascent democratic gains, youth empowerment, poverty and unemployment situations will be grimmer as more youths will become less empowered, unemployed with varying consequences for national security. Hence, under the condition of high level of unemployment, there is urgent need to orientate the youths by inculcating in them self-empowerment, self-reliance and entrepreneurship. Human resources development and management could be an effective tool for youth empowerment, poverty reduction and self-reliance.

Despite the initiation of this several programmes to address youth unemployment and create employment opportunities and reduce poverty for the youths by the government, they have not maximally achieved desired results (some relevant results have been achieved). However, poor funding as well as the irresponsible and corrupt implementation of these programmes have prevented government from achieving the noble objectives for which the programmes were instituted. Also, poor budgetary allocations, management and governance problems have afflicted most of the programmes, resulting in facilities not being completed, broken down, abandoned or ill-equipped. Again, lack of accountability and transparency made the programmes serve as conduit pipes for draining national resources. Their failure is also due to poor implementation, corruption of government officials and public servants, poor targeting mechanism and failure to focus directly on the poor.

Also, the scenario painted above arises because majority of these youths lack entrepreneurial skills to be self-employed.

### **CONCEPTUAL CLARIFICATION OR DEFINITIONS OF KEY CONCEPTS**

After a careful study of various literatures on the subject matter, the study generally derived some of the various definitions of the key concepts as follows:

**Youth:** United Nation General Assembly defined youth as between the ages of 15-24. From the Nigerian context, the youths are segment of the population in a society within the age bracket of 18 – 35 years. Usually, they tend to be active, vibrant, daring with lots of useful energy if put to positive use. The youths have contributed immensely to the development of the country from pre-colonial, independent and post independent or post-colonial era. Notwithstanding their positive contribution to the country, they constitute the critical and volatile segment of the society. The UNDP further emphasized on young women and men ages 15-24 and extend the inclusion of young men and women within the age bracket of 25-30 and even beyond age 35 based on contextual realities, regional and national youth policy directives.

**Unemployment:** Unemployment is situation in which people who are willing to work at the prevailing wage rate are unable to find jobs. It can also mean a state of worklessness experienced by persons who are members of the labour force, who perceived themselves and are perceived by others as capable of working. Unemployment from the perspective of the British Department of Employment, affirms that unemployed is a school-leaver who is not in paid employment but who is available for working. In the view of the United Nations, unemployment consists of all persons who during the reference period, were not working but who were seeking work for pay or profit, including those who never worked before. It also indicates numbers of the economically active population who are without work but available for and seeking work, including people who have lost their jobs and those who have voluntarily left work. It can also be seen as a situation where people who are willing and capable of working are unable to find suitable paid employment. It is one of the macro-economic problems which every responsible government is expected to monitor and regulate. The higher the unemployment rate in an economy the higher would be the poverty level and associated welfare challenges.

**Self-Reliance:** Generally, it is the ability to think and act without the help or influence of others, the ability to decide what you should be or do. Self-reliance encourages the need for people to improve their living conditions using home initiatives and resources at their disposal. It is also seen as development that relies on “internal” resources as opposed to development that relies heavily on “external” resources. Self-reliance is synonymous with self-sufficiency. It means doing things for ourselves rather than having things done for us. Self-reliance is the personal initiative in the ability and effort to identify, harness and manage effectively and efficiently the personal and collective resources, human or natural in the immediate surroundings in order to uplift one’s or a people’s quality of life, standard of living and condition of existence. It also refers to the sole dependence of individual capabilities to improve life and the

ability of an individual to rely on him/herself in order to accomplish a specific task and progress in it. The idea of self-reliance lays heavily on youth empowerment by training of mind and body of the youth for proper integration in to the society and for positive development.

**Youth Empowerment:** The process of continuous improvement of the youth development, structures, institutions and programmes in order to create a social condition, ensure the rights of the youth are advanced and protected, their welfare enhanced, and their effective functioning and self-actualization ensured. Youth development is a sine-quo-non for youth empowerment.

**Entrepreneurship:** Can be seen as the ability to identify and evaluate business opportunities, gather the necessary resources, initiate appropriate actions to ensure success and implement actions to take advantage of the opportunities for rewarding outcomes. Entrepreneurship in a country is an engine for job creation and innovation. It can also be view as the ability to perceive and undertake business opportunities, taking advantage of scares resources utilization. Entrepreneurship is also the process of creating something new with value by devoting the necessary time and effect assuming the accompanying finance psychic and social risk and reserving the resulting rewards of monetary and personal satisfaction and independence. Entrepreneurship education is a form of education that seeks to provide knowledge, skills, attitude and motivation to students for entrepreneurial success in any setting. It equips people with the ability to seek investment opportunities.

## CAUSES OF YOUTH UNEMPLOYMENT IN NIGERIA

Some of the main causes of youth unemployment in Nigeria are as follows:

**1. Rural Urban Migration:** Rural-urban migration is usually explained in terms of push-pull factors. The push factors include the pressure resulting from man-land ratio in the rural areas and the existence of serious underemployment arising from the seasonal cycle of climate. Lack of infrastructural facilities, which makes the rural life unattractive. Youths move to urban areas with the probability of securing lucrative employment in the industries. In addition to this, there is the concentration of social amenities in the urban centers. This meant that the rural areas are neglected in the allocation of social and economic opportunities.

**2. Rapid Population Growth.** Nigeria is the most populous nation in Africa. The high population growth rate has resulted in the rapid growth of the labour force, which is far outstripping the supply of jobs. The fast growth of population on Nigeria's unemployment problem is multifaceted. It affects the supply side through a high and rapid increase in the labour force relative to the absorptive capacity of the economy.

**3. The Outdated School Curricula and Lack of Employable Skills.** Some scholars and commentators have argued that as far as the formal sector is concerned, the average Nigeria graduate is not employable and, therefore, does not possess the skills needed by the employers of labour for a formal employment. After all, employers do not need people to pay or spend their money on but people that will help their organization grow and make more profit as the primary goal of every enterprise is to make profit. Mostly, this is attributed to the education system in Nigeria, with its liberal bias. The course contents of most tertiary education in Nigeria lack entrepreneurial contents that would have enabled graduates to become job creators rather than job seekers.

**4. The Rapid Expansion of the Educational System** which directly leads to increase in the supply of educated manpower above the corresponding demand for them. With the creation of six new universities in the countries by the President Goodluck Administration more youths graduate without jobs. This contributes to the problem of the youth unemployment in Nigeria. Presently, with many universities in Nigeria (both federal, state, and private) and the increasing demand for higher education there has been the problem of

suitable employment for the varieties of graduates who are turned out by these higher institutions every year. Ordinarily, this should not have been a problem, but the reality is that the Nigerian economy is too weak to absorb this large number of graduates.

**5. Lack of Vibrant Manufacturing Sector:** Also, there is no vibrant manufacturing sector which has the capacity to absorb unemployed youths in Nigeria. However, Nigeria is a country with numerous business and investment potentials due to the abundant, vibrant and dynamic human and natural resources it possesses. Even though the country has such potentials, it continues to experience its share of social, economic and political upheavals which have often stunted and retarded its growth and development into the regional economic power that it strives to attain. There is high rate of violent crimes in Nigeria. The fact is that Nigeria is becoming hostile to investment due especially to lack of steady and sustainable power supply energy crisis in spite of the various attempts are reviving this sector lading to firms depending on generators for their operation whose cost of buying, fueling and maintenance are high, thereby increasing the cost of operation in Nigeria. Also, high and multiple levies and taxations being paid by these companies, energy crises have combined to make the cost of doing business in Nigeria to be very high. When the industries and factories closed shops or relocated to a friendlier economic environment, workers were laid off and prospects of recruiting new ones were dashed. All these exacerbated the crisis of youth unemployment in the labor market.

**6. Corruption:** Corruption has permeated the entire social structure of the country and has robbed the country of developing a vibrant economic base. Funds meant for development projects have been misappropriated, diverted, or embezzled and stashed away in foreign banks, while some incompetent and corrupt bureaucrats and administrators in the public enterprises and parastatals have liquidated these organizations. The collaboration of the political elites, local and foreign contractors in the inflation of contract fees have robbed the country of the chances of using billions of dollars estimated revenue from the oil sale to develop a vibrant economy that would have created jobs for the youths in various sectors of the economy. The ruling (political) class failed because they replaced the vision, policy, and strategy, which should be the thrust of every leadership with transactions (contract award and other mundane money related activities), as each successive government took turns to prey on the nation's wealth, by using public power, resources, good will, utilities, instrument of abuse, and personal gains. Thus, crippling the economy and engendering and exacerbating unemployment which creates abject poverty, hunger and frustration; killing the zeal and means for entrepreneurship development in the Nigerian youths.

**7. Lack of Steady and Sustainable Power Supply:** Lack of Steady and Sustainable Power Supply or epileptic or intermittent power supply normally affects the productivity of infant or local industries there by reducing the rate of income in the country and forcing some of them out of business.

## COMPONENTS OF YOUTH DEVELOPMENT AND EMPOWERMENT

**(1) Youth Employment:** Employment opportunities should be provided by the ruling elites to gainfully employ and empower the youths who incidentally are the future leaders. Where there is insufficient paid employment, the ruling petit-bourgeoisies should create enabling environment to sustain entrepreneurship and operation of small-scale ventures.

**(2) Youth Education and Training:** Education is power, it is one of the major indicators of measuring development. Therefore, youth training programs including vocational training through talent/skill assessment inventory.

**(3) Entrepreneurship skill acquisition** should be inculcated in the educational curriculum to cut across all specter of educational system in order to position the youths in act of management, analysis and effective operation of business.

(4) Research, evaluation and publication of such researches, especially those that relate to skill acquisition would foster youth development.

(5) Liaising with state youth departments and international organizations

(6) National youth award scheme.

(7) International youth exchange programme.

(8) Youth holiday programme.

(9) National youth camps.

(10) Coordinating activities of national voluntary youth organizations.

(11) Youth mobilization – Political and social mobilization agencies should be set up and their services should be complemented by non-governmental organizations. They will handle youth mobilization, business and political education. Funds should be made available for effective running of such outfits.

(12) Establishment of coordinating bodies to monitor and evaluate government programmes and policies as they relate to the youth.

#### **NEED OR REASON FOR ENTREPRENEURSHIP DEVELOPMENT IN NIGERIA**

Economic and social realities of today have made it imperative for orientation and re-orientation of people towards entrepreneurship and private sector-based economy. The increasing focus on entrepreneurship development in the country has become obvious for a number of reasons:

(1). **Government Economic Reforms:** The Nigerian economic environment has been witnessing extensive fundamental reforms such as austerity measure, privatization, commercialization, structural adjustment programme, the new industrial policy in Nigeria and deregulation measures. A major feature of these reforms is the steady but gradual withdrawal of government from direct involvement in production and distribution of goods and services.

(2). The Failure of past industrial policies, which were anchored on large capital-intensive projects, to generate self-sustained growth, create employment, resulting in change in large scale industrial promotion strategy and import substitution strategy.

(3). The increasing population of school leavers and graduate of various higher institutions in the country who roam the streets searching for white collar jobs which are very scarce. The high rate of graduate unemployment in the country is gradually leading to underemployment for some people and various forms of exploitation for others.

(4) The influence of globalization and advancement in information technology on jobs and employment could be said to be the most extensive and pervasive globally. Advancement in technology has rendered many organizational systems obsolete, caused the need for restructuring and re-organization with consequential loss of old jobs. In a similar vein, such changes have opened up avalanche of opportunities in all areas where technology can apply.

(5) Industrial downsizing as a result of recently experienced national and global economic recession, resulting in loss of jobs and low rate of new job creation.

(6). The federal government has also realized the significant importance of small and medium scale businesses in its current Poverty Eradication Programme. This could be seen from the entrepreneurship development aspect of small and medium enterprises (SMEs) that bear direct relevance to the empowerment of the population for sustainable development.

(7). The success stories of such countries like the United States of America (USA), India, Indonesia and Malaysia etc, where small business development has accelerated their economic and industrial transformation.

(8). Furthermore, the emerging social vision which supports women employment and economic empowerment to help reduce adverse economic pressures on the family has really created a need for entrepreneurship in our country.

### **OBJECTIVES OF GOVERNMENT'S ENTREPRENEURSHIP EDUCATION**

The continuous increase in the rate of youth unemployment in the country may indicate lack of entrepreneurship rather than lack of opportunities. In 2006, the presidency directed all tertiary institutions to include Entrepreneurship Education (EED) as a compulsory course for all students with effect from the 2007/2008 academic session. The essence is to inculcate in the trainees the ability to identify and solve problems using creative and critical thinking, thus making them self-reliant. Thus, Entrepreneurship education (EED) as structured by government is intended to achieve the following objectives:

- (1). To offer functional education to the youths that will enable them to be self-employed and self-reliant.
- (2.) To provide the youths with adequate training that will enable them to be creative and innovative in identifying viable business opportunities.
- (3). To reduce the high rate of poverty among Nigerians.
- (4). To reduce rural urban migration.
- (5). To provide the young graduates with enough training and support that will enable them establish a career in small and medium sized businesses.
- (6). To inculcate the spirit of perseverance in youths and adults which will enable them to persist in nay business venture they embark on.
- (7). To create a smooth transition from traditional to a modern industrial economy.
- (8). To create employment.
- (9). To serve as a catalyst for economic growth and development.

Entrepreneurship education is designed to enable students acquire skills, abilities and capabilities for self-employment rather than paid employment. It enables trainees or students to acquire basic skills, attitudes and ideas which will help them start new businesses. Generally, the main focus of entrepreneurship education in Nigeria is to empower our youths irrespective of area of specialization, with skills that will enable them to engage income generating ventures where they are unable to secure white collar jobs on graduation.

### **CHALLENGES OF ENTREPRENEURSHIP IN EMPLOYMENT CREATION IN NIGERIA**

Challenges of entrepreneurship development could either be economic resources or human resources. Economic resources are made up of labour, land capital and entrepreneurial abilities, which when combined produce a great output. The key roles of entrepreneurship include mobilization of domestic savings for investment, significant contribution to Gross Domestic Product (GDP) and Gross National Income (GNI), harnessing of local raw materials, employment creation, poverty reduction and alleviation, enhancement in standard of living, increase in per capita income, skills acquisition, advancement in technology and expert growth and diversification. Irrespective of the benefits associated with entrepreneurship, there are lots of barriers that have prevented youths from fully realizing their potentials and assuming responsibilities in the society.

**1. Absence of Infrastructural Facilities:** Basic infrastructural facilities aid the development of the mind and body and assist productivity in any environment. These facilities include good roads, good water supply, constant power supply or electricity, access to information and communication technology and other implements of trade. Where these are lacking in a country, the growth of the economy will be negatively affected. These basic work tools as well as the enabling environment is lacking in Nigeria. All these have made entrepreneurial activities cost intensive, unprofitable and uninteresting thereby dissuading and denying the youths from assuming entrepreneurial leadership positions.

**2. Inadequate Working Capital.** The availability of capital is central to the establishment and continued existence of any enterprise irrespective of the size, focus and objective. For an entrepreneur in Nigeria to start a business, he /she must have adequate funds. In a situation where the working capital is inadequate or unavailable, it becomes a problem. This is one of the main, if not the main challenge that young people encounter when opening a business. Banks are reluctant to give out loans to intending entrepreneurs especially when they are young people. The procedures for accessing such credits are often rigorous and dependent on the provision of collaterals which the potential entrepreneur may not possess. Therefore, intending entrepreneurs often fall back on their personal savings or on loans from family members and friends.

**3. Low Standard of Education:** The world today is a global village and since an intending entrepreneur must be conversant and in tune with events around and about him, education becomes a critical factor in preparing and empowering the entrepreneur with the qualities required of him. Unfortunately, the role of education in forming young people to become change agents seems to have been ignored. Year after year, the quality of education in the Nigerian institutions has gradually been on the decline, due to strikes and unqualified teachers. While those who stay in the system is as a result of the unavailability of alternative jobs. Lack of good education policy has been a major bane of education in Nigeria. The government does not give maximum priority to education. The schools are not adequately funded, equipped, regulated and managed to bring out their optimum potentials in youths and potential entrepreneurs.

**4. Lack of Adequate Training:** Absence of adequate training for students has made it difficult for them to propel transformation in the country. This challenges the future of the youth as entrepreneurs. Educational curriculum in Nigeria focuses more on the theoretical than the practical. Most employers are always compelled to retrain their employees due to lack of knowledge of basic work ideas or familiarity with the area of study of the employee. Technology has been used to improve the quality of life through the use of the computers and other technological discoveries such as the internet. Where the youth does not have the knowledge or skill of the latest technology, it affects their outlook to life. This also results in low morale, inefficiency and lack of confidence.

**5. Lack of Access to Local and International Markets:** The challenge of access to local and international markets stunt and retard entrepreneurial expansion because entrepreneurs find it difficult to successfully market and expand their business as a result of high cost of doing business. Enterprises can only succeed if awareness of market availability is created.

**6. Severe Infrastructure Deficits:** Severe infrastructural deficits such as power and electricity that hamstring both new and existing businesses is also one of the challenges. In a report, the World Bank indicated that if government is able to remove power as a bottleneck, Nigeria will at least gain 30% competitiveness in production. It is therefore imperative that an effective energy policy be developed as business cannot thrive under a bad energy policy.

**7. Inadequate access to finance and the absence of a viable credit policy** that addresses the specific needs of enterprises also serve as a constraint.

**8. Some of the youths in most cases prefer businesses which will give them quick money to businesses such as agricultural ventures that take considerable time to mature to big profits.**

## **HOW TO BECOME SELF RELIANT AND MAKE YOUR OWN WEALTH**

This can help the youths to make their own wealth and stop depending on others for survival particularly the government.

Becoming self-reliant is one thing that might seem difficult to so many young people in Nigeria. What is involved in being self-reliant is just some level of confidence, hard-work and persistence in what you really know how to do. Being self-reliant means that you can be able to proffer solutions to your own immediate problems. When you are self-reliant you can cater for others with your resources, rather than relying on income from someone or government paid jobs. Sometimes it might be good to rely on people for help, at least it gives them a sense that they existed and gave you help, as at the time you really needed help, but a person must learn to pass through life's difficulties and trials in order to attain his/her maximum capacity.

Many great people you see today, were self-reliant because they thought of what they could do to change their world, that is why you see them in the position they are in now.

From the forgoing, the following are the basic tips to become self-reliant:

**1. Think Broad of What You Can Possibly Do:** For you to be a self-reliant person in Nigeria, you have to think wide in order to discover what you are passionate about. You have to think of something that you would always love to do anywhere and anytime. When you are able to think broad of what you can possibly do, it is just so easy to become a self-reliant person in Nigeria. It is a known fact that many unemployed youths in Nigeria does not think broad on what they can do for themselves to be self-reliant or independent rather they solely depend on the government for employment. Once you think broad and discover what you can do best, government may intervene through its youth employment policies to support you.

**2. Have a Mindset that You Can Be Independent:** Many Nigerians, especially the young people feel that they would have to attain a certain age and academic qualification before they can start fending for themselves, but that is a wrong perception. As a Nigerian youth, you have to be self-reliant by gaining entrepreneurial skills that will give you the mindset of being an independent person. If you also observe, in developed places, youths bring up innovative ideas and people would invest in it and in turn it would bring in profit for the youth as a reward, that is a clear situation of a youth being self-reliant. Having a mindset that you would have to depend on someone for help would likely make you not to succeed, because it would limit you from so many things. If you take a look at the Nigerian population, you would discover that you can become a successful person by bringing up ideas that can be profitable, which benefit the masses.

**3. Pursue Your Dreams:** As a person who is hoping to be self-reliant in Nigeria, you have to do something that you love in order not to depend on people or the government for help. If you know how to sing, then sing well and be self-reliant, if you know how to dance, then dance well and be self-reliant, if you know how to write, then write well and be self-reliant and so on and so forth. It all depends on you. No man was born without talent. Discovering your talent and pursuing it at all cost can make you to become a self-reliant person. It might be tough learning how to be self-reliant, but you just have to pass through rough roads in order to discover your true potentials. Being self-reliant has to do with knowing your responsibilities and learning how to manage them by proffering the right solutions without external help.

**4. Think of Alternative Sources of Income:** A young Nigerian can be self-reliant by thinking of alternative ways to make money. Look at an example that illustrates this: You are a man and all you do is depend solely on your salary that the government pays you at the end of each month, let say government was not able to pay you for a particular month and you do not have any other source of income then does it mean you and your family would go hungry? Would you not pay the bills? But when you had already thought of alternative sources of income, you are automatically going to escape a bad situation by being self-reliant. Executing the plan, you had in mind of other ways to make money. There are several businesses you could do to boost your income that would not affect your normal job. All you have to do is create a little time for it and some investment that would not cost you much. Generally, what this point is trying to say is that thinking of alternative sources of income would surely make you to be self-reliant.

**5. Understand Basic Things:** If you really want to be a self-reliant person in Nigeria, then you would have to learn and understand basic things. You need to have a fair knowledge of many things that happen around you, even though you must have been specialized in one thing. Let us take a look at a situation where a man is an engineer and all he knows is about construction and the like, when he gets home, his wife cooks and he eat well but he does not know how to cook. But there is this weekend, where his wife travelled for a function and he was home and no food at home, does it mean that he would not eat the whole weekend, simply because he does not know how to cook? That shows he lacks “self-reliance”. Your ability to do some certain things at some certain conditions makes you a self-reliant person. When you have basic understanding of things that happen within Nigeria, you can know what to do and how to do it without asking or relying on people for help.

## **WHAT SHOULD THE YOUTHS DO IN AN ENVIROMENT WHERE GOVERNMENT JOBS ARE NOT READILY AVAILABLE?**

Crime is on the increase in Nigeria today because so many youths are jobless. Little is done to support Government efforts to engage the thoughts and energies of the youths. They have great potentials to create jobs for themselves and others, but cannot afford the cost of training. I believe, if given the opportunity, they will be resourceful to themselves and the country at large.

At this juncture, the youths are encouraged to engage themselves in specific trade areas such, bead making, shop making, hair dressing, computer training, tailoring, photography, videography, instrumentation, hair cutting, making of cosmetics, making of shoes, catering and confectioneries, interior and exterior decoration and learn some skills like welding, mechanic, building, panel beating among many others.

If Nigerian youths are to succeed, they must remain focused and stop over-reliance on the governments to pursue their dreams. Never wait for the government to do something for you. Its job is to create an enabling environment. Youth do not have to give up, you have to keep going. When you see your business is outdated, innovate. The youths should not pay attention to naysayers and instead focus more on putting their ideas to work. You will want to start a business and you will find people who will tell you that it will not

succeed because there is so much competition, more money, more infrastructure, and more resources but that not derail you. There were many young and successful Africans who today are recognized and respected in America, Europe and the rest of the world, because they had succeeded exceptionally to become the best in a foreign country. The most important thing is to move from thinking, planning, preparing to implementing and do not get discouraged if you fail. Many people have had too many failures in life, they have made many mistakes and they always concentrate more on not repeating the same mistake. Mistakes will be made but you must move forward. Nigerian youths should seize opportunities to innovate and turn their challenges into profitable ventures. Young people have to be the driving force and take charge to build the future that Nigerians want. Work collectively and promote entrepreneurship, job creation for the better future of Nigeria. Work hard and you're your entrepreneurial dreams into working businesses.

Only a paradigm shift in the social consciousness of the literate youth can stem the surging tide of unemployment in Nigeria. Nigeria is a massive opportunity for innovative and enterprising young people to thrive. It is ironic that we have lots of unemployed graduates when there are lots of societal needs that are not being met in the Nigerian market. Entrepreneurs are created through education, experience and mentorship. Nobody is born with exceptional entrepreneurial insight, ability or skills. With the right skills and attitude, any Nigerian youth with ambition and ideas can go far because of the existing limitless opportunities in the market. Nigeria represents an exceptional and extremely exciting opportunity for young and smart entrepreneurs with guts. The Nigerian youths should get over the fixation for paid employment and to boldly venture into the uncharted informal sector.

### **How Importance is Skill Acquisition for the Nigerian Youths?**

A skilled person can survive in any environment. As water is very essential to human life, so is skill training and acquisition needed in the life of every serious-minded human being. Skills can do a lot of great work in the life of every living soul. Lack of entrepreneurial skills is one of major the causes of unemployment and corruption. Youths are to gain skill in areas such as: Computer Literacy, Fashion and Designing, Cosmetology, Catering and Hotel Management, Bag/Shoe making, Hair Dressing, Bead-making and others.

The importance of entrepreneurial skill development in our society today cannot be over emphasized because gone are the days when jobs were available everywhere both in the private and public sectors of the economy and employers go about looking for potential graduates for employment. The question of choice of job or the type of employer one would like is now a story and thing of the old. White collar jobs are scarcely available. Hence many graduates are desperate to get any job to keep body and soul together. Indeed, there is paradigm shift in the labour market.

Therefore, the need to acquire and develop specific entrepreneurial skills cannot be neglected because entrepreneurship is vital to creating employment and indeed a special form of employability for graduates. Empowerment helps individuals or groups to fully access personal/collective power through knowledge, skills and motivation for proper functioning in their society and contribution to the economy. The importance of acquiring entrepreneurial skills includes:

- (1). **Self-employment:** A self-employed person can never go hungry because the skill he acquired provides food for him/her on a daily basis. But one who lacks skill acquisition will find it difficult to be self-employed because he/she has nothing to offer.
- (2). Helps the society not to depend on white collar jobs.
- (3). Helps youth develop a positive attitude towards work and labour.
- (4) It reduces poverty.
- (5). Helps youth to be self-reliant and independent.

**(6) Diverse job opportunities.**

Have you ever seen someone who acquires many skills alone? Such person is classified as someone who is up and doing. Those who have many skills stand the chance of gaining more jobs from many establishments. People who have many skills are being searched for by many companies. Company A, B & C stand in a queue fighting over one person. They are searched for because they can do many functions due to the series of skills possessed.

Here are some of the major probably thousands of things to consider when deciding to become self-employed:

**(1) Create goals you control:** When working on a salary, goals change constantly and are out of individual direct control. While still having to meet the requests of customers, being self-employed can provide a more effective way of creating a more balanced lifestyle.

**(2) Create agendas and plans that support your goals:** Again, when working on a salary, the plans and agendas that are meant to meet the goals of the company change constantly. In a self-employed environment, plans and agendas that direct marketing, sales, production, and distribution can be developed and sustained with more consistency and effectiveness.

**(3) Develop the resources, talents and skills that build and sustain a business:** As a self-employed business person, developing the skills to negotiate contracts, manage employees and contractors, and manage time becomes even more important. In many ways, being self-employed is the most dynamic learning experience an individual will ever encounter.

**(4) Stress can be reduced dramatically:** Building a business that is suited to personal talents and skills creates an incentive to get up in the morning because it is something the individual enjoys doing. It can also give a sense of satisfaction and accomplishment at the end of the day. Added to this, a certain degree of financial comfort and stress can be reduced dramatically.

## CONCLUSION

Today, we should know that entrepreneurship is promoted as an effective means of stimulating economic growth and development through the generation of greater employment opportunities for the youths. Lessons obtained from this paper will impart entrepreneurship skills and attitudes to the youths as well as dispose them towards establishing their own businesses. It will further reduce youth unemployment and empower them to contribute positively in the nation's economic development. It is hoped that the paper will educate the youths on the need for them to be self-reliant and self-employed that will make them to rise out of poverty and be self-employed and self-reliance. These youths would become skill vendors to train other unemployed youths. This would increase job opportunities and develop the economy of the nation. When the youths are engaged meaningfully in this way youth restiveness and crime would be reduced and people will live in peace and harmony.

However, rural youths in Nigeria have the potentials needed to participate effectively in agricultural development. Major problems encountered by youths in agriculture include lack of interest in agriculture as a result of drudgery in farm operations, lack of competitive market for agricultural products, lack of start-up capital, inadequate labour saving technologies for ease of operations, inadequate finance/credit facilities, among others. As a result, they are faced with serious economic challenges which result in undue poverty and vulnerability. This has also made youths to seek employment in other sectors of the economy in order to empower themselves economically, resulting in rural-urban migration and leaving the bulk of agricultural production in the hands of old people who often times produce at a subsistence level. These problems associated with unemployment can be solved by empowering the youths through agricultural development programmes which will enable them to have opportunities for self-employment in agriculture. There is therefore need for specific measures to be taken in order to address poverty among youths. The empowerment of

youths through agricultural development programmes will reduce poverty and provide them with opportunities that will enable them to be gainfully employed. Governments at various levels are encouraged to promote youths in agriculture through creating awareness on Youth Employment in Agriculture Programme to enable young people to know about the programme and participate actively for enhanced agricultural productivity, increased food security as well as empowering them economically. Most rural youths do not foresee a prosperous future for themselves in the agriculture sector, mostly because of lack of profitability of agricultural activities and lack of physical and social infrastructure in rural areas. These infrastructures are necessary in order to reduce rural-urban migration and keep youths in rural areas as well as promote their interests in agriculture. Finally, dependent people often fail to find the motivation to solve problems on their own. Hence, self-reliance is vital for the Nigerian youth to successfully govern their own lives and economy.

Finally, In the face of the serious and growing threat of youth unemployment in Nigeria today, the need for the Nigerian youths of today to seek avenues for self-employment, self fulfilment and financial breakthrough is very crucial.

## **RECOMMENDATIONS**

The paper recommends the following:

- (1).** Entrepreneurship should be taught as an activity (practical) and not just as an academic field or Entrepreneurship studies should be largely practical based to enable students acquire adequate skills and knowledge needed for self-employment.
- (2).** Appropriate conducive environment such as quality infrastructural facilities and start-up capacity should be provided to the youth by the government. In other words, Government should provide basic infrastructures such as regular power, good roads, communication etc for entrepreneurship to boost the Nigerian economy.
- (3).** There is the need for government to provide an enabling environment in the area of security as no meaningful entrepreneurial activity can take place in a volatile or crisis prone economy.
- (4).** It should be made compulsory for students of tertiary institutions to produce marketable products in their areas of entrepreneurial choice before graduation. This will enable them take entrepreneurship education very serious.
- (5).** There is also the need to place students on industrial attachment in relevant firms and industries for a specified period of time. This gesture will help solve the problem of theoretical learning of entrepreneurship education.
- (6).** Tertiary institutions require adequate funding by their sponsors. This will enable them acquire facilities for effective learning of entrepreneurship education.
- (7).** Staff training and retraining should be encouraged. This will enable trainees acquire modern skills as well as rich knowledge in the teaching of entrepreneurship studies, since one cannot give out what he does not have.
- (8).** The youths should be properly encouraged to become entrepreneurs through implementation of relevant policies, in order to forestall the problem of graduate unemployment in the country.
- (9).** Government should play a vital role in creating enabling environment to ensure that the youths who are in private business, are not unduly harassed by thugs hired by Government in the name of revenue generation.
- (10).** Tax holiday should be granted to youths who are engaged in micro businesses for a reasonable period of time.

**(11).** Government should review and produce an appropriate youth development policy that outlines measures to reduce youth migration from rural to urban areas in order to sustain the agricultural human resources requirement and empower youths. In order to attract youths to agriculture, attitudes must change among rural communities to perceive it as a business and make it commercially viable.

**(12).** Efforts should be made to integrate the views of youths into developmental efforts in order to address the actual needs of the youths, thus making agricultural development planning and management sensitive to their needs.

**(13).** Rural youths should be involved in the drafting, implementation, monitoring and evaluation of policies and programmes related to agriculture.

**(14).** Education and capacity-building programmes for rural youths should be defined in a more participatory way and focused on agricultural best practices, land laws and knowledge sharing.

**(15).** Agriculture should be included as a compulsory subject in Nigerian schools starting from primary education curriculum in order to promote interest in farming among youths.

**(16).** Informal education programmes should also be implemented in rural areas to change the mind set parents have about agriculture.

**(17).** There should be regular seminars, workshops and conferences for staff, students and the general public to strengthen and refocus on entrepreneurial education. Strengthening research and capacity of researches into evidence-based researches will promote participatory methods. This will encourage synergy among government, private sectors and the general public on the need for encouraging and developing entrepreneurial spirits among students.

**(18).** Government should increase the budget for the implementation of government policy on mandatory entrepreneurship education and the budgeted sum should be released in order to actualize the purpose of the funding.

**(19).** Youths should be introduced to entrepreneurial activities at their early stage to enable them grow alongside with it in and out-of-school programmes. Government should incorporate practical/field training scheme in the existing mandatory entrepreneurship curriculum of tertiary institutions.

**(20).** Entrepreneurship lectures, teachers/trainers should periodically be retrained and encouraged in the area of research to update their skills in order to be relevant in today's era of dynamic and globalized environment.

**(21).** Education curriculum must be immediately revised to incorporate skills and enterprise development. Hence a process or a program geared towards training youths in Nigeria in the act of entrepreneurship. They ought to be progressive, proactive and pragmatic.

**(22).** The government must be willingly to fund entrepreneurship activities since finance is one of the issues hindering entrepreneurship development in Nigeria.

**(23).** Nigerian government should strengthen the legal framework for entrepreneurship development programmes, mandating states participation in the NDE and Amnesty programmes to ensure that strengths and potentials of the youths are geared towards economic developments rather than violence

**(24).** Government should create labour market that work better for the youths.

(25). The youths should be encouraged to engage in the agricultural sector through various government's agricultural programmes and the government should provide incentives to those youths in the agricultural sector.

(26) The government should provide grants for innovative youths and those that are willing to be self-reliant as that will go a long way in motivating them and boosting their morale. As they become self-reliant and self-employed, it will reduce the burden and pressure on government (make the government less pressured).

(27). Above all, the youths should disabuse their minds from relying on the government for job creation. They should rise up and start doing something independently no matter how small it is, then the government may come in to support them.

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# STRATEGIC INFORMATION TECHNOLOGY AND PERFORMANCE OF TELECOMMUNICATION FIRMS IN KENYA

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**Abstract-** Many Information Technology (IT) firms in Kenya face the challenges of improving the competitiveness, quantity, quality and reliability of data and voice services. Strategic IT is viewed as a key factor in ensuring these challenges are overcome. However, improving firm competitiveness is not always a guarantee to improving firm performance. It is not elaborate whether strategic IT affects firm performance and if it does affect then what the consequent effects can be. The general objective of the research was to determine the effect of strategic IT on the performance of telecommunication firms in Kenya while the specific study objectives included; to establish the effect of strategic IT penetration on performance of Telecommunication firms in Kenya, to investigate the effect of strategic IT access costs on performance of Telecommunication firms in Kenya and to examine how staff strategic IT skills affect performance of Telecommunication firms in Kenya. Task-technology fit theory, efficient structure theory and the resource-based theory were used to guide the study. Descriptive research design was used with a total population of 144 respondents comprising of managers, supervisors and team leaders from the three tier 1 telecommunication firms. Based on stratified sampling technique, the researcher selected a sample size of 44 respondents which is 30% of the total population size. The proposed study employed both secondary and primary data with questionnaires being used to collect primary data. The researcher employed two groups of experts from the ministry of Information and Communication to assess content validity. Reliability was assessed using Cronbach alpha coefficient. Data was analyzed by the regression analysis model and through the aid of SPSS while qualitative data was analyzed through Content analysis through the development of thematic frameworks for each of the open-ended questions. Presentation of analyzed data was done through statistical frequency tables and charts. Based on the study results where all the F statistic as well as the respective t statistic from the study model were significant in their respective p values, the study rejected all the null hypotheses and concluded that strategic IT penetration; strategic IT access costs and staff strategic IT skills all had a positive significant effect on performance of Telecommunication firms. the study stands to benefit the industry players through insightful competitive advantage driving strategies as well as helping scholars by partly anchoring the study on efficient structure theory. The study therefore recommends that Telecommunication firms need to come up with quality innovation capabilities necessary to drive market Penetration process, it is important for Telecommunication firms to ensure that the quality of infrastructure laid to oversee the realization of the projected benefits is firm enough (economically viable) to support the focused benefits and that firms should continually update their personnel with ICT skills through training and especially on any update made on mode operations. The study was limited to its scope but opens window for further research especially on dynamic strategies adopted by ICT firms in response to market turbulence.

**Index Terms-** Strategic IT, Tier 1 Telecommunication firm, Safaricom, Airtel, Telkom

## I. CHAPTER ONE: INTRODUCTION

### 1.1 Background to the Study

According to Black (2017), Information Technology (IT) investment in organizations increased significantly the past thirty years. This is because of the nature of the worldwide telecommunication environmental completeness which is dynamic and in need of continuous improvements and strategic information communication technologies adaptation for firms operating in such an industry to not only flourish but co-exist in the near future. In fact, firms that fail to invent or rather innovate are not only at the risk of reduced profitability but at the risk of eventual failure (Powell & Dent, 1997). IT is an important function that is applicable and succeeds at all operational and strategic functions. Its application brings with it opportunities but at the same time comes with a lot of challenges for the telecommunication sector (Orlikowski, Walsham, Jones, & DeGross, 2016). Even though the IT development process poses a lot of uncertainty, an organization will always experience some positive change. Strategic IT being an important component of

competitive advantage, telecommunication players competing for a market share will not sustain competition unless they embrace it to help them develop innovative products, systems and services. If they disregard it, there is a very big possibility that other innovative players might want to enter the industry to upset the market share of existing companies (García-Quevedo, Pellegrino, & Vivarelli, 2011). North and Varvakis (2016), noted that firms in current business environment need to be agile if they are to be innovative and competitive.

### ***1.1.1 IT and Firm Performance***

Performance of a firm can be viewed as the appraisal of established standards or indicators of efficiency or effectiveness (Soto-Acosta, Popa, & Palacios-Marqués, 2016; Storey, Keasey, Watson, & Wyncarczyk, 2016). Information Technology (IT) used by telecommunication firms is aimed at developing an organization that is agile and proactive to effectively respond to the dynamic environment in order to sustain profitability. Competition, innovation and regulations are some of the factors emanating from the environment that greatly affect the firms in the industry (Letangule, Letting, & Nicholas, 2012). Intellectual assets investment is one of the key strategic tools that can enable a business to sustain growth, competitiveness and profitability in today's knowledge economy (Berry, 2000; Omollo, 2008). Information Technology (IT) is a foundation of positive performance in every economic sector world wide (Abdi & Kinyua, 2018; Achieng, 2011). It has been viewed as a stimulant of economic development and also plays a pivotal role in reduction of transactional costs a big determinant in improving productivity. By IT enhancing immediate connection for visual, voice and data, it contributes towards improvement of accuracy, enhances transparency and maximises efficiency. IT solutions also help to enhance service delivery to stakeholders like customers and suppliers (Oni & Ayo, 2010).

Bilgihan, Nusair, Okumus, and Joon-Wuk Kwun (2011), posited that improved competitive advantage status has been the major force behind the huge investments in IT since it is considered a weapon that can strategically be used to effect change in the organization positively (Schmidt, Möhring, Maier, Pietsch, & Härting, 2014; Weiss, Thorogood, & Clark, 2007). Despite of IT success in various regions and organizations, only about a third of Fortune hundred firms realized their investment potential in IT (Tiong, Cater-Steel, & Tan, 2009). A Standish Group report indicated that despite of organizations in the US investing more than two hundred and fifty five billion dollars per annum on IT projects, projects worth fifty five billion was declared failed projects (Young & Poon, 2013). This clearly shows that its not a guarantee that heavy investments must always reflect positive results and hence the need for strategic IT investment. With the dynamism in IT alot of changes are experienced and this has been considered one of the main factors contributing to project delays and budget overruns (Fang, Benamati, & Lederer, 2011). According to Jensen (2017), it is wiser and objective if organizational performance can be measured by the use of different parameters and approaches that look at different areas of an organizations operations in order to give a true picture. Kaplan (2009) argues that performance can be viewed from the following perspectives; part one-financial, part two-internal business, part three-customer, and lastly, part four-innovation and learning. Organizations use financial perspective to assess key drivers that increase financial performance. For example, cash flow, profit margin (Wadongo, Odhuno, Kambona, & Othuon, 2010). The customer perspective is customer focused measuring performance for example in terms of customer satisfaction, brand image, customer retention or loyalty. The efficiency of systems within the firm is analyzed under Internal processes whereas the ability to change or adaptation to change is the main concern of innovation and learning perspective (Kaplan & Norton, 2007; Salingay, 2012). As a strategic performance measurement model, a balanced scorecard provides key aspects of performance measurement, among them the financial aspect that can also be used as future performance drivers (Mucheru, 2008). This study will adopt the perspectives under the balanced score card to measure performance of telecommunication firms in Kenya.

### ***1.1.2 Strategic Information Technology***

Strategic IT development can well be understood by reflecting on the work of different scholarly articles. To start with, a literature review by Harun and Hashim (2017) indicates that in earlier years IT wasn't strategic in nature, it was traditionally being used for the sole purpose of reducing organizational costs by automating organizational processes. This has however changed over the years with the development of supporting infrastructures like data banks and warehouses an era referred to as data Processing era that took place in 1960's which emphasized on enhancing operational efficiency. The era was also referred to as the computerization period. They also assert that the data processing era was followed by an era which emphasized the importance of organizational effectiveness known as the management information system era. This era was developed fully during the late 1970's, and is still important to date. Organizations were able to integrate separate but interrelated information systems. This era's achievements were instrumental in laying a concrete foundation for the current era, thus the Strategic era which started in mid1980's and early 1990's with its emphasis on competitiveness, moving from reactive nature to proactive nature of business support operations (Lederer & Hannu, 1996). The interface between strategic IT adoption and operations is necessary to provide a firm with a system under which it can understand the industry or the markets based on all perspectives (Tallon & Pinsonneault, 2011). Pressure due to increased service costs and service quality concerns are forcing telecommunication firms to seek strategic IT supported competitive and innovative systems and methods that can improve the firms operations and overall performance (Joe, 2016). Firms need to strategically adopt competitive methods that will aid mobile or device and internet penetration to a wider population to ensure high access rates (Ghebregiorgis & Mihreteab, 2018). According to Parkes and Teltscher (2011) the last decade has had many changes experienced worldwide in the telecommunications industry. For example, from the year 2008 to 2010, ICT service costs reduced, High-speed internet prices reduced drastically, a trend also seen in the mobile cellular section. This trend that enhanced affordability was an advantage to consumers.

Kenya still lags behind globally in terms of IT index. This is because 2016 report from the Botswana held telecommunication indicators symposium placed the country at position 129. In Africa, it was observed that Kenya retained ninth position after Mauritius in position one, Seychelles in position two, South Africa in third position, Cape Verde in fourth, Botswana in fifth, Ghana in sixth position, Namibia in seventh position and Gabon in eighth position respectively. The country also boasts of being a leader in the east African region in terms of mobile penetration (Chesula & Kiriinya, 2018). IT investments are not a cheap venture. Firms need to have sufficient capital to manage costs of network expansions and service improvements that are declared obsolete frequently (Farrell, 2007). A company like Safaricom has a huge capital base having made 180 million dollars since 2006 according to Singh (2009), a figure which was more than triple combined profits made by competitors, and with this the company is in a position to change transmission systems and upgrade frequently to the detriment of competitors (Chesula & Kiriinya, 2018).

One of the most important resources in any industry are the employees. Staff competence and their satisfaction at work greatly influence the competitiveness of a company within its industry (Baldwin, Cave, & Lodge, 2012). A survey by Harindranath et al. (2008) in the United Kingdom revealed that many firm owner and managers untrained in IT skills and this meant that they keep relying on advice from outside consultants or supplier organizations. Confidence was affected by lack of skills and that also explained the cautiousness in strategic IT investments. Kenya educational curriculum so the incorporation of IT as a big step in promoting the reduction in digital gap and this also increase the number of qualified IT technicians (Wims & Lawler, 2007). Several factors have been identified in Kenya as the determinants of IT professional's development and their skill levels. These include: The maturity level and sophistication in a firm's IT set ups, the number of international and local large IT organizations, the size of local and international IT set ups and the small IT segment growth since they are key consumers. Retention of key experienced staff is still a big concern since if not taken care they will always seek greener pastures elsewhere (Kipkoech & Mwangangi, 2018). Another big challenge on skills development and retention has been on the issue of foreigners who do not support locals to acquire the necessary technical skills by employing foreigners in those projects. Transfer of skills is vital for the growth in the IT industry and players need to work within established government frameworks that require locals to benefit from transfer of skills by foreigners. (Arasa & Gathinji, 2014).

### ***1.1.3 IT in the Global Context***

In 2014, China mobile which had an estimated market value of two hundred and eighty billion US dollars and estimated to be the world's top telecommunication company attributes its success to the adoption of good strategic IT. Another company that attributes its success to the implementation of strategic IT is US largest telecommunications company, Verizon Communications Inc. By the year 2015 it had an estimated market value of two hundred and two billion us dollars supported by a sale weigh in which stood at one hundred and twenty-seven billion us dollars and operating in 150 countries. Its general manager attributes the company's success to adapting continuous product and service improvements through strategic information and communication technology (WechuliChesula & Iravo, 2016). IT space worldwide is now shaped by growth of smart devices which allow for smart connectivity. There utilization continues to grow. To illustrate this observation, Klein and Mayer (2011) looked at Global Mobile Consumer Survey (GMCS) for the US market by Deloitte consultancy firm and noted that in aggregate per day, the mobile users access their devices over eight billion times. This information is vital for all players in the sector who are all part of the telecommunication ecosystem. They include; network equipment and or infrastructure companies, wireless and wire line and or broadband carriers, and also the device manufacturers among other players. Telecommunications industry in Africa is seen as being among the best sectors in terms of growth speed. The industry is still experiencing increased new entrants while the existing companies are setting expansion strategies (Ghebrejorgis, Mihreteab, & Sciences, 2018). According to the IT News Africa report published in 2011, which ranked telecommunication companies based their turnover, placed MTN as the leading firm with over 176-million subscribers. The company has over the years invested millions of dollars in strategic information technology systems. Kenya's Safaricom lies at number nine in Africa (Aker & Mbiti, 2010). Rapid development has been experienced in African Countries in the use of IT. With knowledge economy taking centre stage, many institutions are embracing IT solutions as a caterlist for their business growth (Apulu & Latham, 2011). Many scholars have supported the nortion that the use of IT contributes to a large extent to the social and economic development facets of society (Avgerou & Walsham, 2017). IT application in different government, business and community organizations has increased and many are now acknowledging that it is increasing efficiency in administration and delivery of serfvices (Wu, Straub, & Liang, 2015).

### ***1.1.4 IT in the Kenyan Context***

The Communications Authority of Kenya (CA) is an independent regulator which licenses and regulates telecommunications, radio communication and postal services and also ensures that the sector contributes considerably to the development of the country. The CA ensures that all Kenyans are able to access uninterrupted services offered by telecommunication firms (Wyche & Olson, 2018). During the 2016-2017 periods, the CA issued a total of 369 telecom licenses under the Unified licensing Framework (ULF). This represented a 15% increase of the telecom licensee's total number. The Authority also deregistered a total of 412 telecom licensees under the ULF and 276 licensees under the old licensing framework for being non-compliant. The licenses issued by the Authority have fixed terms that are renewable at the licensees' request. In addition, during the period a total of 236 licenses expired out of which 77 were renewed on additional license terms. Deregistration and expiry of licenses without renewal both led to a decrease in number of licensees an indication of their negative impact. Despite of the statistics, the overall Kenyan IT sector registered substantial growth

over the past years (Lodge, 2016). During financial year 2016/2017, a total of six (6) operators provided mobile telephony service, which included three MNOs namely: Safaricom Limited (Safaricom); Airtel Network Kenya Limited (Airtel); Telkom Kenya Limited (Orange) and three MVNOs namely: Sema mobile (Zioncell Kenya ltd), Equitel (Finserve Kenya ltd) and Mobile Pay Ltd (CA Annual Report 2016-2017). The total mobile telephony subscriptions stood at approximately 40.3 million. These subscriptions are distributed as follows: Safaricom (29.2 million), Airtel (6.1 million), Telkom (2.8 million), Equitel (1.8 million), Mobilepay (87,786) and Sema (263). Safaricom, has a 71.2 % market share and it's the only company trading in the securities market. Airtel, holds 17.6% of the market and the remaining market share by several other operators (Stéphane Piot, 2018). According to the CAK 2017 report, performance of the sector in terms of IT penetration is measured through mobile penetration, internet penetration and mobile average revenue per user. Mobile phone penetration in the country stood at 88 percent. The penetration rates on internet hit 112.7 percent which meant that there is continuous growth in customer base and this is bound to increase as almost half the population is still untapped and that's the market that is being targeted which at the end defines the competition in the industry. There was a growth of forty percent on the mobile average revenue per user (MARPU) in the period (2018-2013). Fixed broadband lines have also experienced a similar trend. An increase in voice (over broadband) lines has also been visible. Despite of these growth trends, the overall industry market is classified as being at the growth stage in the industry life cycle (Stéphane Piot, 2018). According to Chesula and Kiriinya (2018) data usage in Kenya has recorded rapid growth. This has been attributed to streaming services. As telecommunication firms move to broadband networks especially by embracing fiber, hence reducing mobile traffic, the usage of Wi-Fi is expected to increase. Services of unlicensed spectrum solution providers (LTE-U) as well as the spectrum efficiency technologies and (VoLTE) Voice over LTE in addition to (VoWiFi) Voice over Wi-Fi services are still considered important in-service expansion and improvements.

The government supported by the private sector contributed to the investments in the IT sector in Kenya. Vision 2030 document has incorporated strategies for IT industry growth. Konza Technology City valued at USD 14.5 billion is one of the mega projected undertaken by the government in the industry. Establishment of IT hubs across the country are also promoting information technologies absorption. iHub for example, has been successfully applied in Kenya. (Mutunga, Were, Ogada, & Management, 2018). Despite of the development in the sector, some parts of the country are still lagging behind in terms of IT infrastructure. Rural market is so much underdeveloped and most of the players within the industry are shifting focus to that market as it is observed that growth of the urban market is stagnating (Namisiko, Sakwa, Waweru, & Business, 2015). Communications Authority of Kenya has stepped up investments in high cost infrastructure to support telecom operators. A good example is the investment in National 4G network through a joint venture ship with the telecom operators. Safaricom has always been on the forefront in advancing its services and this was also replicated in the introduction of the 4G service, Telkom and Airtel launched 4G services in 2017 (Houpis, Rodriguez, Serdarević, & Ovington, 2016). A review of scholarly articles on IT established that several factors are considered key determinants in IT acceptance (Marangunic & Granić, 2015). In Kenya, cost of usage and investment, Infrastructure and use congestion are among the major impediments of IT usage (Oyelaran-Oyeyinka, 2014). Even though the importance of assessing IT investment management processes has been established by many organizations and industry regulators, there still lies difficulty in determining costs of projects, in addition, inability to control cost overruns and ineffectiveness in management of deliverables against set standards are also as a result of failure in evaluation of IT investments (Pai & Huang, 2011). Despite of this, the sector is projected to continue growing as more and more organizations in different industries embrace technology.

### ***1.1.5 Tier 1 Telecommunication Firms in Kenya***

Lodge (2016) asserts that the country has three tier 1 registered telecommunication firms. These includes; Safaricom PLC, Airtel Kenya Limited and Telkom Kenya Limited. According to the communications authority of Kenya telecommunication firm's classifications, tier 1 operators are telecommunication firms that own a network, host their own numbers and provide data and voice services. Other classifications include tier two, three and four. These operators are characterized by operating their own numbering systems and may even own some amount of network. However, in most cases they seek services of a higher tier network provider in order to effectively deliver their services. The lowest tier classification is referred to as Tier 0 operator. They are characterized by having their own systems to manage users and embrace technological innovation to avoid purchasing network access from other service providers to support their own. They however rely to a large extend the Tier one to tier four operators for delivery of services. Growth by the tier 1 players has been substantial. According to the first quarter sector statistics report of 2016/2017 from the CA, it showed that Safaricom recorded a slight increase in mobile subscription base to 29.5 million but still lost some market share to close the period with 69.1% from 71.9%. Airtel on the other hand recorded an increase in mobile subscription base and closed the period with 7.3 million subscribers and a 17.2% market share from 14.9% the previous period. (Mohamed & Atheru, 2017). Telkom Kenya just like Airtel also recorded an increase in subscriber base. This increase was due to the rebranding strategy that saw an increase in marketing activities. As at December 2017 its subscriber base stood at 3.8 million which constituted 9.0% share of the market from 8.4% the previous year. Another player, Equitel had an increase of subscribers ending up with 1.93 million but still lost some market share by 0.2% to 4.5%. A mobile money company, Tangaza, an MVNO which is owned by Mobile Pay Limited recorded a total of 89,892 subscribers up from 88,853 subscriptions in the previous quarter, with a market share of 0.2%. Lastly, Sema Mobile a company that has specialized in offering customized mobile solutions to communities recorded a drop in subscriptions leading to a negligible market share (Mohamed & Atheru, 2017). The operators have also seen an increase on the rate of internet

penetration which has been supported majorly by the installation of fiber optic cables. As at December 2017, Kenya, recorded 379 4G enabled stations, 2281 3G enabled stations and 3562 2G enabled stations (Yackee, 2014).

### **1.2 Statement of the problem**

Kenya has experienced an increase in IT investment and use over the year. This however has also come with a lot of challenges including failures. Even though the failures are not unique to Kenya as seen in a study by Mueller-Jacobs and Tuckwell (2012) which shows that global IT failure in the year 2000 stood at 70%-86 % resulting in massive resource wastage. Over the years, many studies have been pointing out that the problem of Business Information Technology alignment is a perennial one (Luftman, Lyytinen, & Zvi, 2017). Even though a lot of progress on understanding effect of IT on performance of organizations, there are still a lot of challenges on IT business alignments. To start with, in Kenya most models used in performance assessment view the relationship between strategic IT and performance as a non-dynamic one instead of analyzing a wide array of variables and activities under which the effect of IT on performance is attained. Secondly, majority of the study models on strategic IT and performance are not based on strong theoretical foundation. Lastly, due to their static view, the models cannot be used to show how companies or firms can clearly find out the connection between application of strategic IT and performance in sectors like telecommunication. This proposed study helps to determine the effect of Strategic IT on performance of Telecommunication firms and through that help to addresses some of the weaknesses of past studies. The telecommunication industry is important and among the major contributors of growth and influencers of innovation in all other industries (Marchewka, 2014). In addition, there is an increasing uptake of modern ICT in the operations of telecommunication industry to enhance performance among staff, better management of information and satisfaction of clients (Manyika et al., 2017). Telecommunication companies use modern information, communication and technology facilities in their operations (Namusonge, Mukulu, & Mokaya, 2017).

Many IT firms in Kenya face the challenges of improving the competitiveness, quantity, quality and reliability of data and voice services. Strategic IT has played a key role in ensuring these challenges emerge out as opportunities for improving competitiveness (Weil, Mbiti, & Mwege, 2011). Muteti (2013), however, asserts that improving firm competitiveness is not always a guarantee to improving firm performance. It is not elaborate whether strategic IT affects firm performance and if it does affect then what the consequent effect can be. Mulwa (2015) identified several factors like financial resources availability, infrastructure and human resource capabilities as some factors that influence ICT adoption by county governments. The research however was not objective as the sample included members of the public who have no knowledge of county government ICT investments. In the proposed study, this weakness shall be addressed in order to get objective results that can be relied upon by researchers even outside the telecommunication field. Abubakar and Tasmin (2012) investigated the impact of IT on banks' performance and customer service delivery in Malaysia; Costar (2012) investigated the role of IT in financial institutions in Uganda; Basweti, Masese, and Ronald (2013) Researched on the impact and challenges of IT adoption in the Tanzanian banking sector. All these studies and many more have concentrated on IT, competitiveness, firm performance and competitive viability with some studies being biased to only one variable. None of those studies has touched on strategic IT and how it affects firm performance. This study sought to fill the identified gap by determining the effect of strategic IT on the performance of telecommunication firms in Kenya.

### **1.3 Research Objectives**

#### **1.3.1 General Objective**

The main objective as developed in the background of the study was to determine the effect of strategic IT on the performance of telecommunication firms in Kenya

#### **1.3.2 Specific Objectives**

- i. To determine the effect of strategic IT penetration on performance of Telecommunication firms in Kenya.
- ii. To investigate the effect of strategic IT access costs on performance of Telecommunication firms in Kenya.
- iii. To examine how staff strategic IT skills, affect performance of Telecommunication firms in Kenya.

### **1.4 Research Hypotheses**

**H<sub>01</sub>:** Strategic IT penetration has no significant effect on performance of Telecommunication firms in Kenya.

**H<sub>02</sub>:** Strategic IT access cost has no significant effect on the performance of Telecommunication firms in Kenya.

**H<sub>03</sub>:** Staff strategic IT skills have no significant effect on performance of Telecommunication firms in Kenya.

### **1.5 Significance of the Study**

Key beneficiaries are the public sector companies, policy makers and government institutions. The results of the study would help to determine whether to invest in strategic IT as a way of enhancing long term service delivery, efficient production and operations, or on whether strategic IT investment is a misuse and loss of money. Potential investors in the Kenyan telecommunication industry will be able to understanding IT investment factors that they have to consider in investment decision making. Researchers and academicians with an intention of further study on the IT and performance subject would find this study important in providing them with vital content of actual IT investment influencers for local investors in addition, the information from the study shall contribute to literature

that can be used by other scholars. Private investors, governments, academicians and scholars would all find this research findings an important source of knowledge for them to understand and appreciate. Lastly, the study also enriches the practice as well as theory of strategic management, IT and marketing in helping scholars realize the positive relationship between strategic IT and performance in cases where perceptions exist.

### ***1.6 Scope of the Study***

This study was limited to the telecommunication industry in Kenya and more specifically the head offices, retail shops and customer care centers of the firms within Nairobi County. The unit of analysis was based on the three tier 1 telecommunication firms according to the Communications Authority of Kenya 2018 report: Safaricom PLC, Airtel Kenya Ltd and Telkom Kenya Ltd. The research study was carried out between February 2019 and October 2019. The subject scope was to determine the effect of strategic IT on the performance of tier 1 telecommunication firms in Kenya.

### ***1.7 Limitations of the study***

The study was limited to its scope and was also affected by academic timelines which meant that the study be undertaken within a stipulated period in order to qualify for timely graduation which to some extent affected the research process. However, the researcher tried to overcome this by adhering to the revised time schedule and only considered the scope of work of each activity putting more emphasis on more demanding activities. The researcher also employed research assistants in data collection process. The researcher also foresaw a situation where some information perceived to be confidential might be difficult to access an assumption that was overcome by ensuring that there is high level of confidentiality and anonymity when it comes to response through questionnaires.

## **II. CHAPTER TWO: LITERATURE REVIEW**

### ***2.1 Introduction***

The chapter looks at the pertinent literature relevant to strategic IT as well as performance. Under theoretical review section, three theories that help explain study area and study variables have been discussed. This is then followed by empirical literature on the various variables as well as the research topic. A conceptual framework is developed and discussed as an in-depth analysis of the dependent and independent. The other sections covered include, summary of empirical and literature review and summary of research gaps.

#### ***2.1.1 Overview of Strategic Information Technology***

Strategic IT can be viewed as the application of IT to support business operations in order to gain a competitive advantage. This also means that strategic IT strategies and tactics require that resources are allocated appropriately to support the implementation of organizational strategies and hence enhance their performance (Cui, Ye, Teo, & Li, 2015). Organizations that have had success stories on application of Strategic IT boost of being IT flexible. This refers to the ability to quickly and economically adapt IT applications in order to optimally support business operations and enhance capabilities to be able to take competitive actions within an industry (Han, Wang, & Naim, 2017).

### ***2.2 Theoretical Review***

#### ***2.2.1 Resource Based Theory***

The theory stipulates that the fundamental sources of organizational superior performance are mainly associated with its resource attributes and capabilities that are vulnerable though not easily copied (Peteraf & Bergen, 2003). Building competitive advantage as supported by the resource-based theory is at the core of strategic management literature (McWilliams & Siegel, 2011). The theory builds on the assumption that firms in an industry have the strategic resources distributed heterogeneously among them and there are differences which are stable over a period of time (Kozlenkova, Samaha, & Palmatier, 2014). Determinants of a firm's strategy are the competitive environment and the resources it has while at the same time, the resources and the competitive environment are affected by a firm's strategy. This interrelationship creates changes within the organizational environment that eventually new information is which leads to creation of new opportunities for learning that may result to new resources being created or developed. For competitive advantage to be sustainable, the following four factors must be considered; superior resources that are believed to be heterogeneous, imperfect resource mobility, ex post limit and ex ante limits to competition (Gamble, Thompson, & Peteraf, 2013).

Despite the positive contributions of the resource based approach, a lot of problems which stand unresolved are still present as noted by many scholars after a series of scrutinizes and assessments. Some of the criticisms are directed to the determination of unit of analysis, the condition of heterogeneity, the exogenous nature of value, the neglect of the environment and the underlying condition of non-limitability based on the behavioural assumption (Foss, 1998). This theory explains the first objective on IT penetration. Firms with more resource and capabilities can be able to apply penetration strategies that are unique to them only compared to firms that are still struggling with their resource base.

#### ***2.2.2 Efficient Structure Theory***

The efficient structure hypothesis states that those firms that are more efficient than others will earn higher profits. The theory is built on two distinct approaches. The first approach being the X-efficiency hypothesis which postulates that highly efficient firms

eventually become more profitable compared to other firms because of their lower costs (Athanasoglou, Brissimis, Delis, & Money, 2008). It also indicates that firms will end up having more market share that could culminate into high levels of concentration courtesy of them being efficient. However, the approach does not show any relationship (causal) between concentration and the ultimate profitability of the firms (Athanasoglou et al., 2008). The second approach is the Scale–efficiency hypothesis which puts more emphasis on economies of scale as a determinant of profitability rather than differences in management (Rasmussen, 2010). With those economies of scale, large firms will also acquire huge market share that which may then culminate into higher concentration that will then lead to profitability. Demsetz (1973) through his proposition of the efficiency hypothesis formulated the first alternative explanation on market structure and organizational or firm performance. Applied to the telecommunication industry, then the hypothesis postulates that a telecommunication firm that is able to be efficiently run more than others in the industry gains higher profits resulting from low costs of operations. The firm shall also have or acquire huge market share. Hokroh (2013) supported the assumption by stating that efficiency differences shall consequently create industry position differences that eventually intensify concentration. This theory explains the second objective of strategic IT access costs and performance. The theory argues with regards to this variable that firms which are able to reduce costs to a great extent will emerge more profitable and hence with high performance compared to their corresponding firms with high costs and hence minimal profitability.

### **2.2.3 Task-Technology Fit Theory (TTF)**

The TTF theory's assumption is that the capabilities of a technology is measured in terms of how much it can support the demands of a job (Goodhue & Thompson, 1995). TTF models hypothesize that IT shall be applied or used only when, the functions that the user can access fit the job or task of the user. Knowledgeable and rational users will select the methods and tools that can help them accomplish tasks with maximum benefit. IT that do not offer satisfactory benefits shall be avoided. TTF models are based on four major constructs, Technology and Task Characteristics, that jointly affect the Task-Technology Fit (third construct), which later influences the output variable like performance or usage. Individual abilities is accepted universally as an addition to the TTF model (B. Wu & Chen, 2017). Work adjustment theory supports addition of people's abilities to the TTF model which was initially derived from the Work Adjustment Theory. The theory also supports the studies in modern management information system where specific IT experiences are related to the higher utilization of that IT. This theory suggests that customers will choose those financial innovations that will help them complete the task with maximum net benefit and therefore increase the performance of Telecommunication companies (Viswanath & Xiaojung, 2010). This theory supports the third objective on IT skills and performance since it deals with how technological acquired abilities and skills matches with IT capabilities to do the job thereby influencing the overall performance realized by a firm (Goodhue & Thompson, 1995).

## **2.3 Empirical Review**

### **2.3.1 Strategic IT Penetration**

Pradhan, Mallik, Bagchi, and Sharma (2018), studied on ICT penetration and stock markets nexus from cross-country panel evidence using the following independent variables, ICT penetration, stock market development and per capita economic growth. They employed the panel co integration technique and based on the outcome, concluded that the variables are co integrated. Another observation was that a long run relationship existed among them. By employing the vector error correction method and granger causality technique, the study concluded that granger causality in deed existed in the long run as well as in the short run among the variables. However, the exact nature of the results varies for the selected ICT penetration indicators in use. Strategic Information technology's (SIT) penetration is based on how swift IT is able to get rooted to the grassroots. Makanyeza and Ndlovu (2016), assessed on the penetration of IT and its possible effects on export performance using the SME in the manufacturing sector in Zimbabwe as the case study. The research used a cross-sectional survey design of two hundred and forty-three firms in Harare. The study results depicted that the performance of manufacturing firms was directly related to IT penetration. Further, it was revealed that export performance prediction by IT is dimension-specific. Amid three IT dimensions used by the study, it was only the relationship building capabilities that predicted export performance significantly. The rest: marketing capabilities and market intelligence were insignificant predictors of export performance. The researchers recommended for the use of IT to be aligned with firm goals in order to yield greater performance. Oluwole and Adewale (2014) evaluated the penetration effects of IT on the commercial banks in South Africa. The study used secondary data for the period between 1990 to 2012. Orthogonal transformation approach was used to analyze data. The study employed residual cointegration regression analysis by the use of both Kao and Pedroni methods that determined the genuity of the results. The study found out that IT penetration and use increased both ROA and ROCE. Since ROA and ROCE were the determinants of performance, it can thus be concluded that IT penetration and use resulted in high performance levels among the commercial banks in South Africa. The study recommended for banks to emphasize stringent policies that enhance proper IT equipment utilization as compared to emphasis on additional investments which can be costlier to the banks.

Imalingat (2015b), investigated the effect of IT penetration and investment on performance of microfinance banks in Kenya. Descriptive research design was used with a survey of 9 microfinance banks between 2010 and 2014. Secondary data sources were used from World Bank publications and audited financial statements of these banks. The study found that IT adoption and investment directly influenced performance in a positive manner. It was recommended by the study that the microfinance banks keep investing in new technologies such as credit cards and debit cards issuance and use for them to embrace the latest innovations and inventions in the banking sector. The study recommended for further studies on the effect of IT penetration and investment in the entire banking sector

for more representative results across the industry. Another study in Kenya by Wilson, Iravo, Tirimba, and Ombui (2015) investigated the effect of IT penetration and use on the performance of logistics Firms in Nairobi County. The research collected data from 10 logistics firms. Based on the model of the research, they developed on one hand four scales each with an aggregated set of variable to be used to measure IT in company. On the other hand, company performance was measured using three developed scales. SPSS version VI was used to analyze data. The output was then presented using charts and frequency tables. The study realized a 93% response rate. 70% of the respondents were shareholders of logistics firms. The study attributed low performance of logistics firms to low adoption and use of IT since it was established that fifty percent of the firms did not embrace IT in their departments and service delivery. The study results concluded that there was a strong relationship between variables of the study and overall performance of logistic firms in Nairobi County based on the ANOVA result for all variables that was at F value of 2.729 and P value of 0.000.

### **2.3.2 Strategic IT Access Costs**

This variable aimed at establishing whether strategic IT access costs influence performance of firms. IT investment advantages for firms is not limited to the benefits of cost reduction as there are other advantages such as innovation and invention that come with it. Investment in contemporary IT can result in enhanced conveniences such as customer access over wide range of geographical locals thereby creating networking opportunities and more opportunities of cross selling which can result in increased profitability and hence high performance (San-Jose, Iturralde, & Maseda, 2009).

Bell, Bryman, and Harley (2018), did several studies on IT subject between 1987 and 1992. One of them was undertaken between 1987 and 1991 involving 380 large firms. The results indicated that the returns per year on IT capital investments were above 50% while that of Information System (IS) labour capital was very high as well. The annual return on investment in the service area was above 60%. They also did another research study in 1988 – 1992. Using 370 large firm's data on IT spending they studied the impact of IT investment on customer surplus, productivity and profitability. The results indicated that productivity was increased by application of IT which also created substantial value for consumers. They were however unable to detect any increases in profitability as measured by ROA, ROE and Total Return. With the research returning calculated high standard errors of estimates, it meant that some firms obtained significant competitive advantages while others didn't. Despite of the outcome, insufficient data put to question the element of reliability especially in differentiating characteristics exhibited by the high performers and poor performers. It's therefore prudent that further research be undertaken that will be more firm specific and detailed about the applicability of deployed IT and its benefits as well as try to explain why IT investment is beneficial to some firms and a problem to others. Kohli, Devaraj, and Ow (2012), in their article on IT investment influence a firm's market value, noted that managers can only make informed IT investment decisions if they are able to quantify the contribution of IT on a firm's performance. Managers rely on performance evidence such as IT influence on a firm's market value and other performance indicators such as the accounting and financial performance. Through the study, they also examined the efficacy of IT's influence on firm value and also included financial performance measurements for non-publicly traded (NPT) hospitals which didn't use any market-based conventional measures. They found out from their study that influence of IT investment on the firm is more visible and statistically significant on firm value than exclusively on the accounting performance measures.

Avgerou and Walsham (2017) in their book on Information Technology Investment Planning, indicated that the justification for IT investments often rely on anticipated return on investment (ROI). Yet executives frequently struggle with how to incorporate costs and benefits that are associated with employees in the phases of adopting IT. Previous research has shown that these benefits and costs can be significant and ignoring or undervaluing them may lead to inaccurate assumptions about the true expenses and returns of the IT under consideration. This can lead to less than optimal decisions or technology choices that do not provide the anticipated yields.

Hagsten and Sabadash (2014), determined the impact of highly skilled ICT Labour on firm performance. Labour was considered as a cost to ICT as good ICT application in the work place comes with the existence of IT skilled personnel. The study collected secondary data from six European countries. The researchers built a mainstream research applying the economic theory of production in determination of various inputs and outputs' contributions. To investigate the effect of human capital on productivity, the researchers introduced an interaction, but instead of IT investments they allowed both the IT-intensive capital and generally skilled human capital to vary with IT maturity. The European countries used were: Finland, UK, France, Norway, Sweden and Denmark. The study period was between 2001 and 2009. The study established that highly skilled IT labour resulted to high firm performance. The study results were beneficial to the EU employment policy debate on skill mismatch that over time resulted to unmet IT skills' demand. Therefore, from the study results, it was concluded that for firms to meet their IT labour demands, they must be willing to invest in IT costs which in the long run results to high performance.

Onyango and Ngugi (2014), examined the effect of ICT (access cost) investment cost on performance of organizations among other variables like IT competency, organization structure, IT policy and government regulations. The top, middle- and first-line managers from Kenya Revenue Authority formed the study sample. And through a descriptive research design where questionnaires were used to collect primary data, the results indicated that ICT investment costs were critical to ICT success and had a direct influence on performance at the organization. Navimipour and Soltani (2016) in their article on relationship between measures of IT investment and facets of corporate business performance noted that results from their study showed a positive relationship between IT investments and firms output and labor productivity. Despite of that, their model was insufficient and hence there is need for it to be

improved in order to effectively and reliably measure performance effects of total IT investments. The study also suggests that the measures of IT investment have differential effects on the various measurement indicators of corporate business performance. For effective results, it would have been wiser to employ different models and research strategies to measure the IT effects on firm output performance and labor productivity and the ones to determine the IT effects on management effectiveness and strategic business performance.

### ***2.3.3 Staff Strategic IT Skills***

Several research studies have been undertaken in a bid to unveil the effect of staff strategic IT skills on performance of firms both globally and locally (Bennett & McGuinness, 2009). Forth and Mason (2006), aimed to answer the question, do IT skills shortages hamper firms' performance? The researchers used secondary data from UK enterprises' survey sources in 1999 and also post survey on the same enterprises. The study established that IT skill shortages had an indirect negative impact on performance since that resulted to deficiencies in IT adoption and post adoption IT intensity. Hagsten and Sabadash (2014), determined the impact of IT skills on firm performance in UK, Finland, France, Sweden, Norway, and Denmark (six European countries) between 2001 and 2009. The study collected secondary data from the countries in order to investigate the effect of human capital on productivity. The researchers introduced an interaction, but instead of IT investments they allowed both the IT-intensive capital and generally skilled human capital to vary with IT maturity. The study established that highly skilled IT staff resulted to high firm performance. Wachira, Muturi, and Sirma (2014) evaluated the perceived effect of IT skills on performance of licensed Saccos in Nairobi County in Kenya. A comparative survey research design was used. A census of all the 34 licensed Saccos was done. The study relied wholly on primary data which was collected by semi-structured questionnaires self administered. The study revealed that IT skills and knowledge is crucial in determination of organizational performance as high skills and knowledge of IT influenced the performance of the saccos positively. Wangai and Ngugi (2014), researched on the effect of IT skills on the performance of stock brokerage firms in Kenya. The study used stratified random sampling technique to select 387 respondents who formed the sample size. The respondents were stratified from the top, middle and first line levels of management respectively. Primary data was collected through self administered semi structured questionnaires. Descriptive research design was used. Data was analyzed by SPSS and regression analysis. The study found that the automation of IT skills affected the performance of stock brokerage firms in Kenya positively. Onyango and Ngugi (2014), through a case study of Kenya Revenue Authority investigated the influence of ICT staff skills on the performance of an organization. To achieve this, the study reviewed the following five variables; IT competency, investment cost, organization structure, IT policy and government regulations. The top, middle- and first-line management levels formed the sample of the study. The study employed a descriptive research design with questionnaires being used to collect primary data. The analysis of data was done using SPSS statistical software and presented through charts and frequency table. From the results it was evident that performance at the organization was heavily influenced by the use of competent employees with IT skills.

### ***2.3.4 Performance of Telecommunication Firms***

According to Porter (2008), performance is measured by effectiveness, efficiency and profitability. As seen from the resource based theory, in strategic management the fundamental sources of superior performance for organizations are mainly associated with the attributes of the organizations resources and capabilities which are vulnerable but not cheap to copy (J. Wu & Olk, 2014). Strategic Information and communication technology are resources that can enable organizations operate efficiently and effectively towards achieving higher profits (Porter & Heppelmann, 2014). Effectiveness is the ability to choose appropriate goals and achieve them. The main Indicator of effectiveness in an organization is satisfied customers. In telecommunication industry, effectiveness in service delivery includes reliability derived from simplicity in service delivery, speed to market and trust through transparency in operations all brought about by effective implementation of strategic IT systems like customer care management systems (Bititci et al., 2011). According to Porter (2008) the main goal of any business venture is profitability. It therefore means that it's the best indicator of an organizations business success that should be measured. Partial budgeting has been employed by organizations to enable them assess incremental changes in business and their impact on profitability before their main implementation. According to Kariuki (2009), telecommunication companies just like many other companies in different sectors have always measured their success through profitability as they always report their quarterly and annual returns to the public.

## ***2.4 Summary of Empirical and Literature Review***

Even though the research tries to look at the most important strategic IT factors influencing performance of telecommunication firms, the scope is too big and the general objective can still be achieved by a research on any one of the independent variables. It's also difficult to get correct results concerning strategic IT penetration as penetration are majorly associated with big firms yet small telecommunication industry players have contributed a lot to the issue of IT penetration. The research shall also concentrate more on mobile service providers yet the industry is more than just mobile services. However, being an area that is yet to be looked at in details by many researchers within the country, the descriptive nature of the research makes it very objective and the output will be of great benefit to the telecommunication firms, scholars and the public at large. In addition, even though many researchers have done studies on different aspects of the IT industry globally, most of them were never specific on Strategic IT effect on telecommunication industry area and yet it's one of the crucial areas that must be emphasized in strategic management of the companies. They didn't specifically analyze which IT factors were influencing performance. No study has been conducted in Kenya to find out how strategic technologies will impact the performance of Telecommunication firms.

**Table 2.1: Summary of Empirical Gaps**

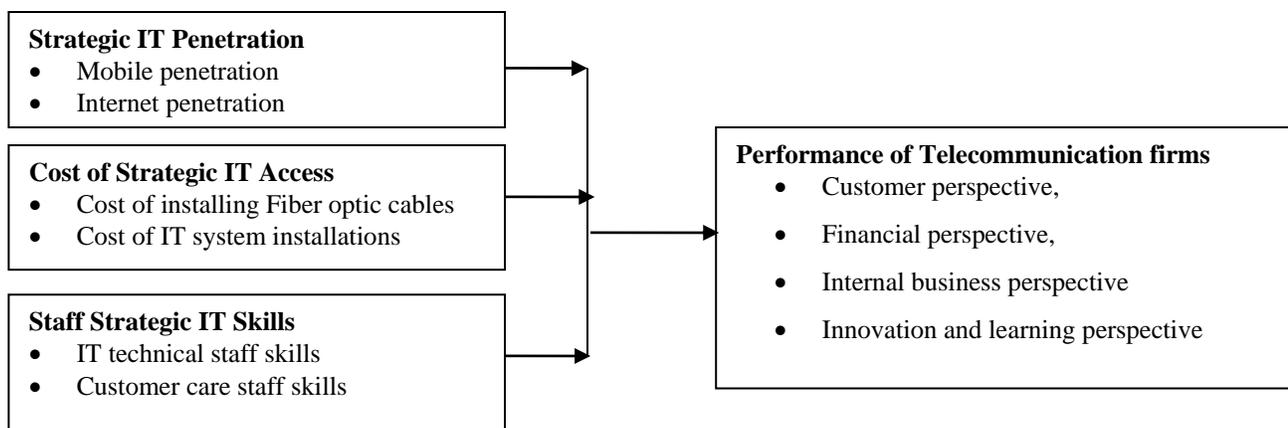
Source	Purpose	Research Gaps
Makanyeza & Ndlovu , (2016). ICT Usage and its Effect on Export Performance: Empirical Evidence from SME in the Manufacturing Sector in Zimbabwe.	Penetration of ICT and its possible effects on export performance	Looked at one aspect of performance influenced by IT which might not give a trues picture of overall company performance
Binuyo & Aregbeshola, (2014). The ICT on commercial bank performance.	Penetration of ICT on, performance	Use of secondary data alone might produced biased results as some data might also not be readily available
Imalingat, S. (2015). The effect of information and communication technology investment on financial performance of microfinance banks in Kenya. University of Nairobi.	ICT Penetration through adoption and effect on performance	Scope limited to banking sector. Need for further research to see if results can be replicated in other sectors.
Wilson, Iravo, Tirimba, & Ombui, ( 2015). Effect of IT on Performance of Logistic Firms in Nairobi County. <i>International Journal of Scientific and Research Publications</i> , 4(5), 241-283.	ICT penetration and use, performance	Indicators of IT penetration like mobile penetration and internet penetration not captured
Hagsten & Sabadash, (2014). <i>The Impact of Highly-skilled ICT Labour on Firm Performance: Empirical Evidence from Six European Countries.</i>	ICT labour cost, ICT Skills performance	Empirical review without adequate statistical inferences for justification
Onyango & Ngugi, (2014). Influence of information and communication technology investment on organizational performance. A case of Kenya revenue authority. <i>European Journal of Business Management</i> , 1(11), 1-17.	Effect of investment cost, and staff IT competency skills on performance	Results derived from one organization might not be objective for generalization. Not clear how investment costs are determined
Wachira, Muturi & Sirma, (2014). An Evaluation of the Perceived Effect of ICT's on the Performance of Sacco's in Kenya: Case of Licensed Sacco's. <i>Information Knowledge Management Research &amp; Practice</i> , 4(12), 14-32.	Analyse the effect of IT skills on performance	No clear performance indicators specified Need for improved reseach model
Wangai, T., & Ngugi, K. (2014). Influence of Information Technology on Performance Of Stock Brokerage Firms in Kenya. In: Sage Publishers.	Analysis of IT skills and performance	Research not related to the telecommunication sector firms

Source: Author (2020)

**2.6 Conceptual Framework**

The conceptual framework in figure 2.1 below illustrates both the independent and the dependent variables of this study with their sub variables as guided by the specific objectives.

**Figure 2.1: Conceptual Framework**



**Independent variable**  
Source: Author (2020)

**Dependent Variable**

### III. CHAPTER THREE: RESEARCH METHODOLOGY

#### 3.1 Introduction

The chapter explains the study methodology in relation to collection and analysis of data.

#### 3.2 Research Design

The research design that was used in this research was descriptive research design. The design was used because it describes things, character and state of affairs as they exist at a particular point in time (Dawson, 2019). A description survey was also used because it allows researchers to gather data at a particular point in time hence helping in describing the nature of existing conditions, or determines the existing relationship between specific events (Kothari, 2009). The method also deals with problems and desired objectives that are clear. In addition, the method allows for large sample data collection resulting to a more representative result. Being also essentially cross section, it allowed the researcher to use quantitative and qualitative data analysis methods to address the problem. It also provided facts and suggestions on relationship between variables and their apparent causes (Mugenda & Mugenda, 2009). The choice of the descriptive study design allowed the researcher without manipulating the study variables and analyze the state of affairs on IT performance within the telecommunication firms. The findings of this study hence can be generalized to the larger population.

#### 3.3 Target Population

Joyner, Rouse, and Glatthorn (2018), defines population as a group of individuals, objects or items from which samples are taken for measurement. Saunders and Lewis (2012) on the other hand, defined target population as all members of real or hypothetical set of people or objects which an investigation wishes to generate results on. Based on population data presented in appendix iv, the target population of the study was composed of 144 respondents as summarized in table 3.1 comprising of managers, supervisors and team leaders within Nairobi County from the three tier 1 telecommunication firms in Kenya as per the Communication Authority of Kenya classification. The total population is calculated as per the table 3.1 below:

**Table 3.1: Target Population of the Study**

Telecommunication firms (strata)	Retail shop/centre managers	Retail shop/centre supervisors/ team leaders	Managers in Technology, Resources and Finance departments	Total
Safaricom (N1)	20	40	8	68
Airtel (N2)	9	9	6	24
Telkom (N3)	23	23	6	52
<b>Totals</b>	<b>52</b>	<b>72</b>	<b>20</b>	<b>144 (N)</b>

Source: Survey Data, (2020)

#### 3.4 Sample and Sampling Technique

Based on judgmental sampling technique, the researcher picked a sample size which constitutes 30% of the total population size. In order to achieve a sample size (n) = 62, the researcher used proportionate stratified sampling technique to determine the number of managers to be interviewed from each stratum (telecommunication company). This sampling technique is justified by Mugenda and Mugenda (2009) who assert that a sample of 30% is significant and hence ideal for research purposes. The sample size is shown in table 3.2.

$$\begin{aligned}
 (\text{Total population size (N)}) \times (30\%) &= (\text{Sample size (n)}) \\
 144 \times 0.3 &= 43.2 \\
 n &= 44
 \end{aligned}$$

**Table 3.2: Sample Size**

Telecommunication firms (strata)	Retail shop/centre managers	Retail shop/centre supervisors/ team leaders	Managers in Technology, Resources and Finance departments	Total
Safaricom (N1)	6 (20x0.3)	12 (40x0.3)	2 (8x0.3)	20
Airtel (N2)	3 (9x0.3)	3 (9x0.3)	2 (6x0.3)	8
Telkom (N3)	7 (23x0.3)	7 (23x0.3)	2 (6x0.3)	16
<b>Totals</b>	<b>16</b>	<b>22</b>	<b>6</b>	<b>44 (n)</b>

Source: Survey Data, (2020)

#### 3.5 Data Collection Instrument

Both primary and secondary data was used for this study. Questionnaires were administered to collect primary data. The admission was done to every member of the sample size of the study. The questionnaires adopted the Likert scale rankings for ease of understanding and clarity of presentations. Further, the questionnaires adopted a semi-structured.

### **3.5.1 Validity**

Validity refers to the extent in to which instruments of collecting data are accurate in its intended measurements (Frankfort-Nachmias, Nachmias, & DeWaard, 2014). Mugenda and Mugenda (2009), assert that validity is the extent to which data analysis results actually represent the phenomenon being studied. There are three forms of data validity namely, construct, content and criterion-related validities (Daniel & Sam, 2015). Construct validity determines the extent to which data collected from data collection instrument accurately reflects a theoretical concept. Criterion-related validity assesses behavior of subjects in specific situations. Content validity is the extent to which the measurement device offers adequate coverage of questions being investigated as is usually assessed by experts in the field of study (Cooper & Schindler, 2014; Salkind, 2010). This study assessed content validity using two groups of experts from the ministry of Information and Communication.

### **3.5.2 Reliability**

Daniel and Sam (2015), defined reliability as the extent to which errors contained in a measuring instrument appear inconsistently each time a given unit is measured by the same instrument. The study instrument was reviewed based on the pre-test experience by both the researcher and the research assistants. Cronbach's alpha was used a measure of internal consistency, that is, how closely related a set of items are as a group and based on recommendation of Nunnally (1978) that instruments used in research should have reliability of about 0.70 and above. If the alpha value is less than 0.7, this indicates low internal consistency of the data that implies that the questions on the instrument are either vague or not understood by the respondents and therefore the respondents are assumed to have used guesswork to complete the questions. In that regard, the questionnaire is edited to achieve desirable Cronbach's alpha.

### **3.6 Data Collection Procedure**

A letter to facilitate data collection stage was attained from Kenyatta University. The questionnaire was self-administered where the respondents themselves complete the questionnaires without the presence of an interviewer (Frankfort-Nachmias et al., 2014). Due to the sensitive information needed for the study, self-administered questionnaires are deemed more effective than mail questionnaires because this gives assurance to respondents that their privacy is protected in that the data they provide would be handled and protected in such a way that they would not be associated with them personally (Cooper & Schindler, 2014). The researcher obtained permission to do research by seeking clearance from NACOSTI.

### **3.8 Analysis and Presentation of Data**

Before embarking on data analysis, the returned questionnaires were checked and corrected for consistency and completeness. Both Descriptive and inferential statistics were used to highlight and explain key findings. Qualitative data was analysed by use of content analysis. Significance relationship of the variables was analysed using ANOVA method. The study used SPSS software to facilitate data Analysis. Regression model was used to analyze data. The independent and dependent variables were analyzed by the following regression equation:

$$Y = \alpha + \beta_1 A_1 + \beta_2 A_2 + \beta_3 A_3 + e$$

Y = Performance of Telecommunication firms in Kenya

$\alpha$  = Constant

$\beta$  = Independent variables coefficients

$A_1$  = strategic IT Penetration

$A_2$  = Cost of strategic IT access cost

$A_3$  = Staff strategic IT skills

e = Error term

#### **3.8.1 tests on assumptions of classical linear regression model Normality Test**

The study undertook normality tests using Shapiro-wilk statistic, multicollinearity tests using variance-inflating factor (VIF), heteroscedasticity tests using Levine's test and linearity tests was done using ANOVA test of linearity in order to determine whether the data and the models meet the assumptions of the classical linear regression model.

#### **3.8.5 Data presentation**

Data that was analyzed was presented by statistical frequency tables and charts. These presentations were supported by results discussions in prose. The presentation was done in systematic order as per the order of the variable and the outline of questions in the questionnaires.

### **3.9 Ethical Issues**

As a way of enhancing ethical standards in the study, confidentiality was of utmost importance. Questionnaires design ensured no questions that prejudice ones emotional or psychological wellbeing were captured. The design promoted anonymity. The researcher also acquired supporting letters that indicated the legality and permission of undertaking the research study from the university and also from other relevant government bodies. This instilled confidence to the respondents. Some of the letters are listed in the appendices.

#### IV. CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

##### 4.1 Introduction

The chapter outlines the study findings presented using tables followed by discussions the findings arranged in order of objectives as outlined from chapter one.

##### 4.1.1 Response Rate

The study targeted a sample size of 44 respondents in collecting data out of which 41 filled in and returned the questionnaires making a response rate of 93.2% as shown in Table 4.1.

**Table 4.2: Response Rate**

Response	Frequency	Percentage
Responded	41	93.2
Not responded	3	6.8
<b>Total</b>	<b>44</b>	<b>100</b>

Source: Survey Data, (2020)

According to Mugenda and Mugenda (2003) assert that response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent. Based on the assertion, the response rate was considered to excellent.

##### 4.2 Diagnostic Tests

##### 4.2.1 Reliability Results

The study sought to determine the reliability of the results. This was tested by the use of Cronbach's alpha.

**Table 4.3: Reliability Analysis**

Variable	Cronbach's alpha	Verdict
Strategic It Penetration	0.844	Reliable
Strategic It Access Costs	0.914	Reliable
Staff Strategic It Skills	0.764	Reliable
Performance of Telecommunication Firms	0.755	Reliable
<b>Aggregate Score</b>	<b>0.819</b>	<b>Reliable</b>

Source: Survey Data, (2020)

A pilot study was conducted to test the reliability and validity of the research instruments. The findings of the pilot study are as presented in Table 4.2. The results showed that strategic IT access costs had the highest reliability alpha of 0.914, followed by strategic IT penetration with a reliability alpha of 0.844, staff strategic IT skills with a reliability alpha of 0.764 and telecommunication firms 0.755, From the findings, the Cronbach's alpha of all the variables was above the threshold of 0.7 thus implying that the instrument was reliable and valid. According to Zikmund and Barin (2012) a reliability test which yields a coefficient greater than or equal to 0.7 is sufficient enough.

##### 4.2.2 Normality test

The normality was tested using the Shapiro-Wilk test which also has power to detect departure from normality due to either skewness or kurtosis or both. If statistic ranges from zero to one and figures are higher than 0.05 there is an indication that the data is normal (Razali & Wah, 2011). Shapiro-Wilk test assesses whether data is normally distributed against hypothesis that:

H<sub>0</sub>: Sample does not follow a normal distribution.

H<sub>a</sub>: Sample follows a normal distribution.

When the p-value is greater than the alpha value, then one fails to reject the null hypothesis. Table 4.3 shows the results of the Shapiro-Wilk normality test.

**Table 4.4: Tests of Normality**

	Kolmogorov-Smirnov <sup>a</sup>		Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.
Strategic IT Penetration	0.127	41	0.019	0.827	41	0.001
Strategic IT Access Costs	0.121	41	0.024	0.874	41	0.002
Staff Strategic IT Skills	0.176	41	0.071	0.624	41	0.004

Lilliefors Significance Correction

Source: Survey Data, (2020)

The table shows that the distribution of data on strategic IT penetration (p-value 0.001>0.05), strategic IT access costs (p-value

0.002>0.05); and, staff strategic IT skills (p-value 0.004>0.05) are all normally distributed. Since the p value for all the variables were less than the alpha value, we reject the null hypothesis that “the sample does not follow a normal distribution”. This therefore implies that sample follows a normal distribution.

#### 4.2.3 Heteroscedasticity

The measure of heteroscedasticity is important multivariate analysis and even though its violation may reduce the accurateness of the analysis, the effect on ungrouped data is not fatal (Tabachnick & Fidell, 2007). Levene test was used to examine the equality of variances for the variables calculated (strategic IT penetration, strategic IT access costs and, staff strategic IT skills). Regression analysis assumes that variances of the population from which different samples are drawn are equal.

**Table 4.5: Test of Homogeneity of Variances**

Levene Statistic	df1	df2	P-value
1.626	41	41	.003

Source: Research data, (2020)

From Table 4.4, the resulting P-value of Levene's test is below the conventional 0.05 critical value, demonstrating that the obtained differences in sample variances are probable not to have occurred based on random sampling from a population with equal variances. Thus, there is momentous difference between the variances in the population.

#### 4.2.4 Multi Collinearity Test

Mason and Perreault (2011) explain that when there exists multicollinearity, the coefficient estimates may change erratically in response to any small changes in the model or the data. The VIF detects multi collinearity by measuring the degree to which the variance has been inflated. A VIF greater than 10 is thought to signal harmful multi collinearity as suggested by Baum (2006).

**Table 4.6: Summary of Collinearity Statistics**

Model	Collinearity Statistics	
	Tolerance	VIF
Strategic IT Penetration	0.748	3.728
Strategic IT Access Costs	0.628	3.436
Staff Strategic IT Skills	0.175	3.478

Source: Survey Data, (2020)

The VIF was checked in all the analysis and the outcome was not a cause for concern based on the assumptions by Baum (2012) who indicated that a VIF greater than 10 is a cause of concern. Results in Table 4.5 shows that all the variables had a variance inflation factors (VIF) of less than 10: strategic IT penetration (3.728), strategic IT access costs (3.436) and, staff strategic IT skills (3.478). This implies that there was no severe collinearity with the variables thus all the variables were maintained in the regression model.

### 4.3 Background Information

This section starts by analyzing the participant’s demographic information. Specifically, this study inquired information on respondent’s gender, age, job title and highest academic qualification.

#### 4.3.1 Distribution of Respondents by Gender

Participants were required to indicate their gender category. This was sought in view of ensuring fair involvement of both genders. Results are presented in Table 4.6.

**Table 4.7 Respondents by Gender Category**

	Frequency	Percentage
Male	25	61.0
Female	16	39.0
Total	41	100.0

Source: Survey Data, (2020)

Based on the finding, this study concludes that there was fair involvement of participants from both genders, thus implying that the findings of this study did not suffer gender biasness.

#### 4.3.2 Distribution of Respondents by Age

Individuals of various age groups tend to perceive and interpret subjects differently. In view of gathering opinions from these groups, respondents were required to indicate their age category. Results are presented in Table 4.7.

**Table 4.8 Respondents by Age Group**

Category	Frequency	Percentage
Below 30 years	7	17.1
31 to 40 years	11	26.8
41 to 50 years	12	29.3
51 to 60 years	8	19.5
Above 61 years	3	7.3
Total	41	100.0

Source: Survey Data, (2020)

The results in Table 4.2 revealed that, most of the respondents (29.3%) were aged between 41 and 50 years, 26.8% of the respondents were aged between 31 and 40 years, 29.3% of the respondents were aged between 41 and 50 years, 17.1 % of the respondents were aged below 30 years whereas 7.3% of the respondents were aged above 61 years. This implies that majority of respondents who took part in this study were aged more than 30 years. The results therefore show fair participation of respondents from different groups.

#### 4.3.3 Job Designation

Respondents were required to indicate their job designation. Results are presented in table 4.8

**Table 4.9: Job Designation**

Category	Frequency	Percentage
Center Managers	6	14.63
Center Supervisors	9	21.95
Team Leaders	8	19.51
Managers in Technology	7	17.07
Resources and Finance Departments	11	26.83
Total	41	100.0

Source: Survey Data, (2020)

Results show that participants worked various positions among which include; with most working with (26.83%) resources and finance departments, 21.95% worked as center supervisors, 19.51% worked as team leaders, 17.07% worked as managers in technology while 14.3% worked as center managers. This implies that participants holding various positions were fairly involved in this study.

#### 4.2.4 Period of Service

Employee period of service is closely related with individual understanding on organizational external and internal operations. Based on this assumption, respondents were required to indicate their period of service in their respective organizations. Results are presented in Table 4.9.

**Table 4.10 Period of Service**

	Frequency	Percentage
Less than 1 year	1	2.4
2 to 4 years	10	24.4
5 to 9 years	12	29.3
Over 10 years	18	43.9
Total	41	100.0

Source: Survey Data, (2020)

The study established majority of the respondents (43.9%) had served for a period of over 10 years, 29.3% of the respondents had served for a period of 5 to 9 years, and 24.4% of the respondents had served for a period of 2 to 4 years, whereas 2.4% of the respondents had served for less than 1 year. This implies that a big number of the respondents had served the organization for a considerable period of time (5 years and more) which implies that they had high levels of experience and understanding of the telecommunication companies they were working in. This depicts therefore that the respondents were in a position to respond to the survey questions regarding their organizations adequately.

#### 4.3.4 Highest Academic Qualification

Individual educational qualifications are closely associated with ability to interpret, and solve challenges. In view of gauging the respondent's ability to respond to study subject participants were required to indicate their highest educational qualifications. From the results in table 4.10, the study established that most of the respondent (39.0%) held bachelors' education 29.3% of the respondents held college diploma education, 17.1% of the respondents held master's education and above while 14.6% of the respondents held

certificate or below as their highest level of education qualification. This indicates that all of the respondents were literate which implies that they were in a position to give comprehensible information sought by the study effortlessly.

**Table 4.11: Highest Academic Qualification**

	Frequency	Percentage
Certificate and below	6	14.6
Diploma	12	29.3
Bachelors	16	39.0
Masters and above	7	17.1
Total	41	100.0

Source: Survey Data, (2020)

#### 4.4 Descriptive Analysis

The following section presents descriptive statistical findings on strategic IT penetration telecommunication firms in Kenya then followed by the second variable on strategic IT access costs by Telecommunication firms in Kenya and lastly, the descriptive findings on influence of staff strategic IT skills on performance of telecommunication firms in Kenya.

##### 4.4.1 Strategic IT Penetration

Participants were required to indicate their level of agreement with the following statements that relate to the strategic IT penetration among Telecommunication firms in Kenya.

**Table 4.12 Strategic IT Penetration Measures**

	N	Min	Max	Mean	Std Dev
Financial performance of telecommunication firm is highly influenced by mobile penetration.	41	3.00	5.00	4.27	0.67
Mobile penetration supports role out of innovative products and services.	41	3.00	5.00	4.22	0.65
Internet penetration helps boost profitability levels and hence performance.	41	3.00	5.00	4.10	0.62
Roll out of 4 <sup>th</sup> Generation network improves service delivery.	41	3.00	5.00	4.10	0.62
<b>Aggregate Score</b>				<b>4.17</b>	<b>0.64</b>

Source: Survey Data, (2020)

Results show that majority of the respondents agreed that financial performance of telecommunication firm is highly influenced by mobile penetration (M= 4.27 SD =0.67) and mobile penetration supports role out of innovative products and services (M= 4.22 SD =.65). These findings support the empirical literature by Makanyeza and Ndlovu (2016) that performance of firms was directly related to IT penetration.

Further the study revealed that internet penetration has helped to boost profitability levels and hence performance and that roll out of 4<sup>th</sup> Generation (4G) network has helped improve service delivery (M= 4.10 SD =0.62). These findings concurs with the observations made by Oluwole and Adewale (2014) that IT penetration and use increased both return on on assets (ROA) and return of capital employed. On overall the aggregated score for all sub-measures was recorded at 4.17 with low standard deviation of 0.64. In other words, based on the measurement scale, the aggregated score of 4.17 translates to agree thus implying that majority of the respondent agreed with each of the above statement that assessed on strategic IT penetration among Telecommunication firms in Kenya. Further a low standard deviation of 0.64 from the mean also reaffirms that respondents almost concurred in their opinions.

Participants were required to indicate some of the challenges that influence the most mobile and internet penetration to the telecommunication firm.

**Table 4.13: Challenges Hindering IT Penetration**

challenges	Percentage
Poor network infrastructure	61.0%
Lack of enough staff skills	61.0%
High distribution costs	51.2%
Government regulation	58.5%
Lack of consumer awareness	53.7%

Source: Survey Data, (2020)

The findings revealed challenges that hindered the efforts by telecommunication firm to enhance mobile and internet penetration. The respondents rated lack of enough staff skills; and, poor network infrastructure highest at 61.0% each. Further, government regulation

(58.5%), lack of consumer awareness (53.7%) and high distribution costs (51.2%) followed in that order. These findings concur with the study findings by Kohli, Devaraj, and Ow (2012) contents that IT adoption and investment in IT firms directly influence performance in a positive manner.

#### 4.4.2 Strategic IT Access Costs

Respondents were required to indicate their level of agreement with the following statements that relate to the influence of strategic IT access costs on performance of Telecommunication firms in Kenya.

**Table 4.14 Statements relating to strategic IT**

	N	Min	Max	Mean	Std Dev
Investment in contemporary strategic IT can result in enhanced efficiency thereby resulting in reduced access costs	41	3.00	5.00	4.24	0.66
Strategic IT investment costs are critical to the success of telecommunication firms	41	3.00	5.00	4.32	0.65
High cost of strategic IT system installations negatively influences internal business operations.	41	3.00	5.00	4.20	0.68
Our firm has a budget allocated for new information technology investments	41	3.00	5.00	4.27	0.59
<b>Aggregate Score</b>				<b>4.26</b>	<b>0.65</b>

Source: Survey Data, (2020)

Results show that majority of the respondents agreed that strategic IT investment costs are critical to the success of telecommunication firms (M = 4.32; SD =0.65), investment in contemporary strategic IT can result in enhanced efficiency thereby resulting in reduced access costs (M= 4.24SD =0.66), the firm has a budget allocated for new information technology investments (M=4.20 SD =0.68) and high cost of strategic IT system installations negatively influences internal business operations (M= 4.20 SD =0.68). These findings concur with the study findings by Avgerou and Walsham (2017) who contents that for firms to meet their IT labour demands, they must be willing to invest in IT costs which in the long run results to high organizational performance. On overall the aggregated score for all sub-measures was recorded at 4.26 with low standard deviation of 0.65. In other words, based on the measurement scale, the aggregated score of 4.26 translates to agree thus implying that majority of the respondent agreed with each of the above statement that assessed on strategic IT access costs among Telecommunication firms in Kenya. Further a low standard deviation of 0.65 from the mean also reaffirms that respondents almost concurred in their opinions.

The study sought to determine if after implementation of strategic IT, the cost of IT services reduced significantly to the benefit of the consumer.

**Table 4.15 Impact of strategic IT implementation on cost of IT services**

	Frequency	Percentage
Yes	30	73.2
No	11	26.8
Total	41	100.0

Source: Survey Data, (2020)

Majority of the respondents agreed that (73.2%) after implementation of strategic IT, the cost of IT services offered reduced to the benefit of the consumer whereas 26.8% were of the contrary opinion. This this implies that after implementation of strategic IT, the cost of IT services reduced and therefore becoming affordable by the customers.

#### 4.4.2 Staff Strategic IT Skills

Respondents were required to indicate their level of agree with statements relating to the influence of staff strategic IT skills on performance of telecommunication firms in Kenya.

**Table 4.16 : Statements relating to staff strategic Skills**

	N	Min	Max	Mean	Std Dev
Strategic IT staff skills' shortages have a direct impact on customer service.	41	3.00	5.00	4.37	0.58
High IT staff technical skills results to improved internal business.	41	3.00	5.00	4.27	0.55
Our firm uses relevant IT skills and equipment necessary for 21 <sup>st</sup> century existence	41	3.00	5.00	4.24	0.54
Most of our customer care staff have pre-requisite IT skills and knowledge	41	3.00	5.00	4.27	0.55
We have frequent ICT trainings in our firm	41	3.00	5.00	4.24	0.58
Has strategic IT skills influenced innovation and learning within the organization	41	3.00	5.00	4.12	0.64
<b>Aggregate Score</b>				<b>4.25</b>	<b>0.57</b>

Source: Survey Data, (2020)

Results show that majority of the respondents agreed that strategic IT staff skills' shortages have a direct impact on customer service (M= 4.37 SD =0.58), high IT staff technical skills results to improved internal business and that all customer care staff employed by telecommunication have pre-requisite IT skills and knowledge (M= 4.27 SD =0.55). These findings support the empirical literature by Forth and Mason (2006) ungues that IT skill shortages has an indirect negative impact on performance. Further the study revealed that most of the telecommunication firms held frequent ICT trainings ((M= 4.24 SD =0.58)), most of the firms used relevant IT skills and equipment necessary for 21<sup>st</sup> century existence (M= 4.24 SD =0.54) and that strategic IT skills influenced innovation and learning within the organization (M= 4.12 SD =0.64). These findings support the empirical literature by Hagsten and Sabadash (2014) that IT skills and knowledge is crucial in determination of organizational performance as high skills and knowledge of IT influenced the performance of the saccos positively. On overall the aggregated score for all sub-measures was recorded at 4.25 with low standard deviation of 0.57. In other words, based on the measurement scale, the aggregated score of 4.25 translates to agree thus implying that majority of the respondent agreed with each of the above statement that assessed on strategic IT skills among Telecommunication firms in Kenya. Further a low standard deviation of 0.57 from the mean also reaffirms that respondents almost concurred in their opinions.

**Table 4.17: Staff Skills of operations and performance of ICT service-based firms**

	Percentage
Able to handle different IT gargets	63.4
Able to increase service delivery speed	63.4
Able to reduce wastages associated with paper work	53.7

Source: Survey Data, (2020)

According to the study, acquisition of strategic IT skills enables the staff to handle different IT gargets and increase service delivery speed as shown by 63.4% of the respondents in each case. Further, the study indicates that acquisition of strategic IT skills enable helps to reduce wastages associated with paper work as shown by 53.7% of the respondents. This implies that acquisition of strategic IT skills enables leads to enhanced organizational performance. These findings support the empirical literature by Wangai and Ngugi (2014) the study established that highly skilled IT staff resulted to high firm performance.

#### 4.5 Performance of Telecommunication Firms in Kenya

This study sought to determine the influence of strategic IT penetration, cost of strategic IT access staff and strategic IT skills on performance of telecommunication firms in Kenya. Results are presented in Table 4.28.

**Table 4.18 Performance of Telecommunication firms in Kenya**

	N	Min	Max	Mean	Std Dev
Our firms overall performance has been declining since the penetration of mobile phones and the internet in Kenya.	41	1.00	3.00	1.68	0.69
The cost of putting in place IT equipment and machinery is relatively high than the benefits derived	41	1.00	3.00	1.76	0.66
The cost of strategic IT access has negative impact on internal business perspectives.	41	1.00	3.00	1.83	0.74
The cost of training staff on strategic IT skills is high making our organization make declined profits	41	1.00	3.00	1.85	0.73
The cost of training staff on IT Skills is more than the benefits derived on organizational performance	41	1.00	3.00	1.78	0.72
Our customers are satisfied with our services and hence we experience high retention rates due to strategic IT investments and installations.	41	4.00	5.00	4.37	0.49
Our firm has invested heavily on IT installations and employment of technical teams to enhance innovation and learning for improved performance and market leadership	41	4.00	5.00	4.46	0.50
<b>Aggregate Score</b>				<b>2.53</b>	<b>0.65</b>

Source: Survey Data, (2020)

Results show that majority of the respondents disagreed that the firms overall performance has been declining since the penetration of mobile phones and the Internet in Kenya (M=1.68 SD =0.69) the cost of putting in place IT equipment and machinery is relatively high than the benefits derived (M= 1.76 SD =0.66), the cost of training staff on IT skills is more than the benefits derived on organizational performance (M= 1.78 SD =0.72). These concur with the empirical literature by(Soto-Acosta et al., 2016; Storey et al., 2016) that information technology (IT) used by telecommunication firms is aimed at developing an organization that is agile and proactive to effectively respond to the dynamic environment in order to sustain profitability. Also, the respondents disagreed that the cost of strategic IT access has negative impact on internal business perspective (M= 1.83 SD =0.74) and that the cost of training staff on strategic IT skills is high making our organization make declined profits (M= 1.85 SD =0.73). These findings support the empirical literature by Kariuki (2009), asserts that effectiveness in service delivery includes reliability derived from simplicity in service

delivery, speed to market and trust through transparency in operations all brought about by effective implementation of strategic IT systems like customer care management systems. However, most of the respondents were in agreement with the statements that most of the telecommunication firms had invested heavily on IT installations and employment of technical teams to enhance innovation and learning for improved performance and market leadership (M= 4.46 SD =0.50). The respondents were further in agreement with the statement that the customers are satisfied with services and therefore telecommunication firms experience high retention rates due to strategic IT investments and installations. (M= 4.37 SD = 0.49). These findings concur with the observations made by North and Varvakis (2016) IT is an important function that is applicable and succeeds at all operational and strategic functions. On overall the aggregated score for all sub-measures was recorded at 2.53 with low standard deviation of 0.65. In other words, based on the measurement scale, the aggregated score of 2.53 translates to agree thus implying that majority of the respondent agreed with each of the above statement that assessed on performance Telecommunication firms in Kenya. Further a low standard deviation of 0.57 from the mean also reaffirms that respondents almost concurred in their opinions.

**4.6 Inferential Analysis**

After the descriptive analysis, the study used inferential statistics (Pearson correlation and regression test) to predict the linear association between the predictor variables and explanatory variables as well as in determining the strengths of association in the model.

**4.6.1 Correlation Analysis**

In order to confirm the relationship between study variables and the performance of telecommunication firms in Kenya, the study used Pearson moment correlation to determine the relationship. The results are as shown in Table 4.18

**Table 4. 19: Correlations results**

		Performance of Telecommunication	Strategic IT Penetration	Strategic IT Access Costs	Staff Strategic It Skills
Performance of Telecommunication	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	41			
Strategic IT Penetration	Pearson Correlation	.371*	1		
	Sig. (2-tailed)	.017			
	N	41	41		
Strategic IT Access Costs	Pearson Correlation	.354**	.322**	1	
	Sig. (2-tailed)	.000	.001		
	N	41	41	41	
Staff Strategic It Skills	Pearson Correlation	.363**	.026	.382**	1
	Sig. (2-tailed)	.020	.084	.000	
	N	41	41	41	41

Source: Survey Data, (2020)

From Table 4.12, show a positive correlation between Strategic IT Penetration and Performance of Telecommunication was established by a correlation factor of 0.371. This fair relationship was found to be statistically significant as the p value was 0.017 which was less than 0.05. The findings contradict study results by Wilson, Iravo, Tirimba, & Ombui, (2015) found low performance by Logistic Firms in Nairobi County which was attributed to low adoption and use of ICT. The study also found a strong positive correlation between performance of performance of Telecommunication and strategic IT access costs as shown by correlation coefficient of 354; the significant value was 0.000 which was less than 0.05. These results contradict the research findings by Onyango & Ngugi, (2014) established that ICT investment costs have a direct influence on the performance. Competent. The study found a positive correlation between staff strategic IT skills and performance of Telecommunication as shown by correlation coefficient of 0.363. The significant value was 0.001 which less than 0.05. The findings support the empirical findings by Hagsten & Sabadash, (2014) established that ICT skills had a direct positive impact on firm’s financial performance.

**4.6.2 Regression Test**

In this study, a multiple regression analysis was conducted to test the influence among predictor variables. The research used statistical package for social sciences (SPSS V 21.0) to code, enter and compute the measurements of the multiple regressions. The model summary is presented in the table 4.19 below.

**Table 4.20: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.661 <sup>a</sup>	.437	.422	.48423

Source: Survey Data, (2020)

The study used coefficient of determination to evaluate the model fit. The adjusted  $R^2$  also called the coefficient of multiple determinations, is the percent of the variance in the dependent explained uniquely or jointly by the independent variables. The model had an average adjusted coefficient of determination ( $R^2$ ) of 0.422 and which implied that 42.2% of the variations on performance of Telecommunication are explained by the independent variables understudy (strategic IT penetration, strategic it access costs and staff strategic IT skills).

The study further tested the significance of the model by use of ANOVA technique. The findings are tabulated in table 4.20 below.

**Table 4.21: Summary of One-Way ANOVA results**

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	19.695	3	6.565	27.999	.000 <sup>b</sup>
Residual	8.658	37	.234		
Total	28.353	40			

Critical value = 4.90

Source: Survey Data, (2020)

From the ANOVA statics, the study established the regression model had a significance level of 0.000% which is an indication that the data was ideal for making a conclusion on the population parameters as the value of significance (p-value) was less than 5%. The calculated value was greater than the critical value ( $27.999 > 4.90$ ) an indication that Strategic IT Penetration, strategic it access costs and staff strategic IT skills all have a significant effects on performance of Telecommunication. The significance value was less than 0.05 indicating that the model was significant.

In addition, the study used the coefficient table to determine the study model. The findings are presented in the table 4.21 below.

**Table 4.22: Coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-2.245	.390		5.759	.000
1 Strategic IT Penetration ( $A_1$ )	.723	.290	.371	2.495	.017
Strategic IT Access Costs ( $A_2$ )	.633	.268	.354	2.360	.023
Staff strategic IT skills ( $A_3$ )	.801	.329	.363	2.433	.020

As per the SPSS generated output as presented in table above, the equation ( $Y = \beta_0 + \beta_1A_1 + \beta_2A_2 + \beta_3A_3 + \epsilon$ ) becomes:

$$Y = -2.245 + 0.723A_1 + 0.633A_2 + 0.801A_3$$

From the regression model obtained above, a unit change in Strategic IT Penetration while holding other factors constant would positively change performance of Telecommunication by a factor of 0.723. These findings concurs with the observations made by Oluwole and Adewale (2014) that IT penetration and use increased both return on on assets (ROA) and return of capital employed. Results show that a unit change in strategic IT access costs while holding the other factors constant would positively change performance of Telecommunication by a factor of 0.633. These findings concur with the study findings by Avgerou and Walsham (2017) who contents that for firms to meet their IT labour demands, they must be willing to invest in IT costs which in the long run results to high organizational performance. Finally test regression results show that unit change in staff strategic IT skills while holding the other factors constant would enhance the performance of Telecommunication by a factor of 0.801. These findings concur with the study findings by Kohli, Devaraj, and Ow (2012) contents that investing in strategic IT skills has a direct positive influence on firm's performance.

**4.6.3  $H_{01}$ : Strategic IT penetration has no significant effect on performance of Telecommunication firms in Kenya.**

The study found a positive significant relationship between strategic IT Penetration and performance of Telecommunication firms in Kenya. The study found a positive correlation between strategic IT penetration ( $A_1$ ) and performance of telecommunication firms in Kenya (correlation factor of 0.371; significant value = 0.017). These findings concur with the study findings by Kohli, Devaraj, and Ow (2012) who contends that adoption and investment directly influenced performance in a positive manner. Also, the regression model confirmed that enhancing quality in strategic IT penetration enhance the performance of telecommunication firms in Kenya. From the coefficients table significant value for Strategic IT penetration was 0.017 which is less than 0.05. Since the P-value of 0.017 is less than 0.05, we reject the null hypothesis. Therefore, the null hypothesis which stated that; Strategic IT penetration has no significant effect on performance of Telecommunication firms in Kenya was rejected. The implication is that there exists a significant positive relationship between Strategic IT penetration and performance of Telecommunication firms in Kenya. The findings are

supported by other studies like Binuyo and Aregbeshola, (2014) which showed that ICT penetration and use results in high performance levels among the commercial banks in South Africa. However these findings contravenes the findings by Imalingat (2015b) who asserts that Use of ICT to enhance penetration came along with high maintenance costs due to a constantly evolving environment that negatively affected firms with limited resources. Descriptive results affirm that that financial performance of telecommunication firms in Kenya is highly influenced by mobile penetration strategies in place. Further, the results indicate that mobile penetration supports role out of innovative products and services. These findings support the empirical literature by Makanyeza and Ndlovu (2016) that performance of manufacturing firms was directly related to IT penetration. Further the study revealed that internet penetration helped to boost profitability levels and hence performance of the telecommunications firms in Kenya. Further, the study has established that rolling out of 4G network improved service delivery by telecommunications firms in Kenya. These findings concurs with the observations made by Oluwole and Adewale (2014) that IT penetration and use led to increased both return on assets (ROA) and return of capital employed. However the findings revealed challenges that hindered the efforts by telecommunication firm in Kenya to enhance mobile and internet penetration. The main challenges were established as lack of enough staff skills, poor network infrastructure, and high distribution costs, government regulation, lack of consumer awareness and high distribution costs. The findings confirms the postulation by resource based theory that firms with more resource and capabilities can be able to apply penetration strategies that are unique to them only compared to firms that are still struggling with their resource base.

#### **4.6.4 H<sub>02</sub>: Strategic IT access cost has no significant effect on the performance of Telecommunication firms in Kenya.**

Results show that strategic IT access costs had a direct significant influence on performance of Telecommunication firms in Kenya. The study found a positive correlation between strategic IT access costs and performance of telecommunication firms in Kenya. These findings concur with the study findings by Avgerou and Walsham (2017) who highlighted that for firms to meet their IT labour demands, they must be willing to invest in IT which in the long run results to high performance. Also, the regression model obtained show that enhancing quality in strategic IT access costs would enhance the performance of telecommunication firms in Kenya. These findings support the assertion by Onyango and Ngugi (2014) that though ICT investment costs may be high, in long term, the investment has a positive direct influence on organisational performance. The significant value for Strategic IT penetration presented in coefficients table was 0.023 which is less than 0.05. Since the P-value of 0.023 is less than 0.05, the null hypothesis two which stated that, strategic IT access cost has no significant effect on the performance of Telecommunication firms in Kenya is therefore rejected. The implication is that there exists a significant positive relationship between Strategic IT access cost and performance of Telecommunication firms in Kenya. Descriptive results confirm that after implementation of strategic IT, the cost of IT services offered reduced leading to enhanced consumer satisfaction. The results also show that strategic IT investment costs are critical to the success of telecommunication firms and that investment in contemporary strategic IT can result in enhanced efficiency thereby resulting in reduced access costs. The study has also revealed that the firms has a budget allocated for new information technology investments and that high cost of strategic IT system installations negatively influences internal business operations. These findings support the empirical literature by Onyango and Ngugi, (2014) established that ICT investment costs have a direct influence on the performance. However these findings contradict the findings by Kohli et al. (2012), who advocate for traditional systems, citing that the cost associated with laying an efficient ICT infrastructure is costly and sometimes, lack of ICT knowledge's especially to old generation may render the whole initiative infeasible.

#### **4.6.5 H<sub>03</sub>: Staff strategic IT skills have no significant effect on performance of Telecommunication firms in Kenya.**

The study found a positive correlation between staff strategic IT skills and performance of telecommunication firms in Kenya. These findings concur with the study findings by Onyango and Ngugi (2014) who revealed that performance at the organization was heavily influenced by the use of competent employees with IT skills. The regression model obtained predicts that enhancing quality in staff strategic IT skills would enhance the performance of telecommunication firms in Kenya. The findings support the augment by Wachira et al. (2014) that IT skills and knowledge are crucial in determination of organizational performance as high skills and knowledge of IT influence the performance of the organisations positively. From the coefficients table significant value for Strategic IT penetration is 0.020 which is less than 0.05. Since the P-value of 0.020 is less than 0.05 the null hypothesis three which stated that strategic IT skills have no significant effect on the performance of Telecommunication firms in Kenya is therefore rejected. The implication is that there exists a significant positive relationship between strategic IT skills and performance of Telecommunication firms in Kenya. Descriptive results show that strategic IT staff skills' shortages have a direct impact on customer service. The results further highlight that high IT staff technical skills results to improved internal business and that all customer care staff employed by telecommunication have pre-requisite IT skills and knowledge. These findings support the empirical literature by Forth and Mason (2006) who argue that IT skill shortages has an indirect negative impact on performance. Further the study revealed that most of the telecommunication firms in Kenya held frequent ICT trainings and used relevant IT skills and equipment necessary for 21<sup>st</sup> century existence. The study has also revealed that strategic IT skills influence innovation and learning within the organization. These findings support the empirical literature by Hagsten and Sabadash (2014) who indicated that IT skills and knowledge are crucial in determination of organizational performance as high skills and knowledge of IT influenced the performance of the sacco's positively. Similar observation are made by Wangai and Ngugi (2014) observed that highly skilled IT staff are a precursor to high firm performance. However these findings contradict the findings by Onyango and Ngugi (2014), Skilled ICT workers command higher wages or annual salaries, highly Skilled ICT employees are limited to their or her area of work and cannot multi-task and that

specialization means taking the chance that complacency could lead to missteps, which can cost the company money and compromise safety.

Assessment on the combined effect of strategic IT penetration cost of strategic IT access staff and strategic IT Skills on performance of telecommunication firms in Kenya revealed that the overall performance of telecommunication firms has been enhanced by penetration of mobile phones and the internet in Kenya. Further, the study has revealed that the cost of putting in place IT equipment and machinery is relatively lower than the benefits derived and that the cost of training staff on IT skills is less than the benefits derived on organizational performance. These concur with the empirical literature by (Soto-Acosta et al., 2016; Storey et al., 2016) who indicated that that Information Technology (IT) used by telecommunication firms is aimed at developing an organization that is agile and proactive to effectively respond to the dynamic environment in order to sustain profitability. The study further revealed that the cost of strategic IT access has positive impact on internal business perspective and that the cost of training staff on strategic IT skills is high challenging performance. These findings support the empirical literature by Kariuki (2009), asserts that effectiveness in service delivery includes reliability derived from simplicity in service delivery, speed to market and trust through transparency in operations all brought about by effective implementation of strategic IT systems like customer care management systems. Finally, most of the telecommunication firms had invested heavily on IT installations and employment of technical teams to enhance innovation and learning for improved performance and market leadership. Further, it was revealed that customers are satisfied with services and therefore telecommunication firms experience high customer retention rates which enhance their performances. These findings concur with the observations made by North and Varvakis (2016) that IT is an important function that is applicable and succeeds at all operational and strategic functions.

## V. CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

### 5.1 Introduction

This chapter presents the study summary, conclusions and recommendations based on the study findings. The objectives of this study were to determine the effect of strategic IT penetration on performance of Telecommunication firms in Kenya, to investigate the effect of strategic IT access costs on performance of Telecommunication firms in Kenya and to examine how staff strategic IT skills affect performance of Telecommunication firms in Kenya.

### 5.2 Summary of the Findings

This section presents the summary of finding presented in the previous chapter. This section is organized into four sections that are in line with the study objectives.

#### 5.2.1 Strategic IT Penetration

In line with the first objective, the study found a positive correlation between strategic IT Penetration and performance of telecommunication firms in Kenya. It was also established that the financial performance of telecommunication firms in Kenya is highly influenced by mobile penetration strategies in place. Strategies such as internet penetration helped to boost profitability levels and hence performance of the companies. Further, the study established that rolling out of 4G network improved service delivery by telecommunications firms in Kenya and that mobile penetration supports role out of innovative products and services. These findings support the empirical literature by Makanyeza and Ndlovu (2016) that performance of manufacturing firms was directly related to IT penetration. Results also show that IT penetration and use led to increase both return on on assets (ROA) and return of capital employed. It was also established that adoption and investment directly influenced performance in a positive manner. The findings support the augment by Binuyo and Aregbeshola, (2014) that ICT penetration and use resulted in high performance levels among the telecom firms in South Africa. However these findings contravenes the findings by Imalingat (2015b) who asserts that Use of ICT to enhance penetration came along with high maintenance costs due to a constantly evolving environment that negatively affected firms with limited resources. However, the findings revealed challenges that hindered the efforts by teleco firm to enhance mobile and internet penetration. Among the challenges noted include lack of enough staff skills, poor network infrastructure, government regulation, lack of consumer awareness and high distribution costs. The findings confirm the postulation by resource-based theory that Firms with more resource and capabilities can be able to apply penetration strategies that are unique to them only compared to firms that are still struggling with their resource base.

#### 5.2.2 Strategic IT Access Costs

In line with the second objective, the study found a positive correlation between strategic IT access costs and performance of telecommunication firms in Kenya. The study findings illustrate that investment in contemporary strategic IT can result in enhanced efficiency thereby resulting in reduced access costs. Further, the study indicates that strategic IT investment costs are critical to the success of telecommunication firms. These findings support the augment by Onyango and Ngugi (2014) that ICT investment costs were critical to ICT success and had a direct influence on performance at the organization. The findings are also in line with others by Onyango and Ngugi, (2014) that indicates that ICT investment costs have a direct influence on the performance, However these findings contravenes the findings by Kohli et al. (2012), who advocate for traditional systems, citing that the cost associated with laying an efficient ICT infrastructure is costly and sometimes, lack of ICT knowledge's especially to old generation may render the whole initiative infeasible.

### **5.2.3 Staff Strategic IT Skills**

In line with third objective, the findings of this research revealed that staff strategic IT skills has positive effect on performance of telecommunication firms in Kenya. IT skills and knowledge is crucial in determination of organizational performance. Also the findings show that knowledge of IT influenced the performance of the organisations positively and that strategic IT staff skills' shortages have a direct impact on customer service. These findings support the empirical literature by Forth and Mason (2006) argues that IT skill shortages has an indirect negative impact on performance. Similarly, Onyango and Ngugi (2014) contend that performance at the organization was heavily influenced by the use of competent employees with IT skills. The study also found high IT staff technical skills results to improved internal business and that all customer care staff employed by telecommunication have pre-requisite IT skills and knowledge. Also, it was established that most of the telecommunication firms held frequent ICT trainings and that the firms used relevant IT skills and equipment necessary for 21<sup>st</sup> century existence. The study highlights that strategic IT skills influences innovation and learning within the organization. These findings are in line with others by Hagsten and Sabadash (2014) who indicated that IT skills and knowledge is crucial in determination of organizational performance as high skills and knowledge of IT influenced the firms performance positively. However these findings contravenes the findings by Onyango and Ngugi (2014), Skilled ICT workers command higher wages or annual salaries, highly Skilled ICT employees are limited to their or her area of work and cannot multi-task and that specialization means taking the chance that complacency could lead to missteps, which can cost the company money and compromise safety

### **5.2.4 Performance of Telecommunication Firms in Kenya**

Assessment on overall performance of Telecommunication firms in Kenya revealed the cost of putting in place IT equipment and machinery is relatively lower than the benefits derived and that the cost of training staff on IT skills is less than the benefits derived. Also, the study revealed that the cost of strategic IT access has positive impact on internal business perspective and that the cost of training staff on strategic IT skills is high hurting the organizational profits. These findings support the empirical literature by Kariuki (2009) who asserts that effectiveness in service delivery includes reliability derived from simplicity in service delivery, speed to market and trust through transparency in operations all brought about by effective implementation of strategic IT systems like customer care management systems. Further the findings show that most customers were more satisfied with services and hence high retention rates due to strategic IT investments and installations were witnessed in the firms. These findings concurs with the observations made by North and Varvakis (2016) that IT is an important function that is applicable and succeeds at all operational and strategic functions.

### **5.3 Conclusions**

The study concludes that strategic IT Penetration had positive significant effect on the performance of Telecommunication firms in Kenya. It was also concluded that ICT penetration and use resulted in high performance levels among the telecom firms. The study also illustrates that strategies such as internet penetration helped to boost profitability levels and hence performance and that rolling out of 4<sup>th</sup> Generation network improved service delivery. Finally, the study has indicated that mobile penetration supports role out of innovative products and services. The study also concludes that strategic IT access costs had a direct significant influence on performance of Telecommunication firms in Kenya. The study further concludes that high cost of strategic IT system installations negatively influences internal business operations. The results have also shown that after implementation of strategic IT, the cost of IT services offered reduced to the benefit of the consumer and that most of the Telecommunication firms had budget allocated for new information technology investments. The study further concludes that high IT staff technical skills results to improved internal business performance and that all customer care staff employed by telecommunication have prerequisite IT skills and knowledge. In addition, the study further established that acquisition of strategic IT skills enables the staff to handle different IT gargets, increase service delivery speed and reduce wastages associated with paper work. It was also established that telecommunication firms held frequent ICT trainings and used relevant IT skills and equipment necessary for 21<sup>st</sup> century existence. This indicates the firms' commitment in enhancing skills and knowledge. Further, the study concludes that strategic IT skills influence innovation and learning within the organizations.

### **5.4 Recommendations**

Based on the study findings, this study recommends that the top management of telecommunication companies in Kenya need to continually adapt the strategic IT penetration as this adoption was found positively linked with market performance. Telecommunication firms need to come up with quality innovation capabilities necessary to drive market penetration process. Given that strategic IT access costs was found to be positively linked with performance of telecommunication firms in Kenya, its therefore paramount for telecommunication firms to ensure quality infrastructure is laid to oversee the realization of the projected benefits. Staff technical skills were established to enhance internal business operations. This study therefore recommends that, telecommunication firms should continually update their personnel with ICT skills and especially on any update made on mode operations.

### **5.5 Areas of Further Research**

The main objective as developed in the background of the study is to determine the effect of strategic IT on the performance of telecommunication firms in Kenya. Similar studies may explore on dynamic strategies adopted by ICT firms in response to market turbulence.

**APPENDICES**

**Appendix I: Questionnaire**

Dear Sir/Madam, RE: **PERMISSION TO CARRY OUT ACADEMIC RESEARCH**

I am a graduate student undertaking Masters of Business Administration Degree (Strategic Management Option) in Kenyatta University and conducting a research study entitled ‘THE EFFECT OF STRATEGIC INFORMATION COMMUNICATION TECHNOLOGY ON THE PERFORMANCE OF TELECOMMUNICATION FIRMS IN KENYA. The purpose of this letter is to request for permission to interview the respondents using the attached questionnaire copy and interview schedule. The information obtained is strictly for academic purpose and shall be treated with utmost confidentiality.

Thank You.

NAME OF TELECOMMUNICATION COMPANY.....

**Section A: Background Information**

1. Please indicate your gender

- (a) Male  (b) Female

2. Please indicate your age.

- (a) Below 30  (b) 31 – 40   
 (c) 41 – 50  (d) 51 – 60   
 (e) Above 61

3. Please State your Job title.....

4. How long have you worked with the company?

- (a) Less than 1 year  (b) 2-4 years   
 (c) 5-9 years  (d) Over 10 years

5. What is your highest academic qualification?

- (a) Certificate and below  (b) Diploma   
 (c) Bachelors  (d) Masters and above

**Section B: Strategic IT Penetration**

This part aims to determine the influence of strategic IT Penetration on performance of Telecommunication firms in Kenya.

1. Please indicate how much you agree or disagree with each of the following statements on a scale of 1 to 5. The scale is indicated as follows;

5 - Strongly Agree (SA); 4 – Agree (A); 3 – Neutral (N); 2 – Disagree (D); and 1 - Strongly Disagree (SD).

S/No	STATEMENT	SA	A	N	D	SD
1	Financial performance of telecommunication firm is highly influenced by mobile penetration.					
2	Mobile penetration supports role out of innovative products and services.					
3	Internet penetration helps boost profitability levels and hence performance.					
4	Roll out of 4 <sup>th</sup> Generation network improves service delivery.					

2. What challenges influence the most mobile and internet penetration to the telecommunication firm?

- a. Poor network infrastructure
- b. Lack of enough staff skills
- c. High distribution costs
- d. Government regulation
- e. Lack of consumer awareness

**Section C: Strategic IT Access Costs**

This part aims to determine the influence of strategic IT Access Costs on performance of Telecommunication firms in Kenya.

1. Please indicate how much you agree or disagree with each of the following statements on a scale of 1 to 5. The scale is indicated as follows;

5 - Strongly Agree (SA); 4 – Agree (A); 3 – Neutral (N); 2 – Disagree (D); and 1 - Strongly Disagree (SD).

S/No	STATEMENT	SA	A	N	D	SD
1	Investment in contemporary strategic IT can result in enhanced efficiency thereby resulting in reduced access costs					

2	Strategic IT investment costs are critical to the success of telecommunication firms					
3	High cost of strategic IT system installations negatively influence internal business operations.					
4	Our firm has a budget allocated for new information technology investments					

5. After implementation of strategic IT, has the cost of IT services offered reduced to the benefit of the consumer?  
YES.....NO.....

**Section D: Staff Strategic IT Skills**

This part aims to determine the influence of staff strategic IT Skills on performance of Telecommunication firms in Kenya.

1. Please indicate how much you agree or disagree with each of the following statements on a scale of 1 to 5. The scale is indicated as follows;

5 - Strongly Agree (SA); 4 – Agree (A); 3 – Neutral (N); 2 – Disagree (D); and 1 - Strongly Disagree (SD).

S/No	STATEMENT	SA	A	N	D	SD
1	Strategic IT staff skills’ shortages have a direct impact on customer service.					
2	High IT staff technical skills results to improved internal business.					
3	Our firm uses relevant IT skills and equipment necessary for 21 <sup>st</sup> century existence					
4	Most of our customer care staff have pre-requisite IT skills and knowledge					
6.	We have frequent ICT trainings in our firm					
7.	Has strategic IT skills influenced innovation and learning within the organization					

8. How do staff skills on ICT services influence internal business operations of the firm?

- a. Able to handle different IT gargets
- b. Able to increase service delivery speed
- c. Able to reduce wastages associated with paper work

**Section E: Performance of Telecommunication Firms in Kenya**

This part aims to determine the influence of strategic IT penetration, cost of Strategic IT access staff and strategic IT Skills on performance of Telecommunication firms in Kenya

Please indicate how much you agree or disagree with each of the following statements on a scale of 1 to 5. The scale is indicated as follows;

5 - Strongly Agree (SA); 4 – Agree (A); 3 – Neutral (N); 2 – Disagree (D); and 1 - Strongly Disagree (SD).

S/No	STATEMENT	SA	A	N	D	SD
1	Our firms overall performance has been declining since the penetration of mobile phones and the internet in Kenya.					
2	The cost of putting in place IT equipment and machinery is relatively high than the benefits derived					
3	The cost of strategic IT access has negative impact on internal business perspectives.					
4	The cost of training staff on strategic IT skills is high making our organization make declined profits					
5	The cost of training staff on IT Skills is more than the benefits derived on organizational performance					
6	Our customers are satisfied with our services and hence we experience high retention rates due to strategic IT investments and installations.					
7	Our firm has invested heavily on IT installations and employment of technical teams to enhance innovation and learning for improved performance and market leadership					

**Appendix II: Population of Tier 1 Telecommunication Firms shop managers within Nairobi County**

FIRM	RETAIL SHOPS AND RETAIL OFFICES MANAGER LIST
SAFARICOM PLC	Buruburu (1 Manager,2 Team leader) Galeria/Bomas (1 Manager,2 Team leader), JKIA (1 Manager,2 Team leader), Nakumatt mega (1 Manager,2 Team leader), Karen hub (1 Manager,2 Team leader), Greenspan mall (1 Manager,2 Team leader), Kitengela (1 Manager,2 Team leader), Sarit (1 Manager,2 Team leader), Sarit Platinum (1 Manager,1 Team leader), I&M (1 Manager,2 Team leader), Junction mall (1 Manager,2 Team leader), Moi Avenue(1 Manager,4 Team leader), Kimathi (1 Manager,2 Team leader), Garden city (1 Manager,2 Team leader), Eastleigh (1 Manager,2 Team leader), Village market (1 Manager,2 Team leader), TRM mall (1 Manager,2 Team leader), Westgate mall (1 Manager,2 Team leader), Two rivers mall (1 Manager,1 Team leader), Ronald Ngala (1 Manager,2 Team leader), Nairobi region (2 managers resources), Head office (2 technology managers, 2 managers finance, 2 managers resources).
AIRTEL KENYA LTD	Village Market (1 retail manager, 1 supervisor), Prestige Plaza (1 retail manager, 1 supervisor) , Junction mall (1 retail manager, 1 supervisor), Westgate mall (1 retail manager, 1 supervisor), Garden City mall (1 retail manager, 1 supervisor), Greenspan mall (1 retail manager, 1 supervisor), The Hub (1 retail manager, 1 supervisor), TRM mall (1 retail manager, 1 supervisor), Parkside Mombasa Rd (1 retail manager, 1 supervisor), Head office (2 technology managers, 1 director and 1 assistant director finance, 1 manager and 1 assistant manager human resource).
TELKOM KENYA LTD	Telkom Plaza Shop (1 retail manager, 1 supervisor), Buruburu Telkom (1 retail manager, 1 supervisor), Prestige shop (1 retail manager, 1 supervisor), Capital Centre Shop (1 retail manager, 1 supervisor), Jamhuri shop (1 retail manager, 1 supervisor), Gateway Mall shop (1 retail manager, 1 supervisor), Telkom Shop - Food Court (1 retail manager, 1 supervisor), Sarit Centre Shop (1 retail manager, 1 supervisor), TRM Telkom Shop (1 retail manager, 1 supervisor), Ngara shop (1 retail manager, 1 supervisor), Village Market shop (1 retail manager, 1 supervisor), Galleria Shop (1 retail manager, 1 supervisor), Utawala Tumaini shop (1 retail manager, 1 supervisor), T-mall Shop (1 retail manager, 1 supervisor), Telkom Kawangware Shop (1 retail manager, 1 supervisor), JKIA - Terminal 1A Shop (1 retail manager, 1 supervisor), Telkom Two Rivers (1 retail manager, 1 supervisor), JKIA - Terminal 1E Shop (1 retail manager, 1 supervisor), Industrial Area Shop (1 retail manager, 1 supervisor), Eastleigh shop (1 retail manager, 1 supervisor), Extelecomms Shop (1 retail manager, 1 supervisor), Greenspan Mall shop (1 retail manager, 1 supervisor), Mega Shop (1 retail manager, 1 supervisor). Head office (1 manager and 1 assistant manager technology, 1 director and 1 assistant director finance, 1 manager and 1 assistant manager human resource).

**Appendix II: NACOSTI research permit**

**THIS IS TO CERTIFY THAT:**  
**MR. MOHAMMED WANDABWA CHESULA**  
**of KENYATTA UNIVERSITY, 0-30218**  
**TONGAREN, has been permitted to**  
**conduct research in Nairobi County**

**Permit No : NACOSTI/PI/19/1290/30550**  
**Date Of issue : 10th June, 2019**  
**Fee Received :Ksh 1000**



**Director General**  
**National Commission for Science, Technology and Innovation**

**Applicant's Signature**

**on the topic: STRATEGIC INFORMATION TECHNOLOGY AND PERFORMANCE OF TELECOMMUNICATION FIRMS IN KENYA**

**for the period ending:**  
**7th June, 2020**

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**Appendix III: University approval letter**

  
**KENYATTA UNIVERSITY**  
**GRADUATE SCHOOL**

E-mail: dean-graduate@ku.ac.ke P.O. Box 43844, 00100  
 NAIROBI, KENYA  
 Website: www.ku.ac.ke Tel. 8710901 Ext. 57530

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Our Ref: D53/OL/EMB/PT/23500/2012 DATE: 12<sup>th</sup> March, 2019

Director General,  
 National Commission for Science, Technology  
 and Innovation  
 P.O. Box 30623-00100  
**NAIROBI**

Dear Sir/Madam,

**RE: RESEARCH AUTHORIZATION FOR MOHAMMED WANDABWA CHESULA- REG. NO. D53/OL/EMB/PT/23500/2012**

I write to introduce Mr. Mohammed Wandabwa Chesula who is a Postgraduate Student of this University. He is registered for M.B.A degree programme in the Department of Business Administration.

Mr. Mohammed intends to conduct research for a M.B.A Project Proposal entitled, "Strategic information technology and performance of telecommunication firms in Kenya".

Any assistance given will be highly appreciated.

Yours faithfully,  
  
**PROF. ELISHIBA KIMANI**  
**AG: DEAN, GRADUATE SCHOOL**

EM/IK

## Appendix IV: NACOSTI research authorization letter



**NATIONAL COMMISSION FOR SCIENCE,  
TECHNOLOGY AND INNOVATION**

Telephone: +254-20-2213471,  
2241349, 3310571, 2219420  
Fax: +254-20-318245, 318249  
Email: [gg@nacosti.go.ke](mailto:gg@nacosti.go.ke)  
Website: [www.nacosti.go.ke](http://www.nacosti.go.ke)  
When replying please quote

NACOSTI, Upper Kabete  
Off Wajaki Way  
P.O. Box 30623-00100  
NAIROBI-KENYA

Ref. No. **NACOSTI/P/19/91290/30550** Date: **10<sup>th</sup> June, 2019.**

Mohammed Wandabwa Chesula  
Kenyatta University  
P.O. Box 43844-00100  
**NAIROBI.**

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on "*Strategic information technology and performance of Telecommunication firms in Kenya.*" I am pleased to inform you that you have been authorized to undertake research in Nairobi County for the period ending **7<sup>th</sup> June, 2020.**

You are advised to report to the **County Commissioner, and the County Director of Education, Nairobi County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit a copy of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.



**BONFACE WANYAMA**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner  
Nairobi County.

The County Director of Education  
Nairobi County.

National Commission for Science, Technology and Innovation is ISO9001:2008 Certified

### ACKNOWLEDGMENT

I would like to greatly thank Dr. James M. Kilika who guided me throughout this research project work. I would also like to thank the administration from the University for giving me an opportunity to undertake MBA degree study program in their institution. I also thank all lecturers and staff of Kenyatta University for their academic and moral support. I sincerely thank students of 2012 Master of Business Administration class for their supportive role. My gratitude also goes to all whom I may not be able to thank individually but rendered their contribution in one way or another in this research including the respondents. I would also like to appreciate my brother Dr. Osman Wechuli Chesula of Raf international University and my beloved wife Salma Ibrahim for their support and prayers towards my education. This work will surely be dedicated to them.

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# Predictive Prognostic Model for Lithium Battery Based on A Genetic Algorithm (GA-ELM) Extreme Learning Machine

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**Abstract:** Prognostic and health management (PHM) verify the working safely and reliably of lithium batteries, PHM system determines the State of Health (SOH) and the Remaining Useful Life (RUL). To avoid severe negative consequences of the system, this paper presents the preliminary development of genetic algorithm, using an extreme learning machine (ELM) method to predict the State of Health (SOH) of the lithium-ion battery. The low prediction accuracy of the State of Health (SOH) of lithium battery, the extreme learning machine (ELM) algorithm improved by genetic algorithm can improve the prediction accuracy of SOH of lithium battery. The weight from the ELM input layer to the hidden layer and the threshold of the hidden layer unit are randomly generated. The ELM algorithm only needs to set the number of hidden layer units and the type of hidden layer activation function. The proposed GA-ELM approach was compared against other traditional algorithms, namely, Back Propagation (BP), Support Vector Machine (SVM), Radial Based function (RBF). Extreme learning machine (ELM) introduces genetic algorithm (GA) to optimize the weight of the input layer to the hidden layer and the threshold of the hidden layer unit. This method can enhance the stability of the ELM algorithm. The experiments compared the GA-ELM algorithm with the ELM algorithm, BP algorithm, RBF algorithm and SVR algorithm for the prediction of lithium battery SOH. The results show that the GA-ELM algorithm has improved prediction accuracy and algorithm stability compared with other algorithms.

**Keywords:** Prognostic and health management (PHM); State of Healthy (SOH); Extreme learning machine; Genetic algorithm; Model simulation

## I. INTRODUCTION

As a high-performance energy storage device, lithium batteries are used in various occasions, namely electric vehicles (EVs), Laptops, Mobile phones, Calculators etc. Therefore, research and development are being actively performed to improve the lithium-ion battery performance.

State of Health (SOH) is an important parameter for evaluating the performance of lithium batteries. Predicting the health status of lithium batteries accurately has important guiding significance for the rational use of batteries.

The prediction of the health status of lithium batteries includes empirical and performance-based methods. The methods based on empirical prediction include the cycle and amperage life methods. The methods based on performance prediction include model-based methods and data-driven methods. And a fusion-based approach.

Due to the highly non-linear changes in the parameters of the lithium battery when its performance is degraded, the linear prediction of the health status of the lithium battery is less accurate. Non-linear prediction methods of lithium battery health include PF algorithm, SVR algorithm, and BP algorithm. Non-linear prediction models are more accurate than linear prediction models.

In this experiment, a batch of 18650 lithium iron phosphate batteries from a certain brand was used as the research object, and the relationship between the health status of lithium batteries and the changes in battery external parameters was explored.

The experiment uses ELM algorithm, BP algorithm, SVR algorithm and RBF algorithm to construct the battery.

The prediction model of SOH is compared with GA-ELM algorithm model, and the results show that GA-ELM algorithm prediction ability is better than other algorithm models.

## II. EXTREME LEARNING MACHINE (ELM)

Extreme learning machine (ELM) proposed is a single-hidden layer feed forward networks (SLFNs) which randomly selected the input weights and analytically determines the output weights of SLFNs. ELM consists of 3 layers: input layer, hidden layer and output layer. The

input layer has  $n$  neurons, representing  $n$  input variables and the hidden layer has  $l$  neurons; the output layer has  $m$  neurons corresponding to  $m$  Output variable.

The connection weight  $w$  of the input layer and the hidden layer is:

$$\omega = \begin{bmatrix} \omega_{11} & \omega_{12} & \dots & \omega_{1n} \\ \omega_{21} & \omega_{22} & \dots & \omega_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \omega_{l1} & \omega_{l2} & \dots & \omega_{ln} \end{bmatrix}_{l \times n} \quad (1)$$

In the formula,  $w_{ij}$  represents the connection weight between the  $i_{th}$  neuron in the input layer and the  $j_{th}$  neuron in the hidden layer. The connection weight  $\beta$  between the hidden layer and the output layer is:

$$\beta = \begin{bmatrix} \beta_{11} & \beta_{12} & \dots & \beta_{1m} \\ \beta_{21} & \beta_{22} & \dots & \beta_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \beta_{l1} & \beta_{l2} & \dots & \beta_{lm} \end{bmatrix}_{l \times m} \quad (2)$$

In the formula,  $\beta_{jk}$  represents the connection weight of the  $j_{th}$  neuron in the hidden layer and the  $k_{th}$  neuron in the output layer.

$$b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_l \end{bmatrix}_{l \times 1} \quad (3)$$

In the formula,  $b_i$  represents the threshold value of the  $i_{th}$  neuron in the hidden layer. The activation function  $g(x)$  of the hidden layer can choose a continuous nonlinear function as the output mapping function.

The output  $T$  of the ELM network is:

$$T = [t_1 \quad t_2 \quad \dots \quad t_Q]_{m \times Q} \quad (4)$$

$$t_j = \begin{bmatrix} t_{1j} \\ t_{2j} \\ \vdots \\ t_{mj} \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^l \beta_{i1} g(\omega_i x_j + b_i) \\ \sum_{i=1}^l \beta_{i2} g(\omega_i x_j + b_i) \\ \vdots \\ \sum_{i=1}^l \beta_{im} g(\omega_i x_j + b_i) \end{bmatrix}_{m \times 1} \quad (5)$$

$j = 1, 2, \dots, Q;$

Where,  $\omega_i = [\omega_{i1} \quad \omega_{i2} \quad \dots \quad \omega_{in}]$

$x_j = [x_{1j} \quad x_{2j} \quad \dots \quad x_{nj}]$

The above formula can be expressed as  $H\beta = T'$

Where  $T'$  is the transposed matrix of the output matrix  $T$ , and  $H$  is the output matrix of the hidden layer.

$$H = \begin{bmatrix} g(\omega_1 x_1 + b_1) & g(\omega_2 x_1 + b_2) & \dots & g(\omega_l x_1 + b_l) \\ g(\omega_1 x_2 + b_1) & g(\omega_2 x_2 + b_2) & \dots & g(\omega_l x_2 + b_l) \\ \vdots & \vdots & \ddots & \vdots \\ g(\omega_1 x_Q + b_1) & g(\omega_2 x_Q + b_2) & \dots & g(\omega_l x_Q + b_l) \end{bmatrix}_{Q \times l}$$

If the number of hidden layer units is equal to the number of training samples, for any given  $w$  and  $b$ , the network can approximate the training samples with zero errors. When the hidden layer is smaller than the number of training samples, the network training error can approach arbitrary accuracy. When the activation function  $g(x)$  of the hidden layer unit is infinitely differentiable, the weight  $w$  and the hidden layer threshold  $b$  from the input layer to the hidden layer can be randomly selected, and the values of  $\omega$  and  $b$  remain unchanged during the algorithm training process. The weight matrix  $\beta$  from the hidden layer to the output layer can be obtained by.

$$\min_{\beta} \|H\beta - T'\| \quad \beta = H^+ T' \quad (6)$$

Where  $H^+$  is the Moore-Penrose generalized inverse of  $H$ .

The LM algorithm steps include:

- Determine the number of hidden layer neurons, and randomly generate the weight  $w$  from the input layer to the hidden layer and the threshold  $b$  of the hidden layer;
- Select the hidden layer activation function  $g(x)$  as an infinitely differentiable function;
- Calculate the output layer  $H$  of the hidden layer and solve the output layer weights

$$\beta = H^+ T' \quad (7)$$

### III. GA-ELM FRAMEWORK

Genetic Algorithm (GA) is an evolutionary algorithm. The algorithm encodes the parameters of the problem as the individuals to be trained, Train individuals to select, intersect, and mutate operations and calculate fitness values. The highest fitness value is selected as the optimal individual. The optimal individual obtains the optimal value of the parameter to be solved through the decoding operation. Genetic algorithm is suitable for solving nonlinear optimization problems that are difficult to be solved by traditional algorithms. Genetic algorithms provide a general framework for solving nonlinear problems, the algorithm optimizes specific problem parameters by encoding into chromosomes,

It reduces the risk that traditional optimization algorithms (such as gradient descent method) easily fall into local minima.

The steps for ELM parameter optimization using GA include:

- Determine the network topology, select the appropriate number of hidden layer units

according to the data size, and select the appropriate hidden layer activation function  $g(x)$ ;

- The initial population of parameters is obtained by encoding the hidden layer weights and thresholds of the ELM, bringing the decoded parameters into the ELM network, training and verifying the model's prediction accuracy, and the error value  $Mse = E(T_{sim} - T_{test}^2)$   $T_{sim}$  is the actual value of the test set;
- Cross, mutate, recombine the elite individuals of the chromosome to obtain the fitness value of the offspring individuals, and select the individual with the best fitness through the ranking function. When the loop reaches the loop maximum or the test error is lower than the set threshold, the GA-ELM algorithm stops,

The algorithm flowchart is shown in Fig. 1.

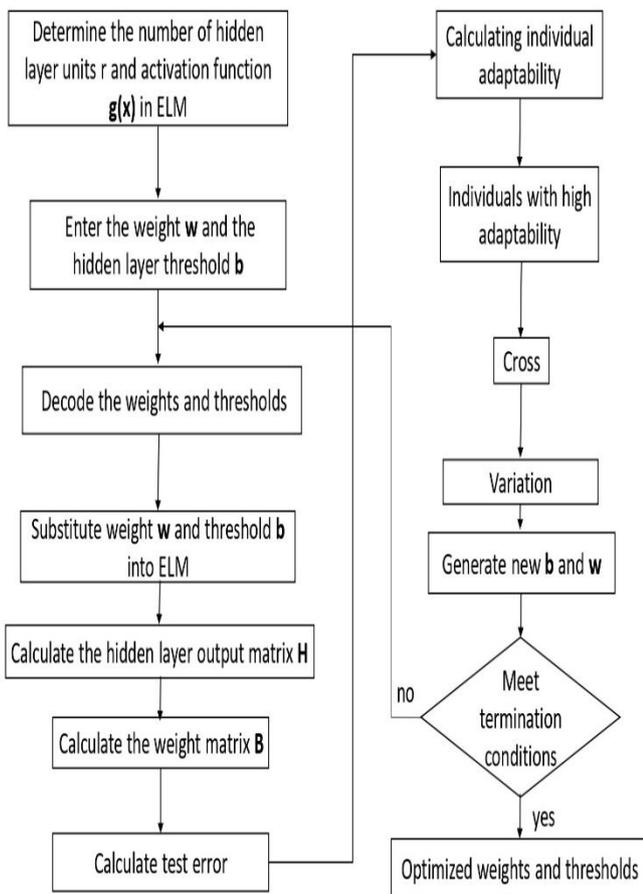


Fig. 1. GA-ELM Framework

#### IV. DESCRIPTION LITHIUM BATTERY HEALTH

##### A. Definition of health status

Battery health is equal to the ratio of available battery capacity to rated capacity,

$$SOH = \frac{C_{norm}}{C_{new} \times 100\%} \quad (8)$$

Where  $C_{new}$  is the amount of battery Constant capacity,  $C_{norm}$  is the available capacity of the battery, this formula

is based on the remaining power Method to define the health status of lithium batteries

##### B. Performance parameters of 2 lithium battery

- Discharge DC internal resistance

The increase in the number of discharges of the lithium battery, due to the decrease in the electrolyte activity of the battery and the aging of the electrode material, leads to a decrease in the battery's conductivity. The results are reflected in the battery parameters, that is, the internal resistance of the battery.

- Average discharge voltage

The discharge average voltage refers to the terminal voltage of the battery when the amount of charge drops to half of the initial value during the discharge of the battery. As the number of discharge cycles of the battery increases, the battery's ability to carry lithium ions decreases, and the average voltage of the battery decreases.

- Discharge rate decay rate

The discharge capacity decay rate refers to the ratio of the amount of charge discharged in this discharge cycle to the amount of charge discharged in the previous discharge cycle. As the number of discharge cycles increases, the overall battery capacity shows a downward trend.

The discharge capacity decay rate, that is, the speed of the capacity decay, reflects the health of the battery.

#### V. TEST RESULTS

Measure the median voltage, discharge DC internal resistance, and discharge decay rate of the lithium battery during the discharge cycle, and calculate and record the SOH value of the lithium battery at this time. The number of experimental cycles, the median voltage, DC internal resistance and discharge decay rate are used as inputs to the prediction model.

The lithium battery SOH value is used as the output of the prediction model. The experimental data are shown in Table -1.

Table -I Battery experiment data

cycles	Average voltage/V	Internal resistance	Discharge decay rate /%	Lithium battery SOH
1	3.481	0.065	100	1.00
2	3.467	0.067	98	0.972
3	3.461	0.067	96	0.964
4	3.463	0.071	96	0.960
5	3.460	0.072	95	0.956
6	3.478	0.062	98	0.981
7	3.474	0.063	98	0.986
8	3.473	0.069	97	0.979
9	3.462	0.068	95	0.956
10	3.458	0.073	95	0.950
⋮	⋮	⋮	⋮	⋮

95	3.449	0.069	97	0.834
96	3.440	0.068	95	0.816
97	3.424	0.075	93	0.799
98	3.419	0.081	92	0.791
99	3.436	0.073	94	0.805
100	3.442	0.070	95	0.812

VI. EXPERIMENTAL VERIFICATION

A. ELM and GA-ELM algorithm model simulation

In order to verify the effectiveness of the improved ELM algorithm, the number of ELM hidden layer units is set to 3, the hidden layer activation function  $g(x)$  selects the non-linear Sigmoid function. The number of genetic algorithm individuals is set to 20, The maximum genetic generation is 100, Chromosome coded as a 10-bit binary number, The input weight and the hidden layer threshold range between -0.5 to +0.5, The generation gap is 0.05, Crossover probability is 0.5, Chromosome mutation probability is 0.01, Observe and record the simulation results of the algorithm as shown in Fig. 2,

From the test set mean square error MSE and the determination coefficient R2, we can see that the GA-ELM algorithm has better prediction set accuracy than the ELM algorithm. The prediction error of the GA-ELM model has stabilized after 40 generations. Experiments on the same data set for multiple simulations. To verify the reliability of the experimental results, Fig. 3 is the result of repeated experiments.

The instability of the ELM algorithm can be seen by comparing Figure 2 and Figure 3.

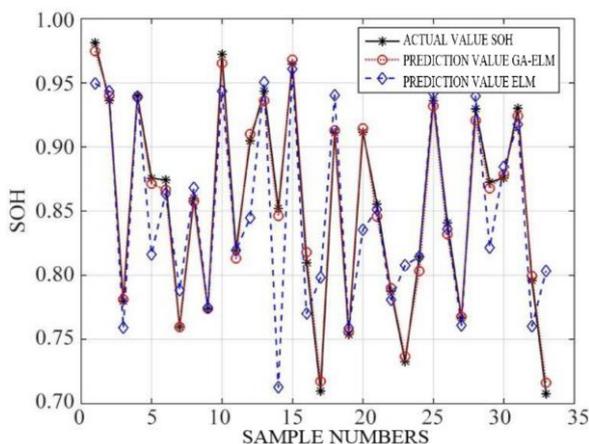


Fig. 2. Comparison of GA-ELM and ELM algorithms

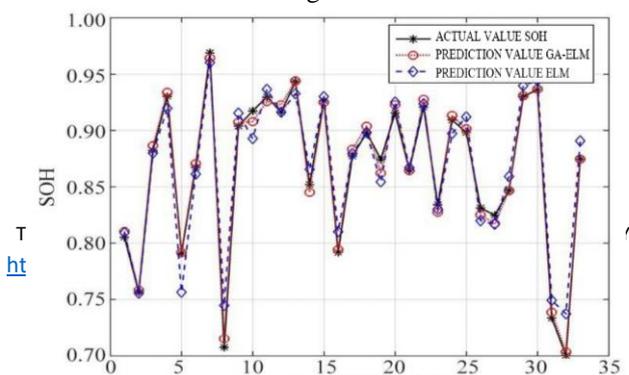


Fig. 3. GA-ELM and ELM algorithm simulation

B. BP algorithm model simulation

In order to compare the prediction performance gap between BP algorithm and ELM algorithm, BP algorithm uses the same network structure as ELM algorithm. The hidden layer transfer function of the BP network also selects the Sigmoid function, the output layer transfer function selects the linear Purelin function, the BP algorithm is optimized by gradient descent method, and the number of reverse iterations is selected 100 times. The simulation result of BP algorithm are shown in Fig. 4.

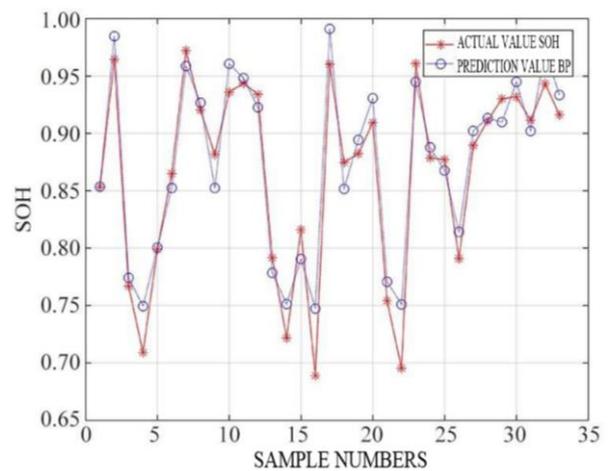


Fig. 4. BP simulation results

Experimental results show that the mean square error of the BP algorithm is equal to 0.015318, the determination coefficient is 0.935, and the algorithm operation cycle is 4.668 s. Under the same network topology, the prediction accuracy and algorithm period of the BP algorithm test set are inferior to the ELM algorithm.

C. RBF and SVR algorithm model simulation

The structure of the RBF algorithm and the SVR algorithm model is different from that of ELM. The accuracy of the RBF algorithm is greatly affected by the spread value of the radial basis function spread velocity. The prediction accuracy is ideal when the model spread = 2. The SVR algorithm needs to set relevant parameters according to the data scale and the type of problem to be solved. The kernel function of the SVR is set to RBF, and the gamma value of the kernel function is obtained by cross-validation method (CV). Gamma = 2.8,

The simulation results of RBF algorithm and SVR algorithm are shown in Fig. 5 and Fig. 6.

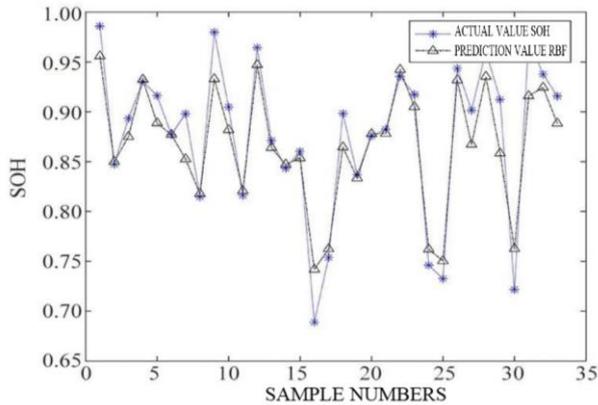


Fig. 5. RBF simulation result

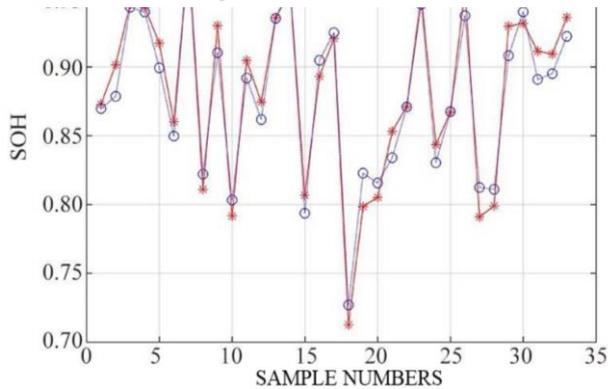


Fig. 6. SVR simulation result

Table-II summarizes the mean square error values  $Mse$ , algorithm determination coefficients  $R^2$ , and algorithm operation period of the above algorithms.

It can be seen from Table -II that compared with ELM algorithm, BP algorithm, RBF algorithm, and SVR algorithm, the GA-ELM algorithm has the smallest mean square error value and the highest degree of prediction fit, but the GA-ELM algorithm has the longest running time.

Table-II: Algorithm prediction results data

Algorithm no.	MSE	$R^2$	Operational time/s
GA-ELM	$3.153 \times 10^{-5}$	0.993	25.421
ELM	$1.040 \times 10^{-3}$	0.817	1.149
BP	$1.533 \times 10^{-2}$	0.937	4.667
RBF	$1.145 \times 10^{-3}$	0.902	2.453
SVR	$1.313 \times 10^{-2}$	0.957	6.850

## VII. RESULT AND DISCUSSION

In summary, the BP algorithm has a long iteration period. The RBF network weights can be solved by linear equations, but the model prediction accuracy is greatly affected by the spread value, and the algorithm parameter selection is more complicated.

The prediction accuracy of the SVR algorithm is greatly affected by the number of hidden layer units of the model and the activation function selected.

The selection of ELM algorithm parameters is relatively simple. Experiments result show that the GA-ELM algorithm has a better ability to solve regression problems than the ELM and BP algorithms. GA-ELM model is less complex than RBF algorithm and SVR algorithm.

## VIII. CONCLUSION

This paper analyzes the advantages of the GA-ELM algorithm over the traditional algorithms. The prediction accuracy and stability of the GA-ELM algorithm are improved compared to the ELM algorithm. The experimental results also confirm the feasibility of the integrated algorithm in practical applications. Genetic algorithms are widely used in the fields of machine learning and signal processing. The characteristics of genetic algorithms are suitable for optimization of large-scale, nonlinear problems. Compared with the particle filter algorithm and GA-SVR algorithm, the GA-ELM algorithm has higher prediction accuracy for the state of health (SOH) of lithium batteries.

The shortcoming of GA-ELM algorithm lies in the long running period of the algorithm, which is caused by the low search efficiency of genetic algorithm. How to reduce the running period of GA-ELM algorithm needs further research.

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# Occupying the Blind Spot: the role of Kuripa ngozi in Transitional Justice in Zimbabwe the case of Hwesa Clan

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**Abstract-** Zimbabwe has a history of many attempts at transitional justice dating back to the 1980s. Healing and reconciliation efforts to address conflicts in Zimbabwe have faced numerous challenges. The Unity Accord of 1987 mainly addressed the issues of the perpetrator and totally ignored the victim. It was an agreement between leaders of two political parties neglecting to address the majority that had suffered in Matebeleland and Midlands. The Unity accord brought alleviation nation-wide, but in parts of the country where it happened problem remain unsolved and resolved. These include poor health, poverty, practical and legal problems and a deep mistrust of Government.

In the absence of an effective and inclusive transitional justice initiated by the state, communities affected by conflict turn to endogenous mechanisms to address conflict. This paper analyses the traditional method of *Kuripa ngozi* used by the Hwesa people of Nyanga, Zimbabwe to resolve conflict involving the death of the victim. The family of the perpetrator is asked to pay the victim's family some form of compensation. This is done through the mediation of the dare and the conducting of cleansing ceremonies to appease the spirit of the dead. This paper analyses the process, its advantages and challenges and makes recommendations of making the traditional mechanism better.

**Index Terms-** Transitional justice, traditional mechanism, dares, Kuripa ngozi, culture, reconciliation

## I. INTRODUCTION

The concept of transitional justice has its roots in the international human rights movement. It was aimed at the use of judicial process to address human rights violations and atrocities committed by repressive regimes. Transitional justice became useful in addressing war crimes and massive human rights abuses committed in violent conflicts (Kritz 1995; Teitel 2000). Transitional justice principles are recognised by the Inter-American Court, European Court of Human Rights and UN treaty bodies such as the Human Rights Committee. The creation of the International Criminal Court in 1998 was a milestone to show states obligation in fighting impunity and to seek justice for victims of human rights violations (International centre for transitional justice).

According to Kofi Annan former secretary General of the United Nations, Transitional Justice is the full range of processes and mechanisms associated with a society's attempts to come to terms with a legacy of large-scale past abuses, in order to ensure accountability, serve justice and achieve reconciliation. They may

include both judicial or non-judicial mechanisms, with differing levels of international involvement (and none at all) and individual prosecutions, reparations, truth-telling, institutional reform, vetting and dismissals or a combination thereof (UN Security Council, 2004).

Transitional justice along the way has extended its importance to include the establishment of tribunals, truth commissions, lustration of state administrations, settlement on reparations, and also political and societal initiatives devoted to fact-finding, reconciliation and cultures of remembrance.

In the African region, as follow up to the June 2006 AU Policy on Post-Conflict Reconstruction and Development, the African Union developed a policy on Transitional Justice. The AU defines Transitional Justice as the various (formal and traditional or non-formal) policy measures and institutional mechanisms that societies, through an inclusive consultative process, adopt in order to overcome past violations, divisions and inequalities and to create conditions for both security and democratic and socio-economic transformation-AU TJ Policy. The policy emphasises that TJ is not new to Africa. Africa has varied experiences in TJ but there is no one, comprehensive policy framework to guide and promote experience sharing among Member States. Based on this, the report proposed developing a policy on TJ for adoption by the relevant AU organs that is home-grown, unique to Africa, rich in its progressive methodologies and approaches, and rooted in African shared values, traditional justice systems and experiences.

Machakanja (2010) reiterates that, "Zimbabwe has been trapped in a complex and protracted political crisis that has seen rising levels of human-rights violations, including kidnappings, disappearances, arbitrary detentions, torture, sexual violence and the forced recruitment of youth by armed groups, to name just a few." There have been attempts at TJ by the Zimbabwe government through amnesties, presidential pardons and unity accords between major contesting political parties. Zimbabwe also put in place through its 2013 Constitution a National Peace and Reconciliation Commission (NPRC) to address Transitional Justice issues affecting the country. However, the government is viewed as unwilling to engage honestly and genuinely with the past as some of the senior government officials are implicated in the atrocities. The oratory of unity based on amnesia has been given precedence over the real mechanisms that promote peace building and reconciliation. Indemnities, amnesties and presidential pardons have been used to protect perpetrators of conflict and violence at the expense of justice (Benyera and Ndlovu-Gatsheni, 2015). Of note in Zimbabwe, is the absence of traditional methods of Transitional Justice in the quest to build

sustainable peace in the country. Traditional methods of TJ in Zimbabwe such as Kuripa ngozi have been relegated to the sidelines whilst the government tries to implement TJ through western methods. This paper argues that traditional methods of TJ in Zimbabwe should be taken from the blind spot where they are currently placed and given prominence side by side with the western methods for effective and sustainable Transitional Justice.

## II. CONTEXT AND METHODOLOGY

The study was carried out in Nyanga, Zimbabwe. Nyanga is situated in the Eastern part of Zimbabwe close to the Mozambique border. Using the case study approach, the researcher carried out an in-depth and multi-faceted exploration of the Kuripa ngozi method in their real-life settings of the Hwesa Clan. The Hwesa clan is domiciled in a remote area where access to modern justice system is difficult due to factors such as proximity and costs. Therefore the use of traditional justice mechanisms to settle disputes is highly prevalent and trusted. The respect for culture and traditional institutions is deep. The researcher carried out in-depth interviews with Headman Sanyamuera *Dare* to gain an understanding of the traditional method of Kuripa ngozi and how it is carried out by the Hwesa. The case of Moses Mupezeni who was murdered and the Kuripa ngozi method was used to settle the dispute were analysed. Face to face interviews with community members, *Svikiro* and victims' families were carried out. The use of the case study approach ensured that the Kuripa ngozi phenomenon is analysed in depth and in its natural context. The uniqueness of the Kuripa ngozi approach is thus brought out and recommendations to improve it proposed.

## III. THEORIES OF TRANSITIONAL JUSTICE

Transitional Justice is a subject area that is highly undertheorised. Although there have been activities conducted globally and the reverberant academic debate on the topic, there are few attempts to conceptualise transitional justice theoretically (Susanne Buckley-Zistel, Teresa Koloma Beck, Christian Braun and Friederike Mieth, 2014).

Transitional Justice discourse and practice are largely based on Western thinking that is strongly influenced and shaped by historical experiences. The events and experiences that have influenced the development of Transitional Justice include the Nuremberg and Tokyo trials after the Second World War, the change from dictatorship to democracy in South America, international criminal tribunals in the former Yugoslavia and Rwanda, and the Truth and Reconciliation Commission (TRC) in South Africa. There have been attempts to theorise Transitional Justice with the focus on justice and transition. Catherine O' Burke (2013) assesses what a transition should achieve, the type of society that must be birthed, how a transition can be accomplished and how gendered citizenship can be achieved after a transition. Aiken (2013) argues that the aim of a transition is the transformation of the antagonistic relationships between the parties to the conflict through transitional justice leading to reconciliation. Other scholars advance the view that transitional should lead towards liberal values and democracy (Teitel 2003;

Mihr 2012). For Oomen (2005) the rule of law remains a paramount objective in the transitional processes.

Scholars that lean on the notion of justice outline different understandings of the matter. Justice is viewed as punitive, corrective, restorative, reparative or distributive. Lambourne (2009) discusses the linkages between the different types of justice for example retributive, restorative and distributive justice. Justice is viewed as aiming to promote just peace and protecting human rights (Mani 2002). Efforts to theorise Justice have also focused on the inclusion of economic, social and cultural rights in addition to political and civil rights (Laplante 2008; Mani 2008).

Theoretical this paper challenges the notion that Transitional Justice is a global norm. Nagy (2008) suggests that Transitional Justice can be perceived from a local situation. The concepts of justice, truth and reconciliation can mean different things to different people and societies. By looking at the traditional method of Kuripa Ngozi as practised by the Hwesa Clan it is clear that the process and components of Transitional Justice are different from the Western perspective.

Thus the need to look at traditional methods of transitional justice in Africa and how they add value to the theoretical framework of the transitional justice discourse. The method of Kuripa Ngozi underpins the theory that Transitional justice must be encompass both the victim and perpetrator and their participation in the process is vital to sustainable peace.

### The Western versus Traditional Methods Contestation

Western methods of TJ include Retributive justice and the rule of law. Criminal courts are the main instruments of this method. Courts are formed to administer penal justice by holding accountable those who committed atrocities and other punishable acts. It acknowledges the suffering of the survivors and by establishing a record of the past misdeeds can be seen as the first step in the process of healing the societal and the individual trauma (Kasapas, 2008). However, critics of retributive justice argue that it focuses on punishing the perpetrators and cannot heal the trauma of the victims. The counts become "combative encounters" that fail to promote the revelation of truth (De Brito, 2010). Another method is Restorative Justice where the focus is on Reconciliation and forgiveness, through a mending process that requires the active participation of the community. The main focus however, is on the victims and the involvement of the offenders. Truth commissions are part of restorative justice- aim to promote truth telling and allow the victims to express their feelings (Brahm, 2007). TCs have received severe criticism because they do not possess the authority to allocate legal punishment or reparations. Their role is restricted to suggestions which can be ignored by the political leadership whether because the new regime lacks the resources to implement the outcomes (Dukalskis, 2011)

According to Mani (2002) Distributive justice aims to "tackle the roots of the unrest" by addressing the structural factors that led to the escalation of conflict to violence. Dealing with injustice and inequality during the reconstruction phase, is really important in order to ensure sustainable peace and reconciliation. Thiessen states that reparations are the key element of distributive justice to rectify past wrongs, restore property or rights and provide compensation, rehabilitation and satisfaction to the victims. However, reparations whether material or symbolic,

cannot totally compensate the victims for the loss and the trauma that was inflicted upon them. Reparations focus exclusively on the past while reconciliation is forward looking. (Kasapas, 2008)

Many of the conflicts that occurred in Africa in the 1990s were approached with a wide range of Western approaches and mechanisms to regulate and resolve them. Approaches such as the use of international statesmen, international and regional organizations, the involvement of neighboring countries, peace support operations and civil society organizations (CSOs) (Galadima, 2006). Bukari (2013) argues that these methods of conflict resolution were western and conventional and did not take into account the cultural milieu of their occurrence. As a result, many of the conflicts became protracted and intractable. Even where there is a return to peace, deep-seated issues still remain to be resolved and therefore make peace in these areas fragile. Scholars like Bukari have thus questioned the effectiveness of most of these conventional and western resolution approaches and mechanisms in Africa. Traditional mechanisms of conflict resolution in Africa have many times been sidelined at the expense of Western mechanisms. Bukari reiterates that the conflicts in Somalia, Sudan, Democratic Republic of Congo and Niger Delta rage on, despite efforts to resolve them. The challenges associated with the resolution approaches call for alternative resolution mechanisms to bring peace to the African continent (Bukari, 2013). Boege (2006) therefore argues that the intervention approaches to these conflicts will need traditional/indigenous methods to resolving them. A fusion of non-state traditional actors and methods (indigenous) and their combination with Western forms of conflict transformation can be an effective method of TJ in Africa.

Scholars such as Huyse (2008) highlight the weaknesses of traditional methods of TJ. Traditional approaches to conflict resolution are usually lumped together, regardless of geographical location and structure. There is a tendency emerging literature on traditional approaches to mystify or “romanticize” these approaches as being more “authentic”, “effective” and “home-grown” while overlooking their limitations (Huyse, 2008). Working with traditional authorities also became appealing to Western audiences as it allowed them to base their “legitimacy on claims to represent and work with authentic African identity and difference, treat Africans with dignity as Africans and avoid imposing Western ideas and models” (Branch, 2017).

Traditional approaches have a weakness of being based on hierarchical or patriarchal systems which are intrinsically exclusive. These Systems exclude the voices of women or youth thereby posing a danger of excluding their views in any TJ process. Branch (2017) supports this view by arguing that the use of traditional methods in northern Uganda among the Acholi people has had the perverse effect of reinforcing the forms of domination and inequality in society that partially led to the conflict in the first place. Mutisi (2012) notes that while “traditional institutions are rooted in the culture and history of African societies, the modern state exerts a large amount of influence on these institutions.... In some cases the traditional institutions are politicized and have become instruments of propagating state ideology.” The politicized involvement of the state in traditional methods of TJ can negate the peace process. As noted by the International centre for transitional justice “transitional justice should include several measures that

complement one another. For no single measure is as effective on its own as when combined with the others”. In every society coming out of conflict there are differences in context, history, interests and parties involved. The decision on which methods of TJ to use depends on several factors including the depth and intensity of the conflict.

#### IV. UN GUIDING PRINCIPLES ON TRADITIONAL MECHANISMS

The success of the Gacaca courts in Rwanda according to Huyse (2008) led to the positive recognition of traditional approaches in the framework of transitional justice and reconciliation policies. It was reflected by the UN’s recognition of traditional mechanisms and their critical role in administering justice and settling disputes. The Secretary General Report on the Rule of Law and Transitional Justice in Conflict and Post-Conflict Societies (2004) notes that “due regard must be given to indigenous and informal traditions for administering justice or settling disputes, to help them to continue their often vital role and to do so in conformity with both international standards and local tradition” Whilst acknowledging the significance of traditional methods in TJ, the UN was fully aware of the gaps posed by their use without international guidelines. The following guidelines were thus put in place by the UN as its approach to the use of traditional methods in TJ:

1. Support and actively encourage compliance with international norms and standards by transitional justice processes and mechanisms. Traditional mechanisms of TJ must be in sync with the modern international legal system: international human rights law, international humanitarian law, international criminal law, and international refugee law

2. Strive to ensure women’s rights through transitional justice processes and mechanisms. They should pay special attention to abuses committed against groups most affected by conflict, particularly women. Gender inequality is one of the most pervasive forms of societal inequality and is often exacerbated by conflict and situations of gross human rights violations.

3. Support a child-sensitive approach to transitional justice processes and mechanisms. Children are among those most affected by violence and armed conflict. Traditional methods of TJ should enhance the protection of children and prosecute offenders of crimes against children. Child soldiers should first and foremost be treated as victims not only as offenders.

4. Encourage a comprehensive approach integrating an appropriate combination of transitional justice processes and mechanisms. The fusion of judicial and non-judicial processes and measures, including truth seeking, prosecution initiatives, reparations programmes, institutional reform or a combination of these in TJ processes.

The recognition of Traditional methods of TJ by the United Nations is an important milestone for traditional approaches in the discourse of TJ. Like any other TJ approach, traditional methods have aspects which require improvement. Traditional methods of TJ should be removed from the shadows and blind spots of transitional justice mechanisms and take a prominent role in the Transitional Justice discourse.

#### Traditional methods of TJ in Africa

Traditional methods of TJ have been used in Africa with different levels of success depending on the context. Since 1986 Uganda has experienced a costly and brutal civil war. The high cost of an unending civil war has caused Ugandans to re-assess the approaches of resolving conflict. For the Acholi of Northern Uganda the bitter experience of unending conflict has generated a commitment to reconciliation and peaceful settlement of conflict rather than calling for retributive justice (Afako, 2013). In the Ugandan context the communities facing the brunt of civil war see the advantages of using the traditional approaches rather than the retributive approach.

The rwodi-traditional chiefs oversee the mediation process called *mato oput* which many Acholi believe brings forgiveness and reconciliation in a way that formal justice system cannot. It's a family and clan centered reconciliation where acknowledgement of wrong, acceptance of compensation, and the sharing of a symbolic drink. The *Mato Oput* has been supported by NGOs, churches and government in the quest to promote transitional justice in Uganda. The process involves former Lord Resistance Army (LRA) combatants who are usually the perpetrators and victims from the community. Individual cleansing ceremonies also take place when an LRA combatant returns forging the way for reconciliation and reintegration. The use of the *Mato Oput* in Uganda has proven that the complexity of conflict, its duration, effects, and inability of formal processes to address serious violations has led to the renewal of traditional methods of TJ (Afako, 2013).

After the civil war in Liberia, the Truth and Reconciliation Commission recommended the use of the traditional method of the *Palava Hut* transitional justice mechanism. It was used to redress, atone for, heal, and resolve community conflicts left in the wake of the civil war (Ministry of Internal Affairs 2012). In Rwanda the use of the *abunzi* mediators is critical for conflict resolution. According to Mutisi (2011) these institutions have presided over cases such as land disputes, civil disputes and, in some instances, criminal cases. In Rwanda, these traditional institutions of dispute resolution are fully recognised under the law. Further Mutisi argues that as "Africa continues to develop and strengthen its political institutions for conflict resolution, the place of traditional institutions attracts the attention of practitioners and policy makers. There are emerging synergies between traditional and modern institutions of conflict resolution". The use of traditional methods in TJ on the African continent is work in progress which is proving to be critical in the quest for justice and sustainable peace. Endogenous approaches to TJ should not be sidelined but rather strengthened to address the numerous conflicts on the continent.

### **An overview of Transitional Justice in Zimbabwe**

Since Zimbabwe's independence in 1980, the issue of achieving sustainable peace and development has remained a challenge due to a lack of comprehensive approaches to issues of transitional justice. The political events and conflicts in Zimbabwe have created challenges that have drawn the attention of both domestic and international actors (Machakanja, 2010). Zimbabwe needs a transitional justice system and process that would guarantee maximum accountability for the committed atrocities with a view to facilitating sustainable national healing and just peace. The argument for a just transitional process is premised on

the argument that families and relatives of those who disappeared need to know what happened to their loved ones and have a sense of who is responsible (Machakanja, 2010)

Machakanja (2010) argues that it is generally agreed that the policy of National Reconciliation, as espoused after independence, lacked practical substance, since it did not seek to address the abuses that occurred before 1980 in a structured and comprehensive way. The Unity Accord of 1987 mainly addressed the issues of the perpetrator and totally ignored the victim. It was an agreement between leaders of two political parties neglecting to address the majority that had suffered in Matebeleland and Midlands (Ndlovu-Gatsheni, 2012). The 2013 Constitution created the National Peace and Reconciliation Commission which was tasked to spearhead TJ in Zimbabwe. However, the Commission is underfunded and has done very little on the ground to address the grievances suffered by victims.

The National Transitional Justice Working Group (NTJWG) is a platform established by forty-six Zimbabwean transitional justice stakeholders to push the TJ agenda in Zimbabwe. The NTJWG work is based on the principles of victim centeredness, inclusiveness, truth, justice, compensation, reparations, healing, reconciliation and never- again. The current transitional justice discourse in Zimbabwe is a top to bottom approach where the state is dictating the process with little input from other stakeholders.

According to Sanchez, (2019) the Zimbabwean context presents challenges as it significantly depart from the conventional TJ conceptualisation. No meaningful transition has taken place and some of the alleged perpetrators of human rights violations hold prominent offices in the government.

The several attempts at Transitional Justice in Zimbabwe point to a neglect of traditional approaches as alternative to the Western methods that have failed to yield results on the ground. Zimbabwe has traditional approaches such as *dare* and *Kuripa ngozi* which if utilized can result in sustainable peace and development in the country.

### **Kuripa ngozi as a traditional method of conflict resolution in Zimbabwe**

*Kuripa ngozi* is a traditional method of conflict resolution that is common and prevalent in all African cultures in Zimbabwe. It is practiced by all the main indigenous African groups in the country. In the Ndebele culture it is called "kuhlaura ingozi". The Ndau speaking people call it "kuripe ngozi". In Tonga it is referred to as "kuliya muzimu". In kalanga it's called "Tshigumba tshenha". In Nambya they call it "Kulipa ndandu weNgonzi". The process of *Kuripa ngozi* has similar characteristics in all the different cultures where it is used as a transitional justice mechanism. There are element of truth telling, compensation, reconciliation and accountability in the *Kuripa ngozi* method.

All these cultures believe that if a person is murdered his spirit will seek vengeance in the family of the murderer "ngozi". The spirit will cause misfortunes and deaths in the family of the perpetrators to a point where they consult spirit mediums and traditional leaders for mediation. According to Chivasa (2018) the traditional practice of *Kuripa ngozi* has proved valuable in terms of its capacity to resolve conflict, re-create social relationships that have been distressed by violent conflict at the family level. He further highlights that it has the "propensity to promote inclusivity

of both men and women and constructive engagement in resolving inter-family murder-related conflict” The approach has the capacity to deliver accountability and compensation as conditions for reconciliation. The process of Kuripa ngozi was meant to restore the lost life in the family of the deceased and to unite the two families through bloodline (marriage and children that will be born). It accounted for truth and justice for the victims and reunites the divided parties (Simura & Mudimu, 2019).

Kuripa ngozi is viewed as the primary traditional transitional justice mechanism mostly in the rural areas of Zimbabwe. This is due to its capacity to deliver on key transitional justice deliverables such as accountability and compensation (Chavunduka, 1994; Goldin and Gelfand, 1975). Kasambala (2009) argues that transitional justice in Zimbabwe is characterized by the absence of the rule of law and run by partisan state institutions such as the courts, police and army. Accessing justice becomes almost impossible for victims. Under this status quo, victims turn to traditional forms of transitional justice as the most feasible alternative for them to get justice and reconciliation. One prominent case where a victim’s family turned to traditional justice mechanisms when they were let down by the state institutions is that of Moses Chokuda a victim of political violence. Chokuda was murdered by four Zanu PF supporters including Farai Machaya the son of Jason Machaya who was a Provincial Governor. Chokuda’s body was not buried for 31 months as he avenging spirit caused misfortune to his murders. He was finally buried after the Kuripa ngozi process was done. The murderer’s family paid 35 cattle and 15 000 United States dollars to the victim’s family (Newsday 2011/02/04).

Despite, being tried and tested as a traditional method of transitional justice, Kuripa ngozi remains in the blind spot of TJ in Zimbabwe. There is no legislation in Zimbabwe that recognises the method as central to transitional justice. Countries such as Rwanda have enacted laws that recognise traditional methods such as Gacaca courts and Abunzi as part of the justice system (Mutisi, 2011). The National Peace and Reconciliation Commission in Zimbabwe is silent about the role that traditional mechanisms such as Kuripa ngozi can play in peace and reconciliation. Rather Western methods have been given prominence whilst traditional methods have been sidelined. Over a long period of time Kuripa ngozi has been the main traditional method of transitional justice and must be incorporated by the NPRC as part and parcel of TJ package.

### **Kuripa ngozi: the case of the Hwesa Clan**

The Hwesa people of Nyanga, Zimbabwe believe that when a person is killed his or her spirit will seek justice by causing misfortunes in the family of the perpetrator through as an avenging spirit called “ngozi” in Shona. The family of the perpetrators experience misfortunes such as illness, one death after another and series of mental illness. These will force the family to consult a “Svikiro” or Spirit Medium looking for a solution. The Headman gave an example of one such case where Moses Mupezani who was a known supporter of the opposition Movement for Democratic Change (MDC) was murdered in June 2008. Mupezani was beaten to death by 14 youths who were sent by a ZANU PF leader in the area. Mupezani family refused to take part in the funeral forcing the chief to bury his body. The killers were arrested and sent to jail but they returned after less than two

months. The Headmen sighted this as a failure of Western methods to bring justice to victims of political violence. Impunity and corruption in the justice system in Zimbabwe force victims to seek for justice in the traditional approaches. The Kuripa ngozi method in the Hwesa clan is done in the following stages:

## **V. THE USE OF DARE**

The Dare is a customary court in Zimbabwe, which is made used for conflict resolution among the Shona people. Criminal and civil cases are tried in the presence of community members and a ruling is arrived at after consultations. In the case of the Sanyamuera of the Hwesa clan the Dare is made up of 7 “makurukotas” officials who are chosen from the community. The current dare consists of 5 men and 2 women of mixed ages. Gender and age representation in the dare is important to provide a fair hearing to women and men and the old and young. The Makurukotas are chosen on the bases of their experiences of life and their “Hunhu” character in the community. The officials of the Dare are chosen by the whole community. The Dare have evolved over the years to accommodate roles such as secretary and treasurer to record the Dare proceedings and the treasurer to oversee the payment of penalties. The positions in the Dare include the secretary whose role is to document all the cases that are handled by the court. Mupurisa vaMambo’s role is to enforce the judgments’ of the court. The treasurer is responsible for collecting the penalties from the offenders. Elders from the chief’s family are also part of the Dare. The Dare is held on the Friday of every week if there are cases for trial. The Dare of Headmen Sanyamuera has presided over transitional justice cases in the area using traditional approaches such as Kuripa ngozi. The cases tried at the Dare include murder cases resulting from political violence during the 2008 Presidential Runoff in Zimbabwe and other cases which have resulted in “ngozi” avenging spirit affecting the family of the perpetrators. Headman Sanyamuera and his Dare have used the traditional methods within their culture to resolve conflict and promote transitional justice.

### **Stage One**

After the murder of a person, the ngozi/ avenging spirit of the murdered person causes misfortunes in the family of the perpetrators forcing them to seek help from the Chief who advises them to seek help from a Svikiro residing in the area.

### **Stage two**

With the help of the Svikiro, a traditional ceremony is held where beer is brewed in the bush by older women. The spirit of the murdered person then speaks through the Svikiro in the presence of the Headman and his Dare and the family of the perpetrators. It has to give an accurate account of what happened, when it happened, where it happened and what it wants as compensation. In the case of murdered Mupezani, the aggrieved spirit demanded that the families of the people involved in his murder should pay compensation in the form of cattle.

### **Stage three**

The Headman and the Dare become mediators between the perpetrators family and the victim’s family. The role of the dare is to bring the families together for dialogue to discuss the way

forward and the payment of the compensation as narrated by the Svikiro. The victim's family is approached and appraised that the perpetrators family want to pay compensation/Kuripa ngozi for the death of their relative. Misunderstandings may arise between the two families and the Dare must mediate until common ground is reached and the conditions for compensation are set.

#### **Stage four**

The family of the perpetrator pays compensation to the victim's family at the Dare in the presence of the whole community, the affected families and the Svikiro. The compensation that is paid must be the exact items as demanded by the avenging spirit through the Svikiro. If this is not done according to the said demands the misfortunes will continue to affect the perpetrator's family. One of the demands of the contested demands of the avenging spirit is that a virgin girl be given to the victim's family as compensation. This has been criminalised under Zimbabwean law as it infringes on the rights and protection of children. However, the practice is still going on at family and community level. It becomes a criminal offence when a child is forced to go to the victim's family but in cases where there is mutual agreement the practice is prevalent.

#### **Stage Five**

Through the Svikiro the spirit of the murdered person is asked if it is satisfied in the presence of the whole community. If the avenging spirit is satisfied and all the affected families confirm that they are satisfied then the reconciling process is set in motion. A "kuchenesa"/cleansing ceremony is then held. Water is poured on the perpetrators family by a member of the victim's as symbol that they have been cleansed. The people participating in the ceremony will clap hands and ululate in celebration.

#### **Stage six**

The perpetrator's family gives the dare a "konde"/token of appreciation in the form of a goat and the Svikiro is given a cow as a payment for its role in the Kuripa ngozi process. This is a way of respecting the Dare and the Svikiro in the roles they play in the reconciliation process.

#### **Stage Seven**

The Headmen and the Dare then provide counseling to both families. The Headman's message will emphasise peace between the two families and that reconciliation is important. This is an important stage of the process as the community leaders use the platform to advise the community on the vices of violence and the benefits of peace. Community members are taught to use non violent means to resolve conflict and to live in harmony. The misfortunes that the perpetrator's family experienced and the compensation that they pay serve as deterrent and a lesson to the whole community. The two families then exchange "pfekamutenga" /peace token in the form of chickens to show the Dare and the community that they have reconciled. From then on the two families are expected to live in peace and the spirit of the victim will cease to cause misfortunes in the perpetrators' family.

#### **The Advantages of Kuripa ngozi as a transitional justice mechanism**

The Kuripa ngozi has several advantages as TJ mechanism. The family of the victim directly benefits from the compensation paid by the perpetrator's family unlike in cases where the criminal and retributive approaches are used. The state benefits and the family of the victim lose out. When using the traditional method of Kuripa ngozi the victim's family benefits from the compensation usually in the form of cattle and goats.

The approach is transparent and has elements of integrity and accountability unlike the modern forms of Transitional justice in Zimbabwe where the state can interfere in the delivery of justice. There are known perpetrators of human rights violations who have never been brought to justice due to corruption and political meddling in the justice system. The ngozi approach brings all perpetrators to justice without fear or favour.

Kuripa ngozi preserves the African culture's belief in the importance and sanctity of human life. The payment of compensation ensures that the sanctity of human life is respected and the right to life protected

Communities learn from the misfortunes of ngozi that killing people does not pay. The right to life is therefore respected. The process of Kuripa ngozi promotes dialogue and healing between the families of the victims and the perpetrator. Conflict resolution is achieved and reconciliation is promoted.

Counseling and peace education is provided by the traditional leader throughout the processes helping the perpetrator, victim's family and the community to appreciate peace and reconciliation.

The approach is cheap compared to western approaches. It makes use of community resources and ensures the involvement and participation of the whole community.

#### **The Disadvantages of Kuripa ngozi**

The people that suffer the consequences of ngozi and pay the compensation are usually not the perpetrators themselves but members of the family. Hence people who may not have committed the crime are caught in the web of misfortunes and end up paying for crimes they did not commit.

In some cases compensation is demanded in the form of a virgin girl which is a gross human rights violation and a crime.

The method is relevant and functional in a specific cultural and religious context. It cannot be used in other cultures and religion e.g. English, Indian

#### **Lessons from the Hwesa Case**

Kuripa ngozi method is a community and cultural based method of transitional justice which brings effective healing and reconciliation through community involvement.

The process has elements of transparency, accountability and integrity making the method an effective tool of justice

When victims' view the state's attempts to justice as skewed they turn to traditional methods such as Kuripa ngozi for redress.

One method of transitional justice may not be enough to achieve justice for the victims. In the case of Moses Mupezani the perpetrators were given prison sentences but the victim's family turned to the traditional method of Kuripa ngozi to get compensation. A combination of two methods TJ may be required to achieve effective healing and reconciliation.

Despite being sidelined by the state, the traditional method of Kuripa ngozi has survived overtime and continues to be effective in conflict resolution and reconciliation

The reliance of Kuripa ngozi on the spiritual realm for the compensation to be paid makes the method rigid and inflexible and leaving no room for the living to negotiate for a lesser punishment.

## VI. RECOMMENDATIONS

The government of Zimbabwe should consider enacting laws to adopt Kuripa ngozi as an approach to TJ justice as countries such as Rwanda, Uganda and Liberia has done. This will ensure that the method is practiced within the law and following guidance and standards of international law.

Kuripa ngozi should be adopted as TJ mechanism by the National Peace and Reconciliation (NPRC) which is spearheading the peace and reconciliation process in Zimbabwe.

Training of traditional leaders in the area of human rights to ensure that as they mediate conflicts through Kuripa ngozi, human rights are protected and women and children are not harmed.

Funding should be made available to traditional leaders and the Dare as a community institution to strengthen the delivery of justice.

There is too much variance on the penalty that is given and it depends on what the spirit of the deceased demands. Traditional leaders and Svikiro/Spirit medium should come up with ways of standardizing the penalty.

## VII. CONCLUSION

Although traditional methods of Transitional Justice have been in use in countries such as Rwanda, Sierra Leone and Liberia in Zimbabwe there are still in the blind spot. Despite Zimbabwe's dire need for a functional and inclusive Transitional Justice process traditional methods have been ignored. Western methods of TJ just like traditional methods have weaknesses and calls for the fusion of the two discourses to come up with meaningful TJ. As shown by the use of the Kuripa ngozi approach in the Hwesa Clan of Nyanga, traditional methods offer a participatory and transparent way of conflict resolution. The traditional approach of Kuripa ngozi has its own weaknesses but these can be addressed to ensure that it's operating within the confines of International law. In the form of traditional methods of Transitional Justice, Zimbabwe has an untapped resource. Approaches such as Kuripa ngozi should be taken from the blind spot and thrust on the Transitional Justice trajectory.

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# Critical Health Literacy and Doctor-Patient Communication: Highlighting the Role of Patients' Support Networks in Chronic Conditions

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## Abstract

Health literacy is a set of individual skills that allow a person to gain and utilize new health information. It incorporates the ability to understand health information from pamphlets, obtain applicable health information during an interview with health experts, and to access and assess health information from other platforms. Patients with inadequate critical health literacy have a poorer understanding of their disease progression, medication regimens, and techniques for dealing with their disease. This study was carried out to establish the influence of critical health literacy in doctor-patient communication among HIV/AIDS patients in Homa Bay county, Kenya. The results showed that 51% of the 362 participants involved in the study were females, and the majority (30.9%) of respondents fell in the age group of 45 years and above. The level of critical health literacy among the study participants was adequate at a mean of 3.515 and Standard Deviation (SD) of 1.186. Critical Functional health literacy also had a significant positive influence on doctor patient communication among the study participants (Nagelkerke R square= 0.318). Critical health literacy is acquired mainly through empowerment-based capabilities, where members become enlightened on issues, take part in important dialogue, and take an interest in decision making for the sake of their health. Therefore, encouraging people living with HIV/AIDS to form or join existing networks and support groups is highly recommended. This will create more avenue for patients, acting as an individual or in a group to improve health.

**Key words:** Critical Health literacy, Homa Bay, Doctor-patient communication, HIV/AIDS

## 1.0 Introduction

Studies show that many adults have challenges with health literacy. For example, in the United States of America, approximately 45% of the adult population has health literacy skills below satisfactory. Although fewer European studies on the topic have been conducted, a recent report about eight European Union member states indicated comparable figures; 47% has inadequate health literacy. In the Netherlands, 25% of the population does not have adequate health literacy (1).

Populations in all likelihood to experience low health literacy are older adults, racial and ethnic minorities, individuals with less than a high school training, people with inadequate income, non-native speakers of English, and people with poor health status (2). Education, language, lifestyle, access to assets, and age are all factors that have effects on someone's

health literacy skills. Health literacy consists of numeracy skills, for example, calculating cholesterol and blood sugar levels, measuring medications, and knowledge of nutrition labels all require math abilities (3). Contrasted with those having good health literacy, patients with limited health literacy experience challenges in health and healthcare access. They have a poorer understanding of their disease progression, medication regimens, and techniques for dealing with their disease. Limited health literacy can also lessen the effectiveness of health services offered, thereby contributing to poorer health outcomes such as higher incidence of hospitalization and infrequent utilization of preventive services, both of which are associated with higher healthcare costs (4)

Nutbean (5) describes critical health literacy as very advanced cognitive abilities that, in combination with social skills, can

be utilized to examine information critically and to use this information to gain greater control over life occasions and circumstances. Taken literally, the 'critical' aspect of critical health literacy may be described as a higher-level cognitive capability as recommended by McLaughlin and DeVoogd (6). If health literacy is the capability to access, comprehend, appraise and apply health information, then critical health literacy is a higher-order process that may be created through training to critically assess the information of significance to health (7).

Critical health literacy has additionally been defined as empowerment in which being critically health literate might imply acting as a person or in a group to improve health through the political framework or social activism (8). Just like health literacy may be portrayed as 'new wine into old bottles' of empowerment so critical health literacy, with its focus on community capacity to take action on social and economic determinants of health, is a critical element for community development (9). Taking critical health literacy from this point of view and borrowing from Freire, critical health literacy is, like community growth, a process where in members become enlightened on issues, take part in the important dialogue, and take an interest in decision making for the sake of their health (10).

Even though the seventh Global Conference on Health Promotion (11) recognized improving health literacy as a method for fostering community engagement and empowerment, critical health literacy might be viewed as the overlooked area of health literacy, hardly receiving any focus or engagements which can significantly contribute towards this outcome. Some people contend that minimal consideration given to the psychological constructs in the definition of critical health literacy may lead to health literacy taking a rather cognitive focus and that health outcomes are much more likely to be achieved while the dichotomy between knowledge and psychological constructs become less pronounced (12). Critical health literacy may provide a chance to overcome the above challenge. The absence of consideration the concept has been given might be because of a lack of conceptual models and frameworks investigating critical health literacy (13). On the other hand, it might be the aftereffect of difficulties and confusion in understanding what exactly empowerment-based capabilities include and in what ways the concept can be improved (14). While such confusion may exist, this concept's role in improving health outcomes cannot be overlooked.

**2.0 Methods**

**2.1 Study design**

This study utilized a cross-sectional, quantitative survey

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design conducted among 384 HIV/AIDS patients in Homa Bay county.

**2.2 Sampling technique**

A stratified random sampling method was applied to select the respondents in the eight hospitals in Homa county or the eight strata for this study as shown in the table 1 below.

**TABLE 1: Strata and sampling intervals for the study**

Hospital	Clients population	Stratified sample	Sampling Interval
Homa Bay County Referral	7214	166	43
Mbita sub county	3226	74	44
Suba sub county	2232	54	41
Rangwe sub county	554	13	43
Ndhiwa sub county	328	8	41
Karachuonyo sub county	873	20	44
Kasipul sub county	975	26	38
Kabondo sub county	1223	27	45
<b>Total</b>	<b>16,625</b>	<b>384</b>	

**2.3 Data collection instrument**

This study used of a structured self-administered questionnaire to obtain data from the respondents. Fifteen questions adapted from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) health literacy item set was used. The CAHPS health literacy item set is a validated tool developed to assess provider communication about medicines, tests, and medical conditions. The study adopted the five response categories standard for CAHPS ("never," "rarely," "occasionally," 'regularly' and "always"). For all but 2 of the CAHPS questions, "always" represented the most positive response, but for the questions that asked about providers using medical jargon and speaking too fast, the "never" response was the most favorable. Thus, the coding for this question was reversed in order to be consistent with the other CAHPS questions. A weighted mean score was calculated for each CAHPS survey collected, with possible scores ranging from 1(lowest rating of provider communication) to 5 (highest possible provider communication rating). Critical Health literacy on the other hand was measured using four items Likert scales adopted from Ishikawa, Takeuchi & Yano (15).

**2.4 Data collection procedure**

The prospective respondents were obtained from the sampling frame and sampled using the sampling intervals, as shown in Table 2.1 above, randomly starting from the first name on the list. The clinic appointment dates for selected patients were then noted, and clients approached at the registration department of the clinic where their consent was sought and questionnaires issued to those who consented. The questionnaires were picked from respondents after they had completed the treatment process. This process was repeated until the 384 questionnaires were distributed. At the end only 362 were fully filled up and included in the final analysis giving a response rate of 94%.

**2.5 Validity and reliability of study instrument**

Thirty (30) participants drawn from HIV/AIDS patients in the neighboring Migori County were participated in the pilot study. Additionally, factor analysis and Cronbach's Alpha test, were used to determine the validity and reliability of the study instrument respectively. The alpha coefficient for variables constituting doctor patient communications was found to be

0.728 the recommended threshold of 0.7. Further, all the items for measuring doctor patient communications had factor loadings ranging between 0.653 and 0.768 making them valid to measure the respective variables of the study.

**2.6 Ethical consideration**

The researchers obtained permit from the National Commission for Science, Technology, and Innovation- Kenya. In Homa Bay county, the county director for health and the chief executive officer, Homa Bay County Teaching and Referral Hospital, granted the study's authority. Informed consent was obtained from each participant. All participants were assured of anonymity and confidentiality and were informed of the purpose, the procedures, risk, benefits, and voluntary participation. This information was reinforced with an informed consent form whose content was verbally presented to each participant. No personal identifying information was included in the tool or report to ensure further confidentiality, and participants were informed that their involvement or lack of it would not affect their care at the clinic.

**3.0 Results and Discussion**

**3.1 Demographic characteristics of the study participants**

The respondents' demographic characteristics included; age, gender, marital status, and education level. The respondents

were also asked to state the year they were first diagnosed with HIV infection from which illness duration was calculated. The results are illustrated in Table 2 below

**TABLE 2: Patients demographic characteristics and effectiveness of doctor patient communication**

Demographic Factors n=362	Frequency	% Percentage
<b>Age of the respondents</b>		
18-24 years	57	15.7
25-31 years	67	18.5
32-38 years	54	14.9
39-45 years	72	19.9
<b>Above 45 years</b>	<b>112</b>	<b>30.9</b>
Total	362	100.0
<b>Marital status</b>		
<b>Married</b>	<b>189</b>	<b>52.2</b>
Divorced	29	8.0
Widowed	54	14.9
Single	90	24.9
Total	362	100.0

<b>Level of education</b>		
Class 8 or less	100	27.6
<b>Some High School</b>	<b>118</b>	<b>32.6</b>
High school completed	93	25.7
College/University	51	14.1
Total	362	100.0
<b>Duration of HIV infection</b>		
0-5 years	67	18.5
<b>6-10 years</b>	<b>107</b>	<b>29.6</b>
11-15 years	91	25.1
16-20 years	71	19.6
21 years and above	26	7.2
Total	362	100.0

The respondents' age distribution was between 18 years and 69 years, with the majority (31%) aged above 45 years followed by 25-31 years (21%), while young people aged between 18-24 years made up 16% of the respondents as illustrated in Table 2 above. Regarding the respondent's marital status, the majority (52%) were married, 25% single, while 15% and 8% were widowed and divorced, respectively. The respondents were asked to state the gender with which they identify themselves, and the option of male, female, or others was given. 184 accounting for 51.05%, were female while 48.69 were male, and a further 0.26% choose 'others' without giving further details, as illustrated in table 2 above. The above results illustrate that there was almost parity in terms of the gender of the respondents, even though the female gender was a slight majority. This is in agreement with the previous studies on HIV/AIDS prevalence in Homa Bay county where women had significantly higher HIV prevalence than men at 6.9% compared to 4.4%;  $P < 0.0001$  (12,13). These results contrasted other previous studies that found HIV

prevalence to be highest among persons who had been widowed or formally married, separated, or divorced probably due to the loss of the absent spouse to HIV/AIDS (14). The finding herein gives hope that with good adherence to HIV/AIDS lifesaving drugs and good self-management skills, a patient can live normally if their partner died of HIV/AIDS. As shown in Table 2 above, 57% of the respondents had post-primary school education, even though 31% of this did not finish high school. 28% were educated up to class eight, while a further 14% were college or university graduates. Table 2 above shows that the majority (30%) of the respondents were those who had been having HIV/AIDS infection for between 6-10 years, followed by 25% who had been with the infection for between 11-15 years while 19% and 7% had had the infection for between 0-5 years and 21 years above, respectively. The fact that over 50% of respondents had lived with HIV infection for more than ten years could be a pointer to the efficacy of preventive and supportive measures put in place by the government.

### 3.2 Critical Health Literacy

**Table 3: Distribution of respondents by responses to critical health literacy items**

Critical Health Literacy Items N=362	Never	Rarely	Occasionally	Regularly	Always.	Mean	SD
1 Since being diagnosed with HIV, how often have you considered whether the information given to by healthcare provider is applicable to your situation?	7.2%	17.1%	35.1%	22.1%	18.5%	<b>3.28</b>	<b>1.161</b>
Since being diagnosed	5.2%	12.4%	22.4%	30.7%	29.3%	<b>3.66</b>	<b>1.173</b>

2	with HIV, how often have you considered the credibility of the information given to you by your doctor?							
3	Since being diagnosed with HIV, how often have you checked whether the information given by your doctor was valid and/or reliable?	5.2%	16.6%	28.5%	25.7%	24.0%	<b>3.47</b>	<b>1.175</b>
4	Since being diagnosed with HIV, how often have you collected information to make health-related decisions	7.2%	12.2%	20.4%	29.0%	31.2%	<b>3.65</b>	<b>1.237</b>
<b>Cumulative mean</b>							<b>3.515</b>	<b>1.186</b>

Nutbean (5) described critical health literacy as more advanced cognitive skills that, together with social skills, can be applied to critically analyze health information and use this information to exert greater control over life events and situations. Critical health literacy was similarly measured using the scale adopted from Ishikawa, Takeuchi, & Yano (15). Each item was rated on a 5-point scale, ranging from 1, 'never' to 5, 'always,' with always denoting a higher degree of health literacy. Critical health literacy was then categorized into either inadequate or adequate for scores between 1 to 3.4 and 3.5 to 5, respectively.

As shown in Table 4.13 above, critical health literacy among HIV/AIDS patients in Homa Bay county was adequate, with a mean score of 3.515 and a standard deviation of 1.186. Liu et al. (8) noted that critical health literacy implies acting as a person or in a group to improve health through the political framework or social activism. Therefore, critical health literacy focuses on community capacity to take action on social and economic determinants of health (9). The adequate level of health literacy in Homa bay county might be due to numerous NGOs and civil society organizations conducting health promotion activities in the country. According to the National Aids Control Council (16), Homa Bay county has about 24 implementing partners fighting the HIV/AIDS pandemic. Through Community Health Strategy implementation, the partners have reached households with

health information through community health workers and other community-based organizations.

This study's results further show that over 40% of respondents regularly considered the applicability of healthcare providers' information to their disease situation. A further 51% had considered the credibility of such information given to them by their doctors. Additionally, over half of the respondents reported that they always go a step further to check the validity/reliability of the information given by doctors regularly. Since being diagnosed with HIV, for example, most of the respondents (64%) in this study have tried to collect information to make health-related decisions, which could be a pointer to the level of social empowerment that these respondents have.

To a large extent, our findings have contradicted findings from other studies conducted in the area of critical health literacy. In the European Health Literacy Survey (17) respondents reported that items reflecting critical health literacy, including judging health information's credibility, are most difficult. Heijmans et al. (17) and Harris et al. (18) similarly found respondents in their studies scoring poorly in the critical health literacy scales. These studies, however, focused mainly on diabetes and not on HIV/AIDS.

### 3.3. Doctor Patient communication

**TABLE 4: Distribution of respondents by perception of doctor patient communication**

<b>Doctor Patient Communication (DPC) Items N=362</b>	<b>Never</b>	<b>Rarely</b>	<b>Occasionally</b>	<b>Regularly</b>	<b>Always.</b>	<b>Mean</b>	<b>SD</b>
How often does your doctor listen carefully to you?	6.1%	11.3%	35.1%	19.9%	27.6%	<b>3.52</b>	<b>1.182</b>
How often does your doctor explain your health concerns in a way that is easy to understand?	2.8%	14.6%	24.9%	24.6%	33.1%	<b>3.71</b>	<b>1.154</b>
How often does your doctor give you easy to understand instructions about taking care of your health problems?	4.1%	11.6%	21.8%	32.0%	30.4%	<b>3.73</b>	<b>1.136</b>
How often does your doctor seem to know the important information about your health problems?	3.3%	9.7%	23.5%	30.1%	33.4%	<b>3.81</b>	<b>1.105</b>
How often does your doctor show respect for what you tell him/her?	2.2%	10.8%	23.8%	24.6%	38.7%	<b>3.87</b>	<b>1.114</b>
How often does your doctor spend enough time with you?	3.9%	7.5%	19.6%	29.3%	39.8%	<b>3.94</b>	<b>1.113</b>
How often does your doctor use medical words that you do not understand?	16.9%	20.4%	35.6%	18.8%	8.3%	<b>3.19</b>	<b>1.169</b>
How often does your doctor talk too fast when talking with you?	16.3%	22.4%	26.8%	22.1%	12.4%	<b>3.08</b>	<b>1.262</b>
How often does your doctor use pictures or drawings or models to explain issues to	11.6%	18.0%	28.7%	24.6%	17.1%	<b>3.18</b>	<b>1.244</b>

you?

How often does your doctor give you easy to understand instructions about how to take your medicines?	2.5%	11.0%	24.6%	25.4%	36.5%	<b>3.82</b>	<b>1.117</b>
How often does your doctor explain the possible side effects of your medicines?	2.5%	12.4%	31.2%	20.2%	33.7%	<b>3.7</b>	<b>1.133</b>
How often does your doctor explain medication side effects in a way that is easy to understand?	4.7%	8.8%	32.3%	24.9%	29.3%	<b>3.65</b>	<b>1.129</b>
How often does your doctor suggest ways to help you remember to take your medicines?	4.7%	8.8%	32.3%	24.9%	29.3%	<b>3.6</b>	<b>1.169</b>
How often does your doctor explain the results of your blood test, X-ray, or other laboratory tests in a way that is easy to understand?	5.8%	16.6%	31.5%	21.8%	24.3%	<b>3.42</b>	<b>1.189</b>
How often do you feel that your doctor cares about you as a person?	5.0%	11.9%	19.3%	20.7%	43.1%	<b>3.85</b>	<b>1.237</b>
Cumulative mean/SD						3.60	1.164

To measure the quality of doctor-patient communication, fifteen questions adapted from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) health literacy item set were used. A five response category comprising 'Never,' 'Rarely,' 'Occasionally,' 'Regularly' and 'Always' was utilized. For all but two of the CAHPS items, "always" represented the most positive response, but for the questions asking about health providers using medical jargon and speaking too fast, the "never" response represented the highest approval from the patients. Therefore, the coding for these questions was reversed to be consistent with the other CAHPS items. A total weighted mean score was calculated for each CAHPS survey collected, with possible mean scores ranging from 1-5, representing the lowest rating provider communication and the highest possible provider communication rating, respectively. Consequently, mean scores below 3.5 were graded as non-effective, while scores ranging between 3.5 to 5 were graded effectively.

Table 4 above illustrates that the patients surveyed rated the quality of their provider's communication as effective with a mean score of 3.60 and a standard deviation of 1.164. Effective communication from providers may compensate for a lack of understanding with patients with inadequate health literacy in clinical settings. Burch & Jackson [19] noted that in the recent past, the average number of clinical items, ranging from diagnoses, medications to diagnostic tests addressed at adult primary care visits, has increased from 5 to 7, while the time spent on each item has decreased from 4.4 to 3.8 minutes. This underscores how effective communication can be an important tool, especially in resource constraint settings.

### 3.4 Critical health literacy and doctor patient communication among HIV/AIDS Patients

Simple logistic regression was carried to establish the level to which critical health literacy influences doctor patient communication among HIV/AIDS patients in Homa Bay

County, Kenya. Before conducting logistic regression analysis, data for doctor patient communication was transformed into a binary form assuming 0 and 1 values to mean non-effective and effective, respectively. The overall effectiveness of the dependent variable was measured using the fifteen items on the questionnaire. To classify the dependent variable (Doctor Patient communication, DCP) as effective or non-effective, the weighted scale of the indicator variables forming the dependent variables was computed as follows: -

$$Y = \frac{DCP1(1) + DCP2(2) + \dots + DCP15(15)}{1 + 2 + \dots + 15}$$

Y (doctor patient communication among HIV/AIDS patients) was a continuous random variable with values lying between 0-5. The Y values were further transformed into two

categories with values of lying between 1-3.4 were categorized as non-effective while any value of Y lying between 3.5-5.0 was categorized as effective. From the above description, new Y values were coded as effective (1) and non-effective (0), respectively, before conducting logistic regression.

The logistic regression between critical health literacy and doctor patient communication was performed. Table 5 below illustrates the findings for Block 0, which demonstrated that majority of the respondents were in the opinion that doctor patient communication among HIV/AIDS patients in Homa Bay county was effective.

**Block 0: Beginning Block**

**Table 5: Classification Table 1 for Critical health literacy**

Observed		Predicted		
		Doctor patient communication among HIV/AIDS patients		Percentage Correct
		Not Effective	Effective	
Step 0	Doctor patient communication among HIV/AIDS patients	Not Effective	Effective	
		0	93	.0
		0	269	100.0
Overall Percentage				74.3

a. Constant is included in the model.

b. The cut value is .500

**Variables in the Equation for Critical health literacy**

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	1.06194	.117	82.149	1	.000	2.892

Further results shown in Block 1 table 6 below illustrate that there was a significant relationship between the dependent variable (doctor patient communication among HIV/AIDS patients) and the independent variable, critical health literacy with p = 0.000. The two pseudo R<sup>2</sup> (Cox & Snell R-Square and Nagelkerke R-square) values of 0.270 to 0.397 for model 1 and 0.314 to 0.461 for model 2 further suggested that 27.0% to 39.7% and 31.4% to 46.1% of the variation in doctor patient communication among HIV/AIDS patients in Homa Bay county was explained by critical health literacy for the model in block 1 in the absence of moderator and in the

**Block 1: Method = Enter**

presence of moderator respectively as illustrated in table 6 below.

Compared to the block 0 results, the inclusion of predictor variable in Block 1 increased the classification rate by 1.7% to 75.8% for model 1(absent of moderator) and 6.9% to 81.2% that 81.2 in the presence of a moderator. The model with the moderator (demographic factors) again proved to be a better model than the model without a moderator (model 1), as was the case with the other two previous objectives.

**Table 6: Omnibus Tests of Model Coefficients for Critical health literacy**

<b>Model 1 (Absence of Moderator)</b>				
		<b>Chi-square</b>	<b>df</b>	<b>Sig.</b>
Step 1	Step	120.720	1	.000
	Block	120.720	1	.000
	Model	120.720	1	.000
<b>Model 2 (Presence of Moderator)</b>				
		<b>Chi-square</b>	<b>df</b>	<b>Sig.</b>
Step 1	Step	144.239	2	.000
	Block	144.239	2	.000
	Model	144.239	2	.000
<b>Model Summary for Critical health literacy</b>				
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	
1	317.024 <sup>a</sup>	.270	.397	
2	293.505 <sup>a</sup>	.314	.461	

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

**Table 0.7 Classification Table 2 for Critical Health Literacy**

<b>Model 1 Without moderator</b>					
Observed			Predicted		Percentage Correct
			Doctor patient communication among HIV/AIDS patients		
			Not Effective	Effective	
Step 0	Doctor patient communication among HIV/AIDS patients	Not Effective	21	72	22.5
		Effective	15	254	94.4
	Overall Percentage				76.0
<b>Model 2 With moderator</b>					
Observed			Predicted		Percentage Correct
			Doctor patient communication among HIV/AIDS patients		
			Not Effective	Effective	
Step 0	Doctor patient communication among HIV/AIDS patients	Not Effective	48	45	51.5
		Effective	23	246	91.5
	Overall Percentage				81.2

a. Constant is included in the model.  
b. The cut value is .500

a. Constant is included in the model.

b. The cut value is .500

**Table 8: Variables in the Equation**

Model 2 Without moderator		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 <sup>a</sup>	Critical health literacy	2.501	.366	46.642	1	.000	12.198
	Constant	-6.254	1.042	36.062	1	.000	.002

a. Variable(s) entered on step 1: X<sub>4</sub>.

Model 1 With moderator		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 <sup>a</sup>	Critical health literacy	1.306	.464	20.436	1	.005	1.358
	Critical health literacy Z	2.707	.581	21.678	1	.000	14.987
	Constant	-7.982	1.009	62.602	1	.000	.000

a. Variable(s) entered on step 1: Critical health literacy, Critical health literacy \*Z.

**Table 9: Hosmer and Lemeshow Test**

Model1 Without moderator	Step	Chi-square	df	Sig.
	1	8.164	8	.418
Model 2 With moderator	Step	Chi-square	df	Sig.
	1	3.348	8	.911

As described by Nutbean (5), critical health literacy as very advanced cognitive abilities that, in combination with social skills, can be utilized to examine information critically and to use this information to gain greater control over life occasions and circumstances. Patients with adequate critical health literacy skills are characterized by the self-confidence to act independently on advice and interact successfully with the health care system and providers. This could explain why this study found a significant positive relationship between critical health literacy and doctor patient communication, similar to other studies comparing health literacy to various health outcomes (17, 19).

Previous studies have found varied results concerning which health literacy domain has the greatest influence on health outcomes. The study by Heijmans et al. (17), for example, concluded that communicative health literacy had the strongest correlations with all health outcome measures, followed by critical health literacy and functional health literacy. However, this study found critical health literacy as, by far, superior to the two other domains of health literacy. The variation could partly be due to different health literacy scales currently in use, coupled with the fact most of these

other studies involved mainly hypertensive and diabetic patients. Further, well organized HIV/IDS support group networks and high concentration of civil societies and NGOs operating in Homa Bay county may be credited with empowering the patients to advocate for their health.

### Conclusions

Inferential statistics revealed that critical health literacy had a significant positive influence on doctor patient communication among HIV/AIDS patients in Homa Bay county. Critical health literacy is more advanced cognitive skills that, together with social skills, can be applied to critically analyze health information and use this information to exert greater control over life events and situations. It implies acting as a person or a group to improve health through the political framework or social activism. Well organized HIV/IDS support group networks and high concentration of civil societies and NGOs operating in Homa Bay county may be credited with empowering the patients to advocate for their health. Such networks, should be encourages and their actions scaled up.

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# The Impact Of Used Imported Fridges, Freezers And Air-Conditioners On The Environment. A Case Study Of The Accra Metropolis /2014, The Year In Review

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**Abstract-** This study sought to investigate the harmful effects of the processes of extraction of metals and other parts from used fridges, freezers and air-conditioners. The harmful effects such as the depletion of the ozone layer, pollution of water bodies, poisonous effects of lead, cadmium in infrared detectors, mercury in the thermostats batteries and switches among which are harmful on humans, water bodies and ozone layer.

To get the primary source of information on the topic, the views of 90 exporters and importers, 45 households, and 65 repair shop that deal in fridges, freezers and air conditioners in the Accra Metropolis were sampled. Although it was realized that importation of fridges, freezers and air conditioners generates employment for the populace and is a primary source of income generation, their activities of the extraction of parts of these used items have an adverse effect on the environment. It came out that most of the technicians that handle the repair works in the country do not know much about the dangers with the handling of refrigeration oils in t

**Index Terms-** E-waste, ozone layer, imported fridges, air pollution and recycling

## I. INTRODUCTION

### Background of Study

This section deals with the e-waste as into the country and its effect on the environment in the Accra Metropolis. Electronic waste, commonly referred to as e-waste, is broken-down of old phones, computers, refrigerators, freezers, air conditioners, television sets, iPods, among others that have significantly diminished in usage value or no longer serve the purpose for which they were brought and are therefore discarded (Koranteng & Darko, 2010; Puckett & Smith, 2002).

Tiong (2013), defined e-waste used electronic equipment which are destined for reuse, resale, salvage, recycling or disposal. Kiransuan (2012), also defined it as re-usable (working and repairable electronics) and secondary scrap (copper, steel, plastic, etc.) to "commodities", and reserve the "waste" for residue or material which is dumped by the buyer rather than recycled, including residue from reuse and recycling operation. Similarly, Shinha (2004), defines e-waste as, an electrically powered

appliance that no longer satisfies the current owner for its original purpose.

The emergence of the digital age has underscored the important role that the Electrical and Electronic Equipment "EEE" plays in the nation's socio-economic development, including education, health delivery and communication as well as global connectivity. All of these have led to a high rate of e-waste generation.

The environmental problems caused by the uncontrolled dumping and inappropriate recycling of electronic-waste have been a growing concern both globally and Ghana. The recent surge in sub-standard electronic and electrical appliances with their short life span has created a challenge especially in the management of waste that emanates from their usage. There is certainly awareness on environmental impact of wrong disposal of waste electrical and electronic equipment among the consumers, especially within Accra but due to lack of environmentally sound disposal options, most obsolete equipment are either given to the informal collectors or stored.

Hitherto, unknown to a lot of people is the delicate natural resource which is the underground water, which when polluted cannot be addressed. Since most of the scrap dealers dismantle their waste on the bare ground the chemical substances in them sip into the underground water thereby contaminating it. Some of the substances are also rained off into nearby water bodies such as ponds, rivers and lakes and the greater parts of the substances find their way into the seas.

### 1.2 Statement of the problem

The advent of technology advancement in the latter part of the century, has caught up with Ghana specifically in the early 1980's, and currently generating a huge market in the areas of e-waste. The fastest growing type of waste stream is the electronic waste stream in the industrialized countries. This form of waste has grown almost three times faster than the overall municipal waste stream (UNEP Reports, 2005).

### 1.3 The purpose of the study

Dealing with e-waste disposal is of great concern to any nation. Unfortunately, some of these e-waste are dumped into the deep seas and most of them shipped to third world countries (including Ghana), who do not have the know how to dispose off

this discarded items most of which have gotten to the end of their life span. This study will bring out the vulnerability the third world countries are exposed to and the need for governments to take the necessary precautions with special reference to Ghana which is the area of study.

It will serve as a source of reference for further research into the subject matter or related topics by interested persons.

#### 1.4 Objective of the study

The main objective of the study was to find out if the disposal of used imported fridges, freezers and air conditioners have impact on the environment in general. The specific objectives of the study are to determine:

1. Ways of disposing used fridges and air conditioners in the Accra Metropolis.
2. Effect of disposals on the environment of Accra Metropolis.
3. Factors affecting the disposal of used fridges and air conditioners on the environment of Accra Metropolis.

#### 1.5. Research Question

The study is guided by the following research questions:

1. Methods of disposing off e-waste in the Accra Metropolis?
2. What are the effects of disposed used fridges and air conditioners on the environment of Accra Metropolis?
3. What are the world's best practices of e-waste disposals?

## II. BRIEF REVIEW

This entails a brief literature review on the history of importation of e-waste including used fridges, freezers and air conditioners into Ghana. Ways of disposing off used fridges and air conditioners and their effects on the environment. Factors affecting the disposal of used fridges, freezers and air conditioners on the environment and the health hazards they pose to humans.

### 2.1 The History of E-Waste Importation

It was scarce to see used imported used fridges, deep freezers on the local market over the years. Until the late 1980's, used imported fridges, freezers and air conditioners were not common on the local market. Before then, buying and selling of used imported fridges, freezers and air conditioners were not part of the major items sold on the Ghanaian market. These used fridges, freezers and air conditioners were imported into Ghana by seamen who worked with the then National Shipping Line, the Black Star Line.

Also, Ghanaians leaving in countries such as Germany and Italy also send these secondhand fridges and air conditioners down to their families in Ghana (Anane et al, 2011).

#### 2.1.1 E-Waste Imported into Ghana over a Period of 6 Years

Used fridges, freezers and air conditioners are mainly imported from Europe and the North American. Though there is

an insignificant local assembly of such equipment, brand new and used fridges, freezers and air conditioners are also imported into the country mainly from China and Dubai. According to Amoyaw-Osei et al (2011).

In the view of Frandsen et al, (2011) the Ghana Shippers Authority in 2011 stated that the country imported 31,400 metric tons of used electrical and electronic equipment including used fridges, freezers and air conditioners in the year 2010 alone, representing 74.6% increase as compared to the 2009 figure of 17,987 metric tons as shown in Figure 1.

2.1.2 Following the figures released for the year 2010 alone, the Port of Tema handled 72% of the total importation, which amounted to 23,623 metric tons, while the port of Takoradi cleared the remaining 7,768 metric tons, representing 28% of the total import.

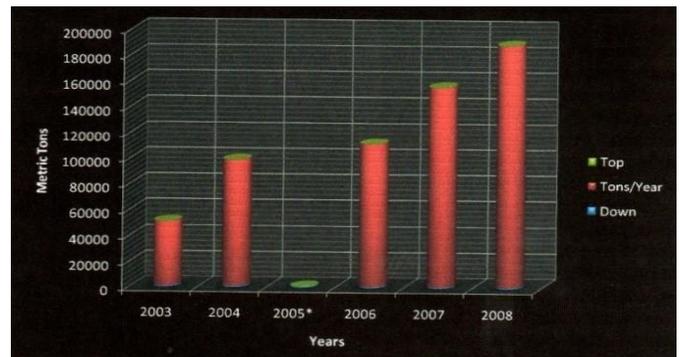


Figure 1. A chart showing the total quantity e-waste imported into Ghana over a period of 6 years

Source: UN Comrade ([http://www. Omtracem.org/dBs/country20058](http://www.Omtracem.org/dBs/country20058): no data available).

### 2.2 Disposing off old fridges

Butcher (2014), stated that CFC, Mercury, Polychlorinated Biphenyls (PCBs) and any other potentially toxic chemicals should not be discharged into the environment. Consumers should dispose off their old fridges appropriately. According to Butcher (2014), if one has not done so already, then he/she should call his or her local sales company to find out if they can offer a trade-in-program.

### 2.3 Effect of Disposed Used -Fridges, Freezers and Air Conditioners on the Environment

Refrigerators, freezers, dehumidifiers and air conditioners contain chemicals such as refrigerants and insulation that releases ozone-depleting substances into the atmosphere when they are thrown away, older models can even contain mercury and Polychlorinated biphenyls (PCBs). Federal laws require proper removal and disposal of refrigerants to reduce the possible effects of these chemicals (Frazier, 2003).

### 2.4 Electronic Waste Dump of the world

For Agbogbloshie dumping site in Accra-Ghana to be mentioned alongside Guiyu in China as one of the world's dumping sites, shows how serious the e-waste menace is in Ghana. Agbogbloshie is said to have a dumping site where electronic waste is burnt and disassembled with no safety or environmental

consideration (Bridgend et al, 2008). The e-waste recycling industry in Ghana is widely associated with severe health and safety risks for workers involved in the sector. These risks emerge primarily due to improper and crude recycling techniques used for the recovery of raw materials, such as, open incineration of cables and wires to recover copper. Low grade printed wiring boards are incinerated to reduce the e-waste volumes. Insulating foam, primarily polyurethane (PUR), from obsolete refrigerators and automobiles tires, are used as co-fuels to sustain the fires used for burning the waste (Ross, 2011).

Guiyu in the Shantou region of China is said to have a huge electronic waste processing area. It is often referred to as the “e-waste capital of the world” (Bridgend et al, 2005). The city employs over 150,000 e-waste workers that work to disassemble old computers and recapturing whatever metal and parts they can reuse or sell. Uncontrolled burning, disassembling, and disposal cause a variety of environmental problems such as ground water contamination, atmospheric pollution or even water pollution either by immediate discharge or due to surface run off (especially near coastal areas), as well as health problems including occupational safety and health effects among those directly and indirectly involved due to the methods of processing the waste.

According to Huo et al, (2007), limited investigations have been carried out on the health effects of Guiyu’s poisoned environment. One of them was carried out by the Shantou University Medical College. The test was carried out on 165 children for concentration of lead in their blood. 85% of the children in Guiyu had lead in their blood more than 100. Anything above that figure is considered unsafe by international health experts. However the average reading for the group was 149. High level of lead in young children’s blood can impact on their intelligent quotient and the development of their central nervous systems. The highest concentrations of lead were found in the children of parents whose workshop dealt with circuit boards and the lowest was among those who recycled plastic.

The nature and extent of chemical contamination found at the sites in Ghana is similar to that found at e-waste open burning site in China, India and Russia (Bridgend et al, 2008). In some countries, studies have found contamination of wider environment around e-waste recycling workers homes. The environmental contamination found in Ghanaian samples, suggest children working on and living near e-waste sites could be exposed to toxic chemicals (Bridgend et al, 2008).

Greenpeace experts collected soil sediment samples from two e-waste recycling sites; Agbogbloshie scrap market in Accra and also from Koforidua. The samples were analyzed at the Greenpeace Research Laboratories at the University of Exeter, United Kingdom. The study found that many samples contained numerous hazardous substances including very high levels of the toxic metal lead; chemicals such as phthalates, which are known to interfere with sexual reproduction; and chlorinated dioxin known to promote cancer (Bridgend et al, 2008).

#### 2.4.5 Effects of E-Waste on the Soil

The recycling activities at Ghanaian scrap yards include mainly dismantling, uncontrolled dumping as well as pyrolytical processes. With reference to Bridgend et al (2008), hydrolytically process such as leaching precious metals from printed wiring boards was not observed.

The recycling activities at numerous small workshops within the scrap yard often take place directly on unfortified grounds. Harmful substances released during dismantling therefore leaks directly into the soil. Within the burning areas, scrap yard workers use numerous temporary fires to burn plastics, mainly from copper cables and wires as well as television casings.



*Figure.2 smoke from a burning electrical cable at Agbogbloshie Scrap Yard*

*Source: Researcher’s Field Trip*



*Figure 3 Scraps at Galloway Scrap Yard. Source: Researcher’s Field Trip. Source: Researcher’s Field Trip*

#### 2.4.6 Effects of Oil on the Soil

According to Patrick (2007), Oil spills that make their way into groundwater can have devastating effects that linger for many years. When people think of oil spills, they often think of spill in the ocean. However, the spills that cannot be seen are often the most costly and difficult to address. Clean groundwater is a delicate natural resource; a serious oil spill can poison that resource in an instant. Cutting open fridges, freezers and air conditioners compressors spills oil on the ground at the scrap yards.



**Fig 4 oil spill at Agbogbloshie scrap yard**

*Source: authors field survey (2014/12/05)*

### 2.4.7 Effect of E-waste on the Water Bodies

The heavy metals and organic substances released to the soil and the surface water lead to high pressure on the ecosystem. The Odaw River in Ghana used to be an important fishing ground for the neighboring communities. Since the waste electrical and electronic equipment's recycling activities started about ten (10) years ago, the river has become dead. Due to the burning and dumping activities, most of the vegetation has disappeared (Amoyaw-Osei et al, 2010).

## III. METHODOLOGY

The methods and techniques employed by the researcher to obtain data for the study consists of methods of the population and sample size, sampling technique, data collection, data collection instruments, field experiences and methods of data analysis. Earlier in the research proposal it was indicated that major part of the study will be carried on at Agbogbloshie Scrap yard and other smaller scrap yards in Accra and its surrounding areas.

### 3.1 Research Design

The research design adopted by the researcher was descriptive research design. Descriptive research design refers to a research which specified the nature of a given phenomenon. It determines and reports the way things are done. Descriptive research thus involves collecting data in order to test hypothesis or answer research questions concerning the current status of the subject of the study. According to Allen et al, (2001) descriptive research seeks to portray accurately the characteristics of a population. The findings also maintain that in descriptive research, accurate description of activities, objects, processes and persons is the objective.

Descriptive survey was used because it specifies the nature of a given phenomenon and reports things the way they are. In this study the researcher does not manipulate variables, data collected under natural settings to answer the research questions which were geared towards determining the status quo of sociological and psychological variables as they occur in natural settings. Also, the descriptive survey is used because condition and events already exist and there is no intervention in terms of treatment to experimental groups.

Moreover, variables and procedures are described as accurately and completely as possible in descriptive survey designs. A descriptive survey involves asking the same set of

questions often prepared in written questionnaire to a large number of individuals. Thus, descriptive survey is directed at determining the nature of a situation as it exists at the time of study. It helps identify conditions presets and points out future needs. Surveys also provide a lot of information from a large sample of individuals from which generalization could be made about the population. A descriptive research study was used for the study because it presents information systematically on evaluation the impact of used imported fridges, freezers and air conditions on the environment in Accra Metropolis.

### 3.2 Data Collection Instruments

The instrument used in collecting the data for the study are questionnaires, observations and interviews. The questionnaires and interviews were employed because different opinions and suggestions which were necessary to obtain first-hand information about the study area were needed.

#### 3.2.1. Target Population

Agbogbloshie being the largest scrap yard in the country was the target area where most of the studies on scrap dealers were carried out. Other areas where some data was obtained on scrap dealers are Galloway, Ashaiman and Kokompe, all in the Greater Accra Region. The study also targeted importers and dealers of fridges, freezers and air conditioners as well as households where items end and exit from.

#### 3.2.2 Sampling Technique

Simple Random Sampling was used at the location level to randomly sample from the demarcated location within the scrap yard that gave the various categories: repairs, importers/dealers and households within the Accra metropolis.

### 3.3 Profile of Agbogbloshie

Agbogbloshie, a suburb of Accra, is known as a destination for exploitation and environmental dumping of electronic waste (e-waste) from industrialized nations. The site covers approximately four acres and is situated on the banks of Korle Lagoon; northwest of Accra's Central Business District. About forty thousand Ghanaians inhabit the area, most of whom are migrants from rural areas. Due to its harsh living conditions and rampant crime wave, the area is nicknamed "Sodom and Gomorrah".

The Agbogbloshie site started as a food stuff market for onions and yams. Over the years it has grown into a slum with people dealing in all kinds of scrap, and a dumping ground for old electrical and electronic products and household waste. The scrap yard has grown steadily into a popular recycling area, where old and discarded Electrical and Electronics Equipments (EEE) could be put to use. Hundreds of tons of e-waste end up there every month as final resting place, where they are broken apart to salvage copper and other metallic components that can be sold.

The scrap dealers discovering the place as good location for business started to erect temporary stalls and sheds for their wares and activities. The dealers later registered with the National Youth Council as the Scrap Dealers' Association of Ghana, and the land was leased to them in 1994. To date, Agbogbloshie has become the hub for informal "recycling" industry in Ghana. Besides this main scrap yard, there are other smaller known scrap yards as

Galloway, Kokompe and Ashaiman in the Greater Accra Region. Other much smaller scrap yards keep springing up throughout Accra. (Amoyaw-Osei et al, 2011).

Figure 5 and 6 shows the aerial view of Agbogbloshie Scrap yard and market area



Figure 5 The Agbogbloshie area  
(Source: Google maps)

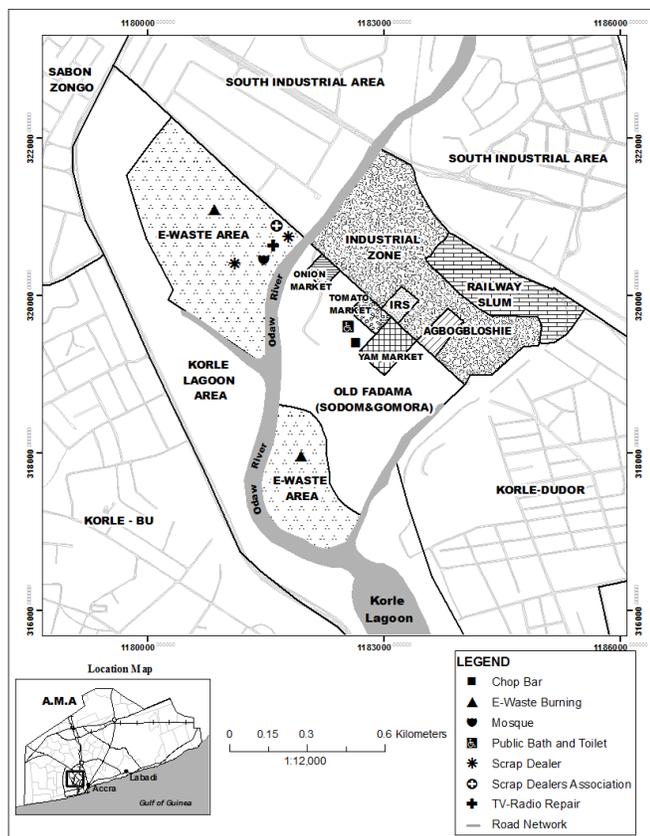


Figure 6 The Agbogbloshie scrap yard  
(Source: qamp.net)

### 3.4 Sampling of Households

Households within the sample areas in the Accra metropolis were selected to participate in the study using simple random sampling technique. The reason for selecting households to

participate in the study is due to high number of used fridges, freezers and air conditioners sold in the Accra Metropolis.

A preliminary study was done in the Accra Metropolis to map out areas that the study was conducted. This was done with the consideration of socio-economic life style of the people. Targeted sampling was used to find the areas that the study was conducted. In each area where necessary, a number of households were identified and each household was marked. Then using simple random sampling technique, one person in the household was selected for the study.

### 3.5 Sampling of Repair Workshops

A study was conducted to find workshops that the study was conducted and this was by observation. It was observed that apart from large workshops that repair fridges, freezers and air conditioners, there were mechanics that do not have workshops but work in small wooden structures along the roads in Accra. Besides this, there were others too who work on fridges and freezers in car body work workshops. Based on this, the 37.5% share of the sample size 200 was given to the Repair Workshop.

### 3.6 Sampling Importers and Dealers

In the area of importers targeted, sampling was used as most of them can be found at the Tema Port. When it came to selecting the respondents for the studies, simple random sampling was used at the port area. Other importers were also picked at other areas in Accra where used fridges, freezers and air conditioners were sold. Available sampling technique was used in selecting the dealers in Accra metropolis. This was done by observing areas that have high concentration of fridges and air conditioners. Sellers were also targeted for the study.

### 3.7 Data Collection Method

The instrument used in collecting information from respondents was the questionnaire. And the method adopted was self-administered face-to-face questionnaires. Respondents who could read and write were given the questionnaires to respond to by themselves and those who could not were guided but not directed by the researcher or his trained research assistant to respond to the questionnaire.

The quantitative data drawn from the study was analyzed with the aid of Statistical Package for Social Sciences (SPSS) version 16. Having pre-coded all the categories on the questionnaire, the quantitative data was then input into the computer on Microsoft Excel. After this the data was moved on the Statistical Package for Social Sciences (SPSS) which helped in the determination of percentages, chi-square analysis, p-value analysis and charts with tabulation that were used to study the relationship between two or more variables.

As stated earlier, the questions were both close-ended and open-ended and structured in such a manner as to make it easy for respondents to understand. The use of close-ended questions were also aimed at yielding the quantitative data required and for the easy understanding of the research once the questionnaires were returned hence the researcher ensured that all possible categories of the responses were included for respondents to answer. The open-minded questions gave respondents the opportunity to give further explanation to the questions other than the "yes/no" answers provided.

### 3.8 Field Experience

Field trips were paid to the scrap yards at Agboghloshie, Galloway, Ashaiman and Kokompe. This enabled access to firsthand information on scrap dealers and activities. Similar visits were paid to the repairers and importers of used fridges, freezers and air conditioners together with used e-waste shops. Some visits were paid to the Tema Port (main harbour) to ascertain operation and possibility of observing the presence of end-of-life fridges, freezers and air conditioners where they are transported straight to scrap yard on arrival. Visits were also paid to land filling sites to see the recycling practices undertaken there.

### 3.9 Selections of Respondents

Respondents for the study were selected by stratified sampling technique. This technique was applied because of the different areas that the study was handling and the different characteristics which were likely to impact on the research. This required that each group should be represented in their right percentages.

Data was collected from repairers, dealers and importers and households. Since the study cannot capture responses from all over the Accra Metropolis targeted sampling was used in some cases and in others random sampling was used.

#### 3.9.1 Sample Size

A total number of two hundred (200) respondents are expected to be involved in the study. Repair workshops, importers/dealers and households were captured, but majority were the importers/dealers with the following distribution:

**Table 1 shows the target population, sampling technique and sample size.**

IDENTITY	TARGET POPULATION	SAMPLING TECHNIQUE	SAMPLE SIZE
Repairers	200	Simple Random	65
Importers and Dealers	300	Simple Random	90
Households	105	Simple Random	45
<b>TOTAL</b>	<b>605</b>		<b>200</b>

Source: Authors Field Survey (2014/12/05)

## IV. PRESENTATION AND ANALYSIS OF FINDINGS

This section presents the outcome of the research which includes analysis of data obtained from the field which was collected mainly through the administering of questionnaires and observations. It describes the views and opinions of stake holders including 45 Repairers 77 Importers/Dealers and 36 Households within the Accra Metropolis who took part in the study about how

the effects of improper disposal of discarded used imported fridges, freezers and air conditioners and the hazards on humans and the environment with particular reference to Aboghloshie, Ashaiman, Galloway and Kokompe suburbs of Accra, Ghana. In all, two hundred (200) questionnaires were administered to the target groups. However, 158 questionnaires were received representing 78% of the total questionnaires distributed.

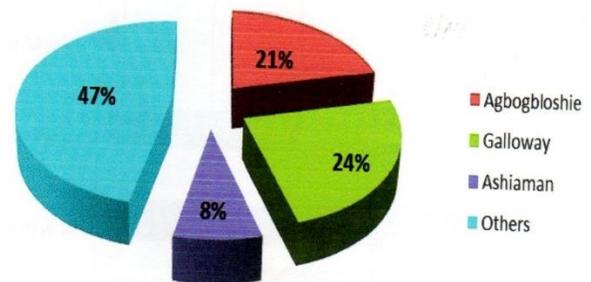
### 4.1 Gender Distribution

Figure 4.1 shows the ratio of male to female respondents within the company of which the males dominate with 66.67%. The remaining percentage, 33.33%, represents the females. Relatively, the ratio of male to female respondents sampled under the category of repairers also indicates that the males dominate with 76.67% whilst the females represent 33.3%. For the sampled respondents for importers/dealers the males represent 92.21% of the total sample whilst the females represent 7.79% of the total sample. This ratio of respondents was obtained due to the females unwillingness to participate in the survey despite the fact that in Ghana, there is a higher percentage of women as compared to men which is 0.98 male/ 1 female (CIA World Fact book, 2013)

### 4.2 Current Situation of Imported Used Electronics

#### 4.2.1 Location of Importers

Figure 7 shows the location of importers/dealers of used fridges, freezers and air conditioners. Majority (about 47%) of the sampled respondents have their business located at Tema, Nungua, Kaneshie. About 24% of the dealers are located in Galloway, a suburb of Accra whilst 21% are in Agboghloshie. Dealers sampled in Ashaiman as their business location constituted only 8%.



**Figure 7. Business Location of importers/ Dealers**

Source: Author's field survey (2014/12/05)

#### 4.2.2 Knowledge of Environmental Legislation on the Importation of Used Fridges, Freezers and Air conditioners

When asked about any knowledge of environmental legislation in Ghana on the importation of used fridges, freezers and air conditioners, about 69.4% of importers/dealers indicated that they know of the existence of an environmental legislation on used electronics whilst about 30.6% of the sampled importers said they did not know about any environmental legislation on importation of used fridges, freezers and air conditioners. These importers (69.4%) also stated that they are aware of the environmental hazards caused by used electronics. About 56.4% of the importers indicated their awareness of a special treatment of

used fridges, freezers and air conditioners for safe disposal whilst 43.6% indicated no awareness of such special treatment.

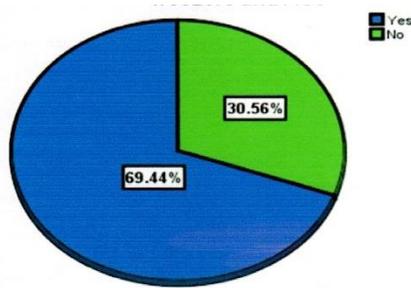


Figure 8. Awareness of disposal substance in fridges, freezers and ACs.

Source: Author's field survey (2014/12/05)

#### 4.2.3 Health and Safety

About 92% of importers disagreed that the used fridges, freezers and air conditioners are hazardous to people's health whilst 8% agreed that it is hazardous to their health. Whilst 72% of importers agreed that the working conditions of used electronics are safe, 28% were of the opinion that they are in good conditions and are safe to use although they are aware of the environmental hazards the electronics are likely to cause when disposed off. About 68% of the respondents were not aware that some hazardous fractions in fridges, freezers and air conditioners need special treatment in order to be safely disposed off. They are also not aware of what happens to the equipment when they are disposed off.

### V. DISCUSSION OF RESULTS

This section addresses significant findings that were identified during the analysis of the data. The discussion highlights the major findings of the research and inferences made.

#### 5.2 Ways of Disposing Used Fridges, Freezers and Air Conditioners in Accra

For a safe disposal of used fridges, freezers and air conditioners which contain CFCs or HFC, the need to dispose them off appropriately is indispensable. Furthermore, other fractions of concern (mercury switches, PCB-containing capacitors, ammonia, chrome-VI and cable-insulations) have to be taken care of.

The results of the study showed that 97% of repairers, importers and households would opt for the unwanted e-waste to be picked from their houses and locations of their shops for disposal. These respondents also indicated that they are not willing to pay for the disposal or recycling of the used equipment. This implies that although there is an immense benefit to recycling and the safe disposal of e-waste, respondents are not willing to pay heed to this action. This action is likely to impose hazards to the environment because collection of the refrigerators that has to be transported to dedicated recycling facilities may cause the used equipment to damage its cooling circuit causing CFCs or HFC emissions. (Prakash & Manhart, 2010).

#### 5.3 The Socio-Economic Effects of Disposed Used Fridges and Air Conditioners on the Environment of Accra

This ratio of respondents obtained for the study was due to the females unwillingness to participate in the survey despite the fact that in Ghana, there is a higher percentage of women as compared to men which is 0.98 male/ 1 female (CIA World Fact book, 2013). The median age of respondents implies dealers/importers, repairers as well as household members who sell used fridges, freezers and air conditioners are within the active/youthful age. This also implies that most importers/dealers, repairers and households have families to cater for. Inferences from the results suggest that the business of used fridges, freezers and air conditioners generate employment for them and thus is the primary income activity for them. The income generated from this business implies that it can cater for the basic needs of importers and repairers.

Used refrigerators, freezers and air conditioners disposed off have to undergo special hazardous waste disposal. For the subsequent degassing of the cooling circuit, the refrigerator has to be lifted and tilted. The cooling circuit is then evacuated using negative pressure. The oil-refrigerant mixture is collected in a tank and treated thermally to separate the refrigerants (Prakash & Manhart, 2010).

#### 5.4 The Factors Affecting the Disposal of Used Fridges and Air Conditioners on the Environment of Accra

The impact of used fridges and air conditioners on the environment of Accra is increasing. The ways of disposing used fridges and air conditioners in Accra, the socioeconomic effects of disposed used fridges and air conditioners on the environment of Accra and the factors affecting the disposal of used fridges and air conditioners on the environment of Accra.

The educational level of respondents may imply that the users and dealers of e-waste in the study area have attained at least the basic level of education to understand the industry they operate in. This implies that the awareness of recycling of e-waste has a dependence on their educational level.

The business of importation of used electronics may be defined as small scale with reference to the number of employees only as the basis for categorizing the business.

Reasons given by the importers for the reduction in the quantities of imported used electronics include a ban on the importation of the goods and the economic hardship in the country. This clearly indicates that the importation of fridges, freezers and air conditioners are done on a regular basis but with a reduction in the quantities of importation.

This implies that there exists an environmental legislation on the importation of used electronics of which importers of used fridges, freezers and air conditioners know of.

Further implications also show that importers are aware of the environmental hazards caused by e-waste and are also aware of a special treatment to these used electronics safe disposal. With no records/inventory on quantities of fridges, freezers and conditioners stores or discarded, importers may not see the need for developing procedure which will guide them in disposing off the unwanted electronics.

## VI. CONCLUSION AND RECOMMENDATION

It can be concluded that;

1. The importation of fridges, freezers and air conditioners generates employment for the youthful population and are primary source of income generation.
2. The activities of the importation of these used electronics have an adverse effect on the environment and awareness creation of this implication and a recycling plant will contribute to the transformation of the handling of e-waste in general in Ghana.
3. A report in the dailies indicated that the e-waste plant at the scrapyard at Abogbloshie is standing idle and should therefore be put to use so that electrical cables that are burnt to extract the copper wires and the emission of smoke into the atmosphere would minimize if not stopped.
4. The scrap dealers should be trained to enhance their capacity to handle the used fridges, freezers and air conditioners and other electrical waste. This is due to the fact that the refrigeration and air conditioning plant either big or small contain some form of gas that have to be handled carefully and not expelled in to the atmosphere. Repairers and others who handle refrigerants, such as reclaiming, recovery and recycling of refrigerants.

Following this study, it is recommended that:

Awareness creation sessions must be organized on e-waste and its importance to the environment when recycled is of positive benefit to the environment. This will ensure that households, repairers and importers/dealers understand the need of recycling of discarded e-waste. Government institutions and other agencies such as the Environmental Protection Agency, Civil Society Organizations and Non-Governmental Organizations have their capacity built in the recycling of e-waste. A remuneration scheme should also be instituted to create a sense of belonging in ensuring the safety of the environment.

There should be an establishment of a recycling plant for e-waste in Ghana with a well-coordinated waste collection mechanism that will operate at the community level to ensure that discarded fridges, freezers and air conditioners are well disposed off. In so doing, jobs are created for scrap dealers and other sections of the population.

Stakeholders play a major role in propagating a clean environment. It is thus recommended that stakeholders such as community leaders and unit committees in the various host communities of the company be duly and adequately informed and their capacity built on e-waste and its effect on the environment.

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# The Efficacy of LUCAS in Cardiac Arrest

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**Abstract-** Introduction: Chest compression is the basic technique of cardiopulmonary resuscitation (CPR) in patients with cardiac arrest. The quality and early performance of CPR is critical to improve the prognosis and chances of restoring spontaneous blood flow. Today we have manual compressions and mechanical chest compression devices. Objective: The aim of this study is to clarify the importance of the LUCAS system (The Lund University Cardiac Arrest System) in CPR. Material and methods: A systematic review of the literature by mobilizing the descriptors "Cardiac Arrest", "Lucas Efficacy" and "nursing", using the methodological head. Ten conceivable databases were selected, between 2010-2020, and seven articles were included for analysis. Results and discussion: The results of the studies are different, as four of the studies indicate that LUCAS is fully effective, particularly in fatigue and transport, but two of them do not recognise its full effectiveness. One of the studies mentions that the fact that compression by the automatic device is effective does not necessarily reflect a better result. The vast majority of the studies recognise the need for further studies to make more convincing decisions. Conclusion: Mechanical chest compression devices can improve patient outcome if used appropriately in the event of cardiac arrest. The hemodynamic performance of the LUCAS compression-decompression system is, according to some results, better than manual CPR. However, the quality of the current evidence is not sufficient. Randomised studies are needed to evaluate the effect of mechanical chest compression devices on survival inside or outside the hospital.

**Keywords:** Cardiac Arrest, Lucas Efficacy and Nursing.

## I. INTRODUCTION

Cardiac arrest is an abrupt drop in heart activity that reduces the effective pumping of blood (Neumar et al., 2010). In the last 50 years, research has steadily improved cardiopulmonary resuscitation (CPR), but much remains to be done as survival rates remain low. The effectiveness of CPR depends on many factors, the most important being the speed and quality of the resuscitation procedure. All optimal parameters of such a procedure, such as time of execution, thoracic compression rate and thoracic compression rate, are given in the guidelines of American Heart Association (AHA) (Kleinman et al., 2015). Outside the hospital, cardiac arrest is the main cause of death and morbidity (Nishiyama et al., 2014). A key factor that improves survival is high quality CPR (Stiell et al., 2012; Idris et al., 2015). The quality of CPR in

ambulatory cardiac arrest is often suboptimal (Wik et al., 2005). Fatigue and the need to perform multiple tasks during cardiac arrest limit the quality of CPR. Cardiac arrest has a bleak prognosis, as usually only 5% of patients are discharged alive and without neurological problems after an out-of-hospital cardiac arrest (Aufderheide, et al., 2011).

Mechanical chest compression devices provide compressions of standard depth and frequency over long periods of time without loss of quality and spare professionals from performing chest compressions manually, allowing them to focus on other aspects of patient care (Couper et al., 2015). The LUCAS device is a mechanical system for compression and decompression of the thorax that allows automated and continuous closed compression of the thorax without unduly restricting other invasive procedures (Agostini et al., 2008; Smekal et al., 2009; Wagner et al., 2010). Automated CPR devices have been developed to address some of the problems that reduce the effectiveness of manual CPR. The first of these problems, probably the most important, is the fatigue experienced by rescuers during CPR. In fact, the human thorax has a thick cushion that dissipates some of the energy applied during massage, so the rescuer must provide energy continuously (Wik et al., 2005; Idris et al., 2015). Over time, fatigue sets in and reduces the effectiveness of the massage (Riley et al., 2011; Perkins et al., 2012; Brooks et al., 2014). As a result, rescuers must change frequently, which interrupts the massage and further reduces the effectiveness of resuscitation (Hewitt et al., 2006).

However, since there is no evidence that automatic devices improve the outcome of CPR, AHA does not advocate their routine use. Nevertheless, such devices are a viable alternative when high-quality manual compression is challenging or dangerous for the provider (Nishiyama et al., 2014).

In this article, the different results of other articles will be analysed to verify the actual effectiveness of automatic CPR devices, in this case LUCAS.

## II. MATERIALS AND METHODS

A systematic review of the literature is one of the research methods used in the practice of evidence-based research, and its purpose is to collect and summarize research findings on a particular topic in a systematic and orderly manner, thereby contributing to knowledge about the topic (Mendes et al., 2008; Benefield, 2003). The method used was based on the strategy PICO (acronym for patient, intervention, comparison and "outcomes"). In this way, it maximizes the inclusion of relevant information in different databases, focusing on the research object and avoiding unnecessary searches (Santos, Pimenta e Nobre, 2007).

In strict compliance with all the steps required for the application of this method, a protocol was developed between May and September 2020 to identify studies of interest for this work, consisting of searches in the search engines: Ebsco and B-ONline, and in the following databases: CINAHL Plus, PubMed/ MEDLINE, LILACS, Scielo, Web of Science, ScienceDirect and Repository of Scientific Open Access of Portugal.

A search strategy using the following descriptors was used to identify relevant studies: Cardiac arrest AND Lucas Efficacy AND Nursing. After all these protocol requirements were met, some articles that did not meet the requirements were discarded and a reductive procedure was methodically developed.

## III. RESULTS

It was selected for the study nine articles that follow in Table 1.

Table 1: Description of selected studies and main results of investigations

Study (S)	Author(s)/ Year	Main Results
S1: "Automatic and manual devices for cardiopulmonary resuscitation: A review"	Carlo Remino, Manuela Baronio, Nicola Pellegrini, 2018	-It was found that almost all studies and meta-analyses could not demonstrate that chest compressions administered with automatic devices are more effective than those administered manually. -However, advances in clinical research and technology and a better understanding of organisational proposals for their use are leading to a continuous improvement in the effectiveness of such devices.
S2: "Mechanical CPR: Who? When? How?"	Kurtis Poole, Keith Couper, Michael A. Smyth, Joyce Yeung, Gavin D. Perkins, 2018	-It has been verified that the provision of high quality CPR is a key modifiable factor in cardiac arrest survival. -It has been established that mechanical chest compression devices consistently provide high quality chest compressions, but this does not lead to better patient outcomes.

		<p>-The use of mechanical devices in certain circumstances (e.g. ambulance or helicopter transport) where high quality chest compression cannot be safely performed may be a rational strategy.</p> <p>-Further studies are needed to evaluate the routine use of mechanical devices in CPR.</p>
S3: "The Efficacy of LUCAS in Prehospital Cardiac Arrest Scenarios: A Crossover Mannequin Study"	Robert A. Gyory, Scott E. Buchle, David Rodgers, Jeffrey S. Lubin, 2017	<p>-This study provided LUCAS with more consistent chest compressions without causing delays in critical resuscitation tasks such as defibrillation.</p> <p>-In addition, LUCAS scenarios reduced the overall time for hands, which would lead to maintaining adequate perfusion pressure and possibly better overall outcomes for the patient.</p>
S4: "Mechanical chest compression devices at in-hospital cardiac arrest: A systematic review and meta-analysis"	Keith Couper, Joyce Yeung, Thomas Nicholson, Tom Quinn, Ranjit Lall, Gavin D Perkins, 2016	<p>-Study concludes that mechanical chest compression devices can improve the patient's outcome when used in hospitalised cardiac arrest.</p> <p>-However, the quality of the current evidence is very poor.</p> <p>-There is a need for randomised studies to investigate the effect of mechanical chest compression devices on survival in hospital cardiac arrest.</p>
S5: "Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial"	Gavin D Perkins, Ranjit Lall, Tom Quinn, Charles D Deakin, Matthew W Cooke, Jessica Horton, et al., 2015	<p>-Study compared the group using chest compressions with the use of LUCAS and another group with the use of manual compressions.</p> <p>In this study, seven clinical adverse events were reported in the LUCAS group (three patients with chest bruising, two with chest lacerations and two with blood in the mouth) and 15 incidents with the device occurred during surgical use.</p> <p>-No adverse or serious adverse events were reported in the manual group.</p> <p>There was no evidence of an improvement in the 30-day survival rate with LUCAS compared to manual compressions.</p> <p>-Based on other recent randomised studies, the widespread introduction of mechanical CPR equipment for routine use has not resulted in an improvement in survival.</p>
S6: "The Study Protocol for the LINC (LUCAS in Cardiac Arrest) Study: a study comparing conventional adult out-of-hospital cardiopulmonary resuscitation with a concept with mechanical chest compressions and simultaneous defibrillation"	Sten Rubertsson, Johan Silfverstolpe, Liselott Rehn, Thomas Nyman, Rob Lichtveld, Rene Boomars, Wendy Bruins, et al., 2013.	<p>-Study shows that the primary endpoint is the four-hour survival rate after triumphant restoration of spontaneous circulation.</p> <p>-The safety aspect is further assessed by postmortem examinations in 300 patients who may have been injured by CPR.</p> <p>-It was concluded that this study will contribute to the evaluation of mechanical chest compression during CPR and in particular to the efficacy and safety of the LUCAS device, as it will function correctly when used in conjunction with defibrillation during ongoing CPR.</p>
S7: "Use of the LUCAS mechanical chest compression device for percutaneous coronary intervention during cardiac arrest: is it really a game changer?"	G Biondi-Zoccai, G Landoni, A Zangrillo, P Agostoni, G Sangiorgi, M G Modena, 2011	<p>-It has been verified that cardiopulmonary support, including chest compression, is a major support in the treatment of cardiac arrest.</p> <p>-However, chest compression by traditional means can be challenging, especially in patients requiring urgent invasive procedures such as percutaneous coronary intervention for cardiac arrest due to acute myocardial infarction.</p> <p>-The LUCAS mechanical chest compression device provides external and automated chest compression, enabling even complex invasive procedures without interrupting cardiopulmonary support.</p> <p>-However, no randomized study has yet demonstrated its benefit compared to standard manual chest compression, and to date only observational studies and consensus opinions support its clinical use.</p>

#### IV. DISCUSSION

The survival rate without any neurological consequences of cardiac arrest is determined not only by early detection but also by high-quality cardiopulmonary resuscitation. Since the effectiveness of manual CPR is usually impaired by rescuers' fatigue, devices have been developed to improve it through equipment or ergonomic solutions. However, it is assumed that some devices completely replace manual resuscitation, either by unleashing its effects or by generating hemodynamic

effects with completely different working principles. This article provides an overview of such devices, both manual and automatic. They are mainly classified by method of actuation, applied force, working space and positioning time (Remino et al., 2018). These facts are consistent with all studies, especially with the S2, S5 and S6 studies.

The hemodynamic performance of the LUCAS compression-decompression system is better than that of manual CPR, according to the results of studies S3, S4, S6 and S7. The data from this study confirm data from the literature on the same subject. According to current knowledge, automated systems for external cardiac massage provide hemodynamic benefits thanks to the quality of the massage and ensure better cerebral and myocardial perfusion over a longer period of time. However, although the benefit to physiological data has been demonstrated, no human studies have clearly shown that automated systems improve survival, neurological prognosis or ROSC percentage, as the S2 study shows (Gates et al., 2012). Prolonged cardiac massage is still the only indication for the use of these devices. Achieving optimal hemodynamic parameters is also essential to achieve the best possible tissue perfusion in the event of transplantation in cardiac arrest or the decision to initiate circulatory support during chronography (Fox et al., 2013). Automatic devices do not fatigue at all and can continue to massage during defibrillation or other necessary surgery (Libungan et al., 2014). In addition, if a strict stretcher is used during the transport of the patient from the accident site to the ambulance, the massage can continue uninterrupted, as described in the S2 and S3 studies. The LUCAS device does not fatigue or interrupt the compressions, and it provides uniform depth and rate of chest compressions. Of course, it gives a provider the freedom to perform other treatments and it provides improved patient access. The patient can be safely moved and transported while undergoing CPR. Defibrillation can be performed while the device is in operation.

In the literature there are some references to the poor quality of chest compression (Kampmeier et al., 2014). Consequently, chest compression is as crucial as alerting the emergency services or early defibrillation in the survival chain. According to the guidelines, chest compressions must be performed continuously in order to improve the outcome, according to the reviewers of all studies. However, the effectiveness of manual chest compression decreases over time with provider fatigue (which appears to be trapped by the minutes of the start of the procedure) and is compromised during transport, exposing patients to unexpected interruptions and a deterioration in the quality of the massage in terms of strength and rhythm (Walcott et al., 2007). These facts are confirmed by studies S2 and E7, which found that the quality of chest compressions is impaired during transport, e.g. in an ambulance or helicopter. It has been reported that the effectiveness of manual chest compression decreases by 20% per minute (Ock et al., 2011, Blomberg et al., 2011). Mechanical chest compression overcomes this problem of operator fatigue by ensuring continuous effectiveness in both qualitative and quantitative terms, as it mentions S5 and S1.

Complications induced by manual CPR have been reported in the literature, including cardiac rupture, aortic and vena cava injuries, esophageal rupture, rupture of solid organs and multiple rib fractures. However, there are few robust methodological studies that compare the actual complication rates of CPR methods. Deras et al (2014) concluded that the injuries seen with LUCAS appear to be of the same variety and incidence as those seen with manual CPR, as described in study S5. Regardless of the type of CPR performed, it is critical that the compressions are applied in the correct anatomical location and that their application requires consistent and careful monitoring (Bonnemeier et al., 2008; Smekal et al., 2009). Even if the compressions are applied correctly, the complication potential of manual and automated CPR is real, as developed in S2, S3, S4, S6 and S7. However, it should not be forgotten that the last complication has already occurred in these patients, and we have a duty to provide all patients with the care that offers them the highest chance of survival. This risk-benefit ratio is of crucial importance to readers (Steen et al. 2002; Matsuura et al., 2008; Yannopoulos et al., 2014).

The results of the studies are mixed, with four of them stating that LUCAS is fully effective, particularly in fatigue and transport, but two of them do not recognize its full effectiveness. One of the studies mentions that the fact that compression by the automatic device is effective does not necessarily reflect a better result. The vast majority of studies recognize the need for further studies (particularly S2, S4 and S7) to make more convincing decisions.

## V. CONCLUSION

With regards the results of the studies analysed, it should be noted that there are data in these studies that show that LUCAS is very effective in cardiac compressions either before or during hospitalisation, in the patient's results, and that the device is safe for the patient and does not cause undue serious injury to the patient. On the other hand, there are studies that point out as disadvantages of the use of LUCAS.

Automatic devices deliver compressions at a more consistent rate and depth than manual compressions. However, AHA does not recommend the routine use of automatic devices, as there is no evidence that they achieve a better result than

manual massage. Automated devices must be applied to the patient and this requires time, especially if personnel are not familiar with the device and not properly trained. There is a knowledge curve to overcome and the performance of a resuscitation team habitually improves over time with practice and regular training. However, as there is not enough data on real patients, this area is obviously ripe for future work.

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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# Acute And Long Term Toxicity Study Of Siddha Poly Herbal Formulation Kiranthi Mega Chooranam

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**Abstract-** The siddha system of medicine uses a fascinating combination of herbs, minerals and metals and to promote good health and longevity. *Kiranthi mega chooranam (KMC)* is one of the Siddha formulations which are indicated as an effective drug for various diseases. Acute Oral Toxicity study and Long term toxicity study in vivo toxicity studies were carried out on Kiranthi Mega Chooranam (KMC) by World Health Organization (WHO) guideline for testing traditional medicines. In Acute toxicity study there was no abnormal signs reported at the dose level of (2000 mg/kg b.wt) within 24-72 hours in wistar albino rats. Long term toxicity study was conducted for about 90 days as per WHO guideline in 3 doses Low dose (270mg/kg b.wt), Mid dose (540mg/kg b.wt), High dose (1080mg/kg b.wt). Animals were observed throughout the period. The histopathological study on the organs such as lung, brain, kidney, liver, spleen, heart, stomach, ovary, testis, uterus was normal in Control and High dose group of the animals. Analyses of these results with the information of signs, behavior, and health monitoring could lead to the conclusion that Acute and Long term oral administration of *Kiranthi mega chooranam (KMC)* for 90 days does not cause toxicity.

**Index Terms-** Kiranthi mega chooranam, Toxicity study, Siddha medicine, WHO guideline

## I. INTRODUCTION

Siddha Medical system is a special, significant and scientific system, being in practice, since time immemorial. It is one of the ancient systems of medicine contemporaneous with Grecian, Egyptian, Mesopotamian, Chinese medicines. It is a unique system which dwelt among the Tamil people of South India rendering service to humanity for more than five thousand years BC era in combating diseases and in maintaining physical, mental, social and spiritual health Traditional Medicine has played an important role in meeting the demands of primary health care in many developing countries and its use has expanded widely in many developed countries<sup>1</sup>. Siddha system of medicine is one among them, which has flourished in the Southern India especially Tamilnadu<sup>2</sup>. In Siddha system of medicine, Drugs are prepared with ingredients of herbs, minerals, metals and animal products. Siddhars use single or combinations in their medicine preparation in addition of herbs to increase its potency, efficacy, therapeutic index because of the long shelf life. Siddhars are highly

intellectual and spiritual combined with supernatural power their works involve high order of chemistry (Rasavatham). Siddha medicine uses herbal formulations as a first line drug of choice, which emphasizes to use roots of the plants as medicine primarily and then to use leaves and other parts of the plant and finally to use herbo-mineral preparations in its oxide form, sulphide forms etc<sup>3</sup>.

*Kiranthi mega chooranam (KMC)* is one of the traditional Siddha formulation which is indicated as a best drug for Kiranthi (Syphilis), kadividam (Poisonous bites), kuttam (Skin diseases), Thadippu (Urticaria), megasoolai (syphilitic arthritis) in Siddha text *Anuboga vaiithiya navaneetham*. Therefore, an endeavor has been made to reveal the facts about the poly herbal Siddha drug Kiranthi mega chooranam, from the literature by scientific analysis of its purification and preparation process by evaluating the Physico chemical characters, Pharmacological actions and toxicological analysis.

There is no report available on the toxicological profile of above mentioned drugs; therefore, present studies were conducted to evaluate the acute and long term toxic effects on the test drug *Kiranthi mega chooranam (KMC)* on rodents (Rats).

Sub chronic toxicity studies are generally designed to examine the adverse effects resulting from repeated exposure over a portion of the average life span of experimental animals. This study gives valuable information on the cumulative toxicity of substances on target organs and on physiological and metabolic tolerance of a compound at two dose levels for prolonged exposure<sup>4</sup>.

## II. MATERIALS AND METHODS

### 2.1 Preparation of test drug

The herbal drugs such as *Nilavaarai ilai* (Cassia senna), *Thavasi murungai samoolam* (Justicia tranquebariensis), *Sivanaar vembu samoolam* (Indigofera aspalathoides), *Vellarugu samoolam* (Elicostemma littorale), *Thoothuvalai samoolam* (Solanum trilobatum), *Kottai karanthai samoolam* (Sphaeranthus indicus) The Ingredients were purified as per siddha literature. After purification of all the above ingredients are dried well and equal quantity the plant leaves and Whole plants were taken make as fine powder and filtered well (Vasthira kayam) mix chooranam and stored in the air tight container<sup>5</sup>.

### Sample Solubility

S.No	Solvent Used	Solubility
1.	Water	Soluble
2.	Methanol	Soluble
3.	Ethanol	Soluble
4.	Hydrogen Peroxide	Soluble

### 2.2 Toxicological evaluation of Kiranathi Mega Chooranam

The following in vivo toxicity studies were carried out on Kiranathi Mega Chooranam (KMC) by World Health Organization (WHO) guideline for testing traditional medicines<sup>6</sup> Acute Oral Toxicity study and Long term toxicity studies were carried out at National Institute of Siddha. The study was done after getting permission from the Institutional Animal Ethics Committee IAEC Approved No: **NIS/IAEC-II /28082018/19.**

For Acute and Long-term toxicity studies test animals were obtained from Tamil Nadu Veterinary and Animal Sciences University, Madhavaram. Animals were kept in animal house, National Institute of Siddha, Chennai.

#### a) Selection of the animals:

Animals were selected as per WHO guideline. Healthy adult animals of Wistar albino rat, both male and female rats were used for acute oral toxicity study and Long term toxicity study. The female animals used in the studies were nulliparous and non-pregnant.

#### b) Housing and feeding conditions:

Temperature: In the experimental animal room: 22°C (± 3°C)  
Humidity: 60 ± 10 %  
Lighting: Artificial, the sequence being 12 hours light, 12 hours dark.

The animals were housed in polypropylene cages provided with bedding of husk. The animals had free access to RO water.

For feeding, Standard pellet diet (bought from Sai Meera foods pvt. Ltd, Bangalore) was used.

#### c) Preparation of animals:

The animals were randomly selected, to permit individual identification by cage number and individual marking on the fur of each animal was made with picric acid. The animals were kept in their cages for 7 days prior to dosing to allow for acclimatization to the laboratory conditions. The principles of laboratory animal care were followed.

#### d) Test Substance:

Kiranathi Mega Chooranam (KMC) was brown in color, without taste and odour. The drug was dissolved in hot water to obtain and ensure the uniformity in drug distribution.

#### e) Route of administration:

Oral route was selected, because it is the normal route of clinical administration.

#### f) Preparation of doses:

The stock solution was prepared freshly as dose per animal suspended in 1ml hot water.

### 2.3 Acute oral toxicity

Acute oral toxicity of the test drug will be evaluated in rats following WHO guideline. Animals will be divided into 2 groups by randomization method, each group containing 10 animals (5 females and 5 males). One group as control and the other as test group. Control group is treated with hot water and test group were treated with the test drug Kiranathi Mega Chooranam ten times more than the therapeutic dose (2000mg per kg b.wt)

No of animals used for long term toxicity study:

GROUP	NO OF RATS
Group-1 Control (Hot water)	5 Male, 5 Female
Group-2 Test drug (2000 mg/kg b.wt)	5 Male, 5 Female

#### a)Administration of doses:

The test drug was administered in a single dose by using oral gavage. Animals were fasted prior to drug administration. Following the period of fasting, the animals were weighed and test drug was administered. The control groups received equal volume hot water. The test drug was administered at 10 times the therapeutic dose (2000 mg / kg b.wt). The food was withheld for 3-4 hours after dosing the animal.

#### b) Cage side observations:

The animals will be observed closely for behaviour in the first four hours which includes abnormal gait, aggressiveness, exophthalmos, ptosis, akinesia, catalepsy, convulsion, excitation, head twitches, lacrimation, loss of corneal reflex, loss of traction, piloerection, reactivity of touch, salivation, scratching, sedation, stereotypes (chewing), stereotypes (head movements), stereotypes (sniffing), tremor and writhes, diarrhoea, leathery, sleep and coma.

#### c) Gross necropsy:

At the end of 14<sup>th</sup> day animals will be sacrificed for gross necropsy. It includes examination of the external surface of the body, all orifices, and organs like brain, thymus, lungs, heart, spleen, liver, kidneys, adrenals and sex organs of all animals. If there will any occurrence of mortality during the trial period, the vital organs will be subjected to Necropsy.

2.4 Long term toxicity study : ( WHO guidelines)

Long term toxicity study was carried out at different dose levels. The animals in both sex was divided in four groups (group I, II, III & IV). Each group consists of 20 animals (10 males and 10 females). Group-I served as control and the other three groups II, III and IV for test drug of Low dose (108 mg/kg/b.wt), Mid dose (540 mg/kg/b.wt) and High dose (1080 mg/kg b.wt) respectively. The low dose was calculated from the therapeutic dose (6g) and body surface area of rats.

No of animals used for long term toxicity study:

GROUPS	NO OF RATS
Control (Hot water)	(10 Male, 10 Female)
Low Dose	(10 Male, 10 Female)
Mid Dose	(10 Male, 10 Female)
High Dose	(10 Male, 10 Female)

Total 80 (40 Female + 40 Male)

#### a) Administration of doses:

The animals were dosed with the test drug daily for a period of 90 days. The test drug mixed with ghee and was administered by oral gavage, and this was done in a single dose to the animals once in daily for 90 days.

#### b) Observations:

During the study, body weight of the animals, water and food consumption were evaluated weekly; mortality events were evaluated daily. By the end of 90 days, on 91<sup>st</sup> day animals were sacrificed by excessive aesthesia. Blood were collected in all overnight (12 hours) fasted rats through abdominal aorta and it were processed for investigations like Complete heamogram, Renal function test, Liver function test, Lipid profile. Vital organs were collected from the animals and subjected to histopathology.

#### c) Statistical analysis:

Findings such as body weight changes, food consumption, water intake, haematology and biochemical analysis were subjected to One - way ANOVA Dunnet's test using a computer software program followed by D Graph Pad Instat - 3.

### III. RESULTS AND DISCUSSION

#### 3.1 Acute oral toxicity study of Kiranthy Mega Chooranam

Acute toxicity study carried out as per WHO guidelines, there were no treatment related death or signs of toxicity developed in Wistar albino rats at dosage of 10 times the therapeutic dose (2000 mg/kg b.wt) throughout the study period. Further, No abnormal behavior and mortality was observed during study and observational period after drug treatment in any experimental group. no gross pathological changes have been seen in the internal organs of both control and treated groups.

#### 3.2 Long term toxicity study of Kiranthy Mega Chooranam

Long term toxicity study carried out as per WHO guideline for a period of 90 days. The changes in the food intake, water intake, body weight changes, haematological and biochemical parameters were observed and noted in consideration for assessing the toxicity profile of the test drug Kiranthy Mega Chooranam (KMC).

##### a) Body weight:

The mean body weight of male and female rats changed after administration 10 times higher than recommended dose are depicted in Table 1 (a and b) respectively. There was no significant difference abnormality in body weight gain of KMC treated rats compared to control rats during the entire period of study.

##### b) Food and water consumption:

The average daily food and water intake consumption of KMC treated rats was comparable with control animals. Data of food and water intake is presented in Table 2 and Table 3 respectively. There is no significant changes in Food and water intake.

##### c) Effect of on haematology:

The 90 days oral administration of test drug KMC did not depress the haemoglobin and blood cell values. There was no major shift in white blood corpuscles of drugs treated rats compared to control animals. There was no leukocytosis or leucopenia for 10 times higher than recommended dose respectively. The result of haematology is presented in Table 4.

##### d) Effect on Liver:

The test drug KMC did not cause any disorder in hepatic functions as compared to control group rats. The excretory function of liver in the test drug KMC treated animals was not disturbed because alkaline phosphatase values (ALP) were not elevated in comparison to control rats. The alanine transaminase (ALT) and aspartate transaminase (AST) values are more important in assessing and monitoring the degree of liver cell damage, inflammation and necrosis<sup>7</sup>. In present study, it is found that there is no statistically significant increase in values of these enzymes even when the rats were administered up to ten times higher than the recommended dose. Further, biochemical parameters showed that drugs taken for the study did not cause any disturbances in synthesis of albumin even at high dose. The total serum cholesterol values, which are statistically insignificant, suggest that the test drug KMC devoid of any metabolic adverse effects. The results are presented in Table (5 and 6)

##### e) Effect on Kidney:

There was no any adverse effect on renal function after the administration of the test drug KMC. Biochemical parameters revealed that excretory function of kidney was well maintained, as there was no rise in the values of blood urea nitrogen (BUN), and serum creatinine levels in plasma of rats which treated with above-mentioned drug. (Table 7).

**TABLE 1.a.Effect of Kiranathi Mega Chooranam on Body weight changes of Male Wistar albino rats in long term toxicity study.**

GROUPS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
0 <sup>th</sup> day	183.7±11.4	181.5±8.6	192.5±8.6	194.4±6.1
15 <sup>th</sup> day	198.7±10.1	196.5±12.5	209.2±4.1	209.2±5.1
30 <sup>th</sup> day	218.2±13.6	221.8±17.6	231.6±5.3	229.2±6.4
45 <sup>th</sup> day	239.6±17.7	241.6±16.5	253.8±5.9	256 ± 8.6 *
60 <sup>th</sup> day	264.2±15.8	265.6±17.6	285.2± 9.2	280.2±8.6*
75 <sup>th</sup> day	288.2±16.0	287.6±12.9	308±9.2**	312±8.8**
90 <sup>th</sup> day	316.2±18.2	308±15.5	335±12.9*	340 ±6.5**

**TABLE 1.b.Effect of Kiranathi Mega Chooranam on Body weight changes of Female Wistar albino rats in long term toxicity study**

GROUPS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
0 <sup>th</sup> day	151.3±12	157.2±15.7	167.4±16.4	170±16.2
15 <sup>th</sup> day	164±11.6	172.6±16.2	182.2±22.1	178.3±16.0
30 <sup>th</sup> day	173.4±12.8	186.6±17.1	193±26.5	195.2±19.0
45 <sup>th</sup> day	193.6±6.8	194.6±15.2	199.4±18.6	205.2±20.0
60 <sup>th</sup> day	214.4±6.0	215.6±11.5	214.6±20.8	219.8±18.1
75 <sup>th</sup> day	241.6±10.1	240.4±15.0	247.2±25.0	262.8±26.1
90 <sup>th</sup> day	261.2±12.6	272.8±19.6	270.6±24.5	284.8±26.9*

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10.

**TABLE 2: Effect of Kiranathi Mega Chooranam on feed intake of Wistar albino rats in long term toxicity study.**

GROUPS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
1 <sup>st</sup> day	41.5±2.53	31±6.07	35±14.1	56±14.6
15 <sup>th</sup> day	40.2±12.8	36.8±5.87	42.3±9.44	45.4±13.2
30 <sup>th</sup> day	35.2±8.5	39.5±7.01	43.5±10.6	45.8±12.1
45 <sup>th</sup> day	36.6±7.9	39.1±10.5	43.9±12.5	51.5±14.1*

60 <sup>th</sup> day	39.5±9.12	42.5±10.0	45.5±17.3	50.5±12.0
75 <sup>th</sup> day	43.4±12.6	47.9±13.4	47.8±13.6	48.8±15.5
90 <sup>th</sup> day	44.5±11.5	46.4±18.5	55.5±13.4*	57.7±15.5

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10

**TABLE 3: Effect of Kiranthy Mega Chooranam on water intake of Wistar albino rats in long term toxicity study**

GROUPS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
1 <sup>st</sup> day	86±7.07	62±14.1	71±28.2	89±20.2
15 <sup>th</sup> day	60±17.4	55.4±16	73.3±21.8	80.9±25.1
30 <sup>th</sup> day	66±18.7	74.1±22.1	75.6±25.2	81±27.3
45 <sup>th</sup> day	68±22.5	79.5±23.1	82.1±21.6	87.4±28.8
60 <sup>th</sup> day	70±20.8	81.2±24.9	87.6±32.9	84.3±25.2
75 <sup>th</sup> day	71.3±22.5	84.2±28.1	88.2±32.5	88.8±31.1
90 <sup>th</sup> day	82.3±23.5	89.3±32.1	91.3±33.8	93±29.8

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10

**TABLE 4: Effect of Kiranthy Mega Chooranam Haematological parameters of Wistar albino rat in long term toxicity study**

PARAMETERS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
RBC (X 10 <sup>6</sup> /μl)	5.5±1.32	6±1.07	6.1±0.9	6.9±1.53
WBC (X10 <sup>3</sup> /μl)	10±2.08	9.3±2.48	5.4±0.96**	9.04±1.35
Platelet(X10 <sup>3</sup> /μl)	752.8±172.6	642.9±164.5	762.6±113.7	723±138.4
Haemoglobin(g/dl)	12±2.03	13.2±1.43	12.1±2.38	13.5±2
MCH(pg)	18.2±1.57	17.5±1.64	19.10	17.3±1.14
MCV(fl)	58±5.10	58.1±4.24	58.5±6.4	62.1±6.11
Neutrophils 10 <sup>3</sup> /mm <sup>3</sup>	22.3±0.72	22.6±0.78	22.1±0.75	21.6±0.43
Eosinophils (%)	1.3±0.27	1.3±0.29	1.4±0.30	1.4±0.32
Basophils (%)	0.3±0.38	0.1±0.32	0.3±0.40	0.3±0.38
Lymphocytes (%)	73.7±12.2	74.2±12.1	75.8±10.66	75.1±8.89
Monocytes (%)	4.2±0.74	3.1±0.81	3.2±1.50	3.9±0.96

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10

**TABLE 5: Effect of Kiranthy Mega Chooranam biochemical parameters-Liver function test of wistar albino rat in long term toxicity study**

PARAMETERS	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
TOTAL BILIRUBIN (mg/dl)	0.4±0.13	0.3±0.14	0.5±0.13	0.6±0.14
SGOT(U/dl)	99±16.4	89±16.9	98±16.4	101±16.9
SGPT(U/dl)	26±12.20	28±1.50	32±0.12	35 ±12.0

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10

**TABLE 6: Effect of Kiranthy Mega Chooranam on biochemical parameters- Lipid profile of wistar albino rat in long term toxicity study**

PARAMETERS (mg/dl)	CONTROL	LOW DOSE	MID DOSE	HIGH DOSE
TOTAL CHOLESTROL (mg/dl)	125±18.13	132.6±15.8	137±27.15	139.8±25.3
HDL(mg/dl)	59.3±5.86	62.8±10.8	68.2±6.05	115±27**
LDL(mg/dl)	50.3±21.0	50.1±20.8	50.8±21.4	49.2±20.3
VLDL(mg/dl)	15.7±2.25	15.9±2.15	16.1±4.02	16.3±4.12
TGL(mg/dl)	39.1±8.21	37.7±10.6	40.1±7.88	38.1±11.6

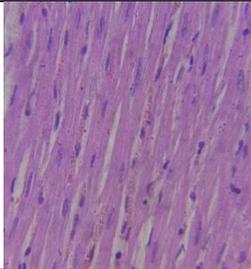
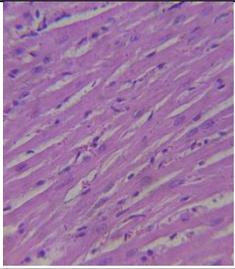
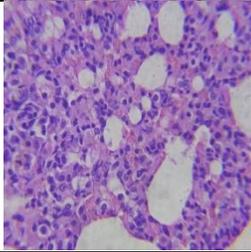
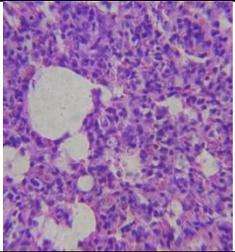
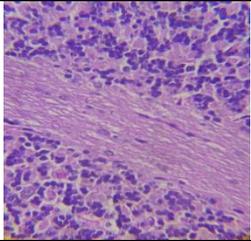
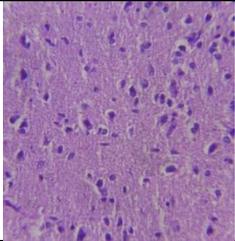
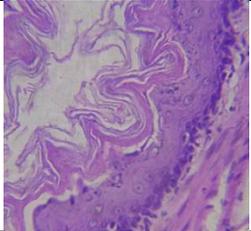
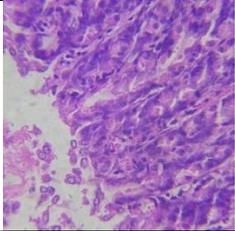
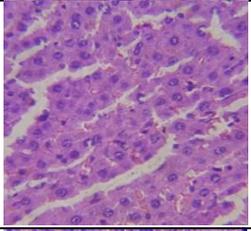
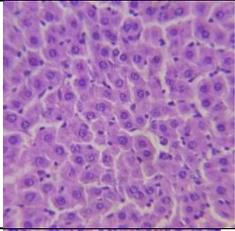
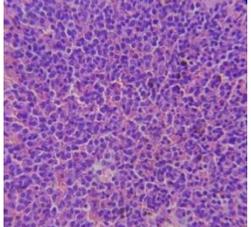
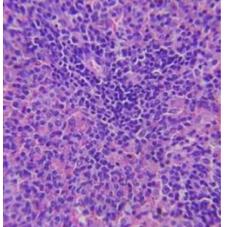
Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10

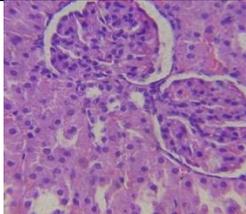
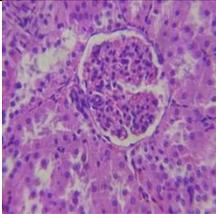
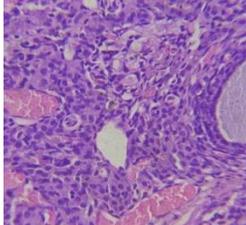
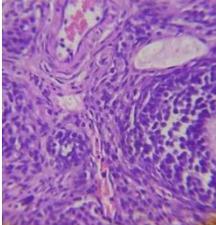
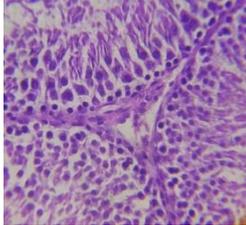
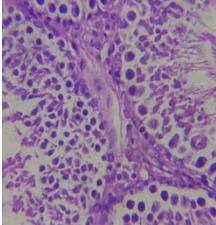
**TABLE 7: Effect of Kiranthy mega Chooranam on biochemical parameters- Renal function test of Wistar albino rat in long term toxicity study**

Parameters	Control	Low dose	Mid dose	High dose
BUN (mg/dl)	15.8±3.32	16.1±2.54	15.1±3.15	14.9±3.27
Serum Creatinine(mg/dl)	0.7±0.12	0.69±0.17	0.71±0.22	0.73±0.16

Values are mean± S.D. (Dunnett's test). \*P<0.05, \*\*P<0.01, N=10.

**Table 8: Histopathology of High power magnification Vital organs 40X (Albino Rats)**

ORGANS	LOW DOSE	HIGH DOSE	RESULTS
HEART			No abnormality
LUNGS			No abnormality
BRAIN			No abnormality
STOMACH			No abnormality
LIVER			No abnormality
SPLEEN			No abnormality

KIDNEY			No abnormality
UTERUS			No abnormality
TESTIS			No abnormality

### 3.3 Histopathological study:

Histological sections of vital organs of control and test group show normal architecture (Table 8). Liver biopsy of treated rats show normal lobular architecture of liver with normal central portal vein, radiating plates of hepatocytes and peripheral portal tracts composed of hepatic artery, bile duct and distal portal vein. No focal or diffuse foci of necrosis of hepatocytes, and infiltration of chronic inflammatory cells were observed. Kidney biopsy of KMC treated rats show normal architecture composed of normal renal glomeruli, collecting tubules, interstitial tissue and blood vessels. There were no foci of necrosis, degeneration or fibrosis in the interstitium. Histological study of sections of stomach shows normal architecture. No any epithelial damage and ulceration was noted in the stomach sections of test drug treated groups. Submucosa, muscularis propria and serosa were all unremarkable.

#### IV. CONCLUSION

In vivo toxicity study reveals that there was no mortality and signs of toxicity observed for acute oral administration of Kirantheni Mega Chooranam till the dose of ten times the therapeutic dose of 2000mg/kg b.wt in prescribed manner. In long term toxicity study there was no significant changes in haematological and biochemical parameters in test drug treated groups when compared to control group. The histopathological reports also confirm that there was no cellular changes at all doses level. It clearly demonstrates that No Observed Adverse Effect Level (NOAEL) is up to the high dose level (1080mg/kg b.wt), which is ten times of that therapeutic dose. Acute and Long term toxicity studies of drugs used in the study clearly showed the non-toxic nature and high safety profile of Kirantheni Mega Chooranam in Rodents.

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# Isolation of Endophytic Fungi from Selected Bamboo Species of Arunachal Pradesh, India

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**Abstract-** The present study attempts to isolate and identify the number of endophytic fungal association in three species of bamboo leaves; *Dendrocalamus sikkimensis* (DS), *Bambusa polymorpha* (BOP) and *Phyllostachys bambusoides* (PB). The endophytic fungi was isolated from the plant tissue following the protocol of Suryanarayanan *et al.*, 1998. A total of 196 endophytic fungi were isolated and identified up to genus level. Among all the fungal isolates, *Xylaria* and *Nigrospora* sp. showed highest level of colonization frequency (i.e. 18%). *Xylaria* sp. was more dominant in BOP, whereas, DS and PB displayed deviation in terms of fungal dominance with sp2 (sterile) and *Nigrospora* sp. to be dominant respectively. The isolation of endophytic fungi from healthy mature leaves of host plant suggest that the fungi residing inside them is asymptomatic and may be beneficial to their host, as they are found to protect their host against domestic herbivores, pest and pathogens. The study opens the gate for further biological analysis of endophytic fungi associated with bamboo creating a genetic resources for future researchers.

**Index Terms-** Bamboo endophytes, Bambusicolous fungi, Arunachal Pradesh, *Xylaria* sp.

## I. INTRODUCTION

India being the second largest producer of bamboo worldwide, has the richest diversity with 23 genera and 125 species, both indigenous and exotic (Verma and Bahadur, 1980). The North Eastern part in India alone harbors major diversity of bamboo consisting of 19 genera and 78 species (Hore, 1998) and Arunachal Pradesh consisting of 57 species (Bhuyan *et al.*, 2007) is richest in the country as far as the bamboo resources are concerned. This region of India represents existing bond for both indigenous knowledge on utilization and management of bamboo species, which goes along with the traditional uses.

Endophytes are asymptomatic microorganism colonizing the living tissue of plants (Wilson, 1995) and believed to be protecting its host plant from both abiotic and biotic stresses (Rodriguez *et al.*, 2008). They mostly belong to ascomycetes and anamorphic fungi (Arnold, 2007), representing an important part of fungal diversity and are known to affect the diversity and structures of plant communities (Krings *et al.*, 2007) with promoting the growth of its host plant (Omacini *et al.*, 2001).

Review on literature related on bamboo-associated fungi reveals nearly about 1100 species belonging to 228 genera of bambusicolous fungi (Hyde *et al.*, 2002a, b). Tanaka and Harada (2004) mentioned some important bamboo-associated fungi from

Hino and Katumoto records. Among the bambusicolous fungi, the described population of endophytic fungi of bamboo is very limited. The largest diversity of bamboo endophytes recorded in Asia were roughly 500 species and about 38% were recorded from Japan (Hyde *et al.*, 2002).

Owing to global diversified distribution of bamboo in tropical, subtropical and temperate regions, its micro-fungi (endophytes) are widely studied. Most bamboo associated fungal records were based on its symptoms and morphology, thus, requiring a more extensive study on its molecular taxonomy. Also, majority of taxa of endophytes related with bamboo species have been recorded from other parts of Asia like China and Japan, while little has been known from India and South America (Bhagobaty and Joshi, 2011).

Arunachal Pradesh, being one of the biodiversity hot post of India has the potential to create genetic resources based on endophytic fungi from bamboo and provide a plethora for novel substances which can be of probable use in modern medicine, agriculture, antimicrobial, immune suppressants and anti-cancer compounds (Strobel and Daisy, 2003). Till date, there has been very limited study on fungal endophytes of Arunachal Pradesh. Thus, investigation on the endophytes of bamboo will help in broadening the knowledge on untapped endophytic fungal resources.

## II. MATERIALS AND METHODS

### 2.1 Collection site

The three bamboo species; *Dendrocalamus sikkimensis* (DS), *Bambusa polymorpha* (BOP) and *Phyllostachys bambusoides* (PB), were collected from two different regions of the state (Fig. 1). Bamboo species DS and BOP were collected from Bamboo setum in Chessa Van Vigyan Kendra in Papum Pare Dist., and PB was collected from Ziro, Lower Subansiri Dist (Fig 1.). From each of the selected bamboo species, healthy mature leaves were selected and collected in a sterile collection bag.

### 2.2 Isolation of endophyte

The fresh mature healthy leaves of bamboo species were collected in sterile collection bag from different sites of Arunachal Pradesh and processed for isolation of fungal endophytes within 24 to 36 hours of collection (Fisher *et al.*, 1987; Suryanarayanan *et al.*, 1998). The leaf samples were washed in running water for any debris and dirt and one hundred tissue segments of 0.5 cm<sup>2</sup> were excised from each bamboo species. Each leaf tissue segments were excised so as to include apical, middle and basal portion of

the leaf including the lamina. The tissue samples were then surface sterile following the protocol of Suryanarayanan *et al.*, 1998. The tissue segments were dipped in 70% ethanol for 5 second followed by 4% NaOCl for 90 seconds and finally rinsed with sterile distilled water for 10 seconds for surface sterilization. The segments were then inoculated in freshly prepared PDA (potato dextrose agar) media with desired antibiotics (Chloramphenicol). Total of 10 petri dishes were inoculated for each bamboo species where, each petri plates were inoculated with 10 tissue segments and kept for incubation at  $26 \pm 2^\circ\text{c}$  under 12 hours light and 12 hours dark period for 4 weeks (Suryanarayanan, 1992).

### 2.3 Identification of endophytic fungi

The endophytic fungi grown from the tissue segment were isolated to make pure culture and identified both morphologically and microscopically following the standard manuals described by Barnett and Hunter 1972; Wei, 1979; Carmichael *et al.*, 1980. The microscopic observations were made by observing the slide culture under the microscope and photographs were taken with the help of *Lica* DM500 (Fig 3.). The sterile isolates were given codes based on culture characteristics such as growth rate, colony surface texture and hyphal pigmentation (Suryanarayanan *et al.*, 1998) and were expected to represent different taxonomic species (Bills and Polishook, 1994).

### 2.4 Statistical analysis

For data analysis, Colonization Frequency (CF) of each endophytes and Isolation Rate were calculated.

$$CF\% = \frac{\text{No. of segments colonized by each endophytes}}{\text{Total no. of segments observed}} \times 100$$

$$\text{Isolation Rate (\%)} = \frac{\text{The number of fungi obtained from segment } x}{\text{Total numbers of segments inoculated}} \times 100$$

Simpson index (D), Shannon-Wiener's diversity (HS) and Margalef's species richness index (R1) (Shannon and Weiner, 1963; Yuan *et al.*, 2010; Maheshwari and Rajagopal, 2013) were used to assess and quantify endophytic fungal diversity in host plants.

Simpson's index of Diversity was calculated using the formula:  $1-D$

$$D = \sum_{i=1}^S \frac{N(N-1)}{n(n-1)}$$

Where,

$n$  = the total number of organisms of a particular species and  $N$  = the total number of organisms of all species.

Shannon-Wiener Diversity index (HS) was calculated using the following formula:

$$H_s = - \sum_{i=1}^S (P_i)(\ln P_i)$$

Where,

$H_s$  = Diversity in a sample of  $S$  species or kinds,

$S$  = Number of species in the sample,

$P_i$  = Proportion of total sample represented by species ( $i$ ). Where,  $i$  is number of individuals of species.

$N$  = Total number of individuals of all kinds,  $N_i$  is the number of individuals of species  $i$  and  $\ln$  is log to base 2.

Margalef's Species Richness  $R1$  was calculated using the following formula:

$$R1 = \frac{(S-1)}{\ln(N)}$$

Where,  $S$  = total number of species and  $N$  = the total number of isolates of all species.

## III. RESULTS

In the present study a total of 196 endophytic fungi were isolated from healthy matured leaves of three bamboo host plant and identified up to the genus level. The fungal endophytes isolated are characterized into 11 morphotypes of fungi depending on colony morphology and microscopic structures (Fig 3). Out of 11, three fungal genus are characterized as sterile, as no spore formation were seen. All the fungal endophytes isolated belong to phylum Ascomycota. Of the total fungal isolates, 65 isolates belonged to Sordariomycetes genera, 59 to Hypomycetes, 6 belonged to Coelomycetes, 2 to Eurotiomycetes and 2 Ascomycetes.

Among all the fungal isolates, *Xylaria* and *Nigrospora* sp. showed highest level of isolation rate (i.e. 18%) and *Penicillium* sp. and *Chaetomium* sp. showed lowest isolation rate (0.66%) (Table 1; Fig 2). *Xylaria* sp. was more dominant in BOP, whereas, DS and PB displayed deviation in terms of fungal dominance with sp2 (sterile) and *Nigrospora* sp. to be more dominant respectively. The host sample *D. sikkimensis* showed highest level of species diversity depicting similar result with values 0.818, 1.85 and 1.739 in Simpson's index of diversity, Shannon diversity index and Margalef's Species Richness, respectively (Table 2). In contrast, *B. polymorpha* showed lowest value for diversity with values 0.488, 0.787 and 0.476 in Simpson's index of diversity, Shannon diversity index and Margalef's Species Richness respectively. The statistical analysis also explains that DS shows more evenness in terms of species distribution with the value of 0.794 (Table 2). The ubiquitous nature of endophytic fungi is depicted by the omnipresence of *Nigrospora* sp. and *Xylaria* sp. in all the three host plant showed in Table 1. Each host species were collected from different sites of Arunachal Pradesh and all the three host displayed different dominant fungi, suggesting that the association of endophytic fungi may be environmental and host dependent. The statistical analysis explains that DS is more diverse with higher species richness and evenness when compared with other two host plant (Table 1).

## IV. CONCLUSION

In the present investigation, the versatility of colonization of fungi is limited as the endophytic fungal isolates such as *Xylaria* and *Colletotrichum* occur in wide range of plant host and in various geographical location, dominating the assemblage of plant tissues, thus creating a depression in overall endophytic diversity in a given ecosystem (Sudhakara *et al.*, 2016).

The result also corroborated with the previous findings, which has been isolated previously in bamboo tissues (Morakotkarnet *et al.*, 2007; Shen *et al.*, 2012). Previous reports have also mentioned the species of endophytic fungi to be identified from Dothideomycetes and Sordariomycetes, isolated from tissues of bamboo species and their molecular diversity were analyzed based on ITS region of ribosomal DNA (Morakotkarnet *et al.*, 2007; Shen *et al.*, 2012).

The leaves of all the host plant recruit similar type of endophytes such that the frequency of endophytes in leaves increases but not its diversity (Murali *et al.*, 2007). The scenario is so, because of the presence of multi-host endophytes such as *Colletotrichum* sp. and *Xylaria* sp. (Suryanarayanan, 2017). The statistical analysis of diversity indices shows that Shannon-Wiener Diversity is high (1.85) in *D. sikkimensis* than other bamboo species (Table 2). The value of Shannon diversity indices, Simpson's index and Margalef diversity indices shows increased evenness in bamboo species coded DS than other two bamboo host plants (Table 2). The higher level of evenness can be contemplated to show increase in fungal diversity.

The isolation of endophytic fungi from healthy mature leaves of host plant suggest that the fungi residing inside them is asymptomatic and may be beneficial to their host, as they were previously found to protect their host against domestic herbivores, pest and pathogens (Weber, 1981).

About 93% of the estimated fungal species are found in tropics and a stress is needed to explore the various ecological groups of fungi including endophytes to identify novel species of fungi (Manoharachary *et al.*, 2005). India has reported of about 27,500 fungal species which includes 15,500 from litter, 327 from dung of herbivore and 450 endophytes (Bhat, 2010) which is scanty number for a country with great multitude of geographical area supporting vast habitat. Endophytic fungi are gaining attention as they appear to be more innovative in terms of metabolic activity than soil fungi or fungi in association with algae (Schulzet *et al.*, 2002) in producing bioactive compounds. Very limited study has been done on endophytes associated with bamboo and its data relating to its diversity in India as a whole and Arunachal Pradesh in particular is scares. Most of the study on endophytes related to bamboo in done on other part of Asia like China and Japan. So, focusing on isolating fungal endophytes and study of its biological activity from one of the major hotspot (Myer *et al.*, 2000) area like Arunachal Pradesh ponder a great interest.

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#### Figure legends:

Fig 1. Map of Study area

Fig 2. Isolation rate of each endophytic fungi from some selected bamboo species of Arunachal Pradesh, India

Fig 3. Endophytic fungi from some selected bamboo species of Arunachal Pradesh, India:

- A. *Arthrimum* sp. (a1) Microscopic structure of spores (a2) Colony morphology
- B. *Chaetomium* sp. (b1) Microscopic structure of spores (b2) Colony morphology
- C. *Colletotrichum* sp. (c1) Microscopic structure of spores (c2) Colony morphology
- D. *Fusarium* sp. (d1) Microscopic structure of spores (d2) Colony morphology
- E. *Nodulisporium* sp. (e1) Microscopic structure of spores (e2) Colony morphology
- F. *Penicillium* sp. (f1) Microscopic structure of spores (f2) Colony morphology
- G. *Xylaria* sp. (g1) Microscopic structure of spores (g2) Colony morphology
- H. *Nigrospora* sp. (h1) Microscopic structure of spores (h2) Colony morphology

**Table 1: Number of endophytic fungi isolated**

<b>Fungi</b>	<b>Segment of host plant used for isolation</b>	<b>DS</b>	<b>BOP</b>	<b>PB</b>	<b>Total no. of fungal strains</b>	<b>Isolation rate (%)</b>
<i>Xylaria</i> sp.	Leaf	10	43	1	54	18%
<i>Nodulisporium</i> sp.	Leaf	6	3	2	11	3.66%
<i>Colletotrichum</i> sp.	Leaf	5	-	1	6	2%
<i>Arthrimum</i> sp.	Leaf	15	-	-	15	5%
<i>Nigrospora</i> sp.	Leaf	-	-	54	54	18%
<i>Penicillium</i> sp.	Leaf	2	-	-	2	0.66%
<i>Fusarium</i> sp.	Leaf	3	-	1	4	1.33%
<i>Chaetomium</i> sp.	Leaf	2	-	-	2	0.66%
Sterile sp.2	Leaf	13	-	-	13	4.33%
Sterile sp.4	Leaf	-	21	-	21	7%
Sterile sp.7	Leaf	-	-	15	15	5%
CF%		56	67	73		
Total no. of species		8	3	6		

**Sample size: 100 leaf tissue segments (0.5 cm<sup>2</sup>) from each bamboo species**

**Table 2: Dominance and species Richness of endophytic fungi in Bamboo species**

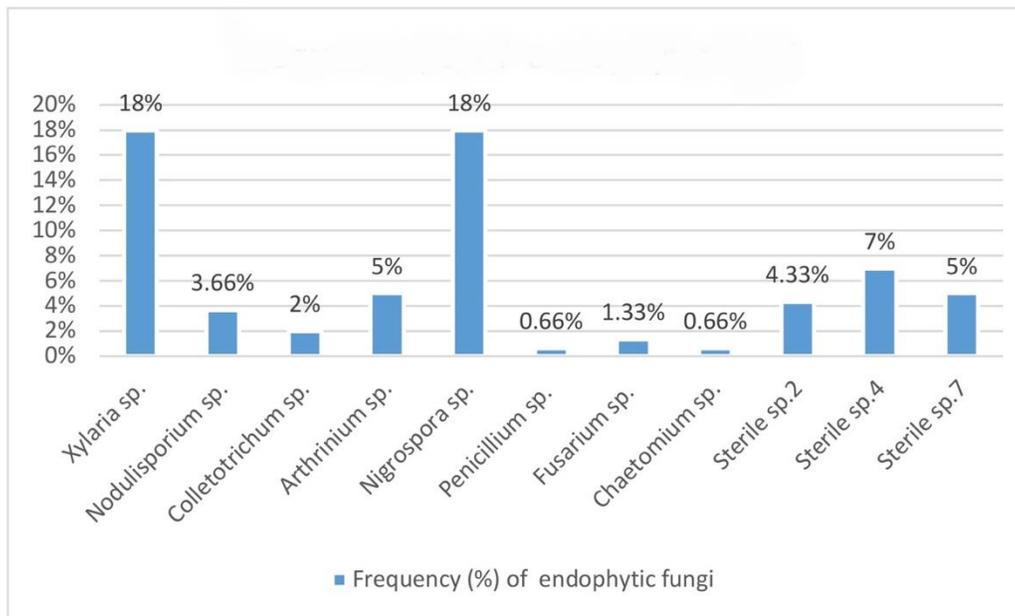
<b>Bamboo species.</b>	<b>Dominance_D</b>	<b>Simpson_1-D</b>	<b>Shannon_H</b>	<b>Evenness_e^H/S</b>	<b>Margalef</b>
BOP	0.512	0.488	0.787	0.732	0.476
PB	0.575	0.425	0.826	0.380	1.162
DS	0.182	0.818	1.85	0.794	1.739

## MAP OF ARUNACHAL PRADESH

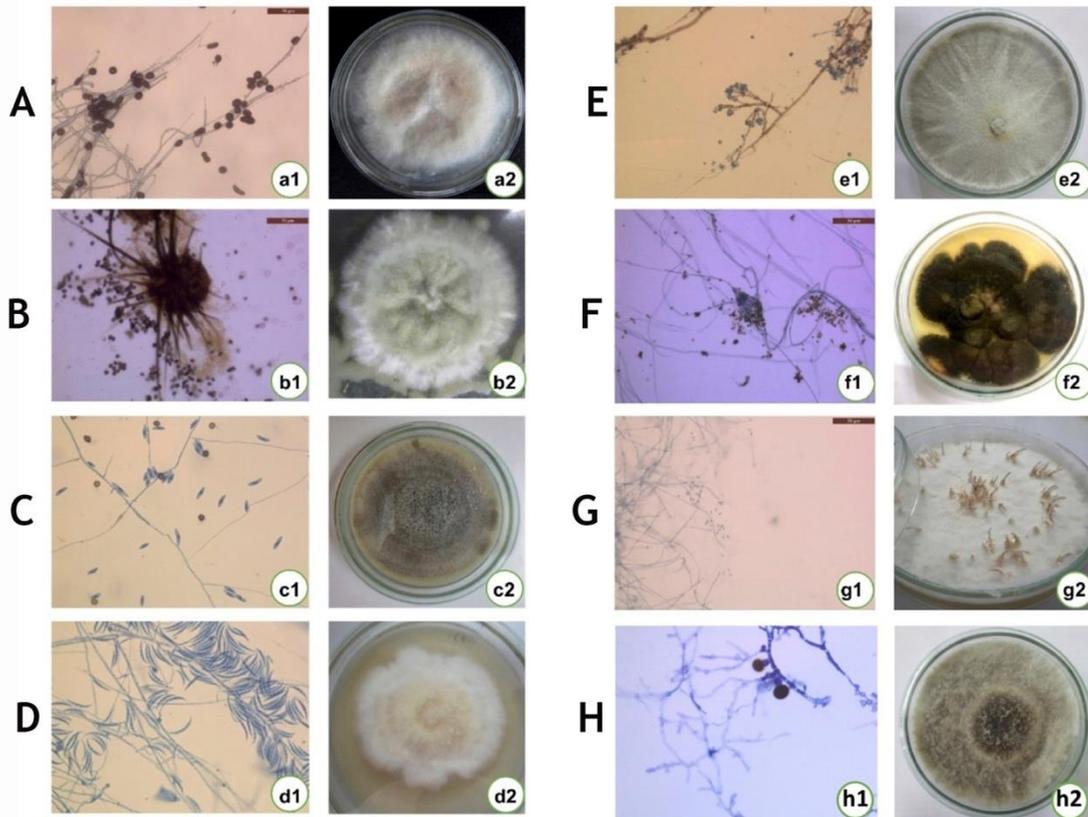
● Study Sites



*Note: Map is not for scale*  
**Figure 1. Map of collection site**



**Figure 2. Isolation Rate of each endophytic fungi from some selected bamboo species of Arunachal Pradesh, India**



**Figure 3. Endophytic fungi from some selected bamboo species of Arunachal Pradesh, India: A. *Arthrimum* sp. (a1) Microscopic structure of spores (a2) Colony B. *Chaetomium* sp. (b1) Microscopic structure of spores (b2) Colony C. *Colletotrichum* sp. (c1) Microscopic structure of spores (c2) Colony D. *Fusarium* sp. (d1) Microscopic structure of spores (d2) Colony E. *Nodulisporium* sp. (e1) Microscopic structure of spores (e2) Colony F. *Penicillium* sp. (f1) Microscopic structure of spores (f2) Colony G. *Xylaria* sp. (g1) Microscopic structure of spores (g2) Colony H. *Nigrospora* sp. (h1) Microscopic structure of spores (h2) Colony.**

# Impact of Job Design on Managerial Employees' Job Performance in Apparel Sector in Matale District, Sri Lanka

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**Abstract-** Proper people management drives to the success of an organization. In order to having Optimum employee performance within the organization Job design is crucial. In Sri Lankan context apparel industry plays significant role in relate to enhancing the GDP, employment rate and foreign exchange. The purpose of this study was to examine the impact of job design on managerial employees' performance in apparel sector in Matale district. Therefore, this study could make important contribution to management field. A structured questionnaire was used to measure the dependent and independent variable. Total of 70 managerial employees were selected from garment factories in Matale district. Results of the study were analyzed using the univariate, bivariate and multivariate analysis. Results of the study revealed that there is significant positive impact on job design on employee performance. Results indicated that there is a significant positive impact of Skill Variety on Job Performance, Task Identity and Job Performance, Task Significance and Job Performance and Feedback and Job Performance. Hence it can come to the conclusion that managerial employees job performance depends on their job design. Furthermore,  $R^2$  indicated that 61.8% variance of employee performance was explained by independents variables. (skill variety, task identity, task significance, feedback) The study suggests that improving Job Design factors to upgrade the employees' Performance is essential.

**Index Terms-** Employee Performance, Job Design

## 1. INTRODUCTION

Sri Lankan Apparel industry is the largest value addition industry in Sri Lanka which provides the highest contribution for the Gross Domestic Production (GDP) of Sri Lanka. The beginning of the Apparel industry occurred in early 1950s with some pioneering industrialists. At the beginning, it limited to some popular garment items, only in the local market. Over the decade of 1960s, textiles and other readymade garments were begun to be manufactured locally. Exporting of our readymade garments to the international was started in late 1960s. Apparel exports grew rapidly during the 1980s resulting being the largest share of all exports in 1986. The operation under the 200 Garment Factories Program (200-GFP) is considered to be a turning point in the history of Sri Lankan apparel industry. Through this program, Board of Investment (BOI) offered incentives for manufactures to transfer their operations to rural parts of the island. In 2002, the island's textile and garment sector accounted for 6% of GDP, 30% of industrial production, more than half of total exports and just over two thirds of industrial exports. In 2014, apparel industry accounts nearly 70% industrial exports from Sri Lanka. Sri Lanka is estimated to be more than \$4.8 billion and is regarded as one of the best clothing export destinations in the Asia Pacific region for its reliability, quality, and lead time. (World Bank, 2018) The clothing industry in Sri Lanka accounts for more than 30% of the total employment for all the manufacturing industries nationwide and constitutes over one-third of the industrial output for the country every year. The Government of Sri Lanka has also taken several initiatives through invested around \$70 million in 2017 for Research and Development to promote the growth of the apparel industry in Sri Lanka. Also, the textile industry in Sri Lanka aims to make 15 zones with a focus on export of apparels. (Deshappriya & De Zylva, 2016)

Apparel industry in Sri Lanka has grown to be one of the largest contributors to the export revenue of the country. According Sri Lanka export development board Apparel Contribution to total merchandise exports in 2019 is 44.25% and Export performance in 2019 US\$ Million 5,205.95. Moreover, Sri Lanka's apparel industry continuous to manufacture world renowned quality apparels for global brands. The apparel industry in Sri Lanka accounts for a market share of almost 1.2% of the global garment industry, which means it is still not among the top 10 garment manufacturing countries in the world. However, the Sri Lankan apparel industry has set a goal to of figuring in the list of top 10 garment manufacturing countries in the world by the year 2023. (Apparel Industry in Sri Lanka, 2018) Thus, focusing on uplifting employee performance in apparel industry is important to development of the country. Apparel factories' operation run through the target or mission driven activities, for such companies having trained, efficient employees within the organization is mush important, meanwhile for achieving the firm's goals on time well performing employees are really crucial.

Hence, employee Performance is the achievement of targets of the tasks assigned to employees within particular period of time. The success of business depends on employees' performance. One of the most effective ways to increase business performance and profit is to increase the performance of employees, from the lowest levels of the organization to senior management (Aroosiya & Ali, 2010). Focusing on enhancing employees' performance becoming major strategy to accomplishing organization goals and objectives. Most of managerial level employees' focusing on monetary benefits, promotion, job satisfaction, and job design in order to enhancing the employee performance. (Ali & Rehman, 2014; Sarwar, Imran, Jabbar & Hannan, 2013) According Hackman and Oldham's job characteristic model is basis for many work design theories and extends the notion of meeting employee's human/mental needs to improve performance processes. They depicted positive work structure in the form of five job characteristics (skill variety, task identity, task significance, autonomy, feedback) which promoted higher intrinsic psychological factors (meaningfulness, responsibility, knowledge of results) and thus improve motivation and work performance. If employee have knowledge of results of their work, a sense of responsibility, and an understanding of the meaningfulness of their work will ultimately have grater satisfaction on the job.

## 2. PROBLEM STATEMENT

Job design plays significant role for optimizing employee performance. In order to increasing job satisfaction and motivation of employees it is important to focusing on job design. Effective job design measures of the degree which employee is involved in task and assignments. Even though job design is not a new concept it has failed to attain much attention from managers. (Zareen, Razzaq, Mujtaba, 2013) Thus, it is important to examine the impact of job design on job performance. Even though many researches have done studies factors affecting job performance, many of them included training, motivation, employee satisfaction, (Hijr & Haleem, 2017; Zhangpeidi, 2016; Hailesilasi, 2009) it has few empirical evidence to examine the impact of job design on job performance. There is no study to examine the impact of job design on job performance on managerial employees in apparel sector in Sri Lanka or Matale District, hence this study within Sri Lankan context is a new thing. Factors affecting job designs empirically studied dimensions indicate organizational factors, environmental factors and behavioral factors, (Rajaguru, 2019) work flow, autonomy, work practice (Sinha, 2017) Job rotation, job enrichment and job enlargement (Zareen, Razzaq, Mujtaba, 2013) But dimensions of skill variety, task identity, task significance, feedback less addressed in studies to examine the impact on managerial employees performance in apparel sector in Matale district.

Therefore, here contradictions on job design and its impact on managerial employees' performance in apparel sector in Matale district lead to the identification of a research problem that is worth to study. The problem statement addressed;

**Do skill variety, task identity, task significance, feedback, contribute to managerial employees' performance in apparel sector in Matale district?**

## 3. LITERATURE REVIEW

### 3.1 Employee Performance

Well performing employees contribute to the efficiency and success of the organization. (Hameed & Wasead, 2011) Quality of work will refers completion of the task on time with desired standards. The working quality can be carried out through the employee maximum commitment to perform task, employee positive attitudes to meeting organization's expectation being understand personal performance objectives. (Zhangpeidi, 2016) Organizational optimal performance depends on human resources attempts in order to develop organizational capabilities of employees. Performance is considered as behavior or a method which operates based on the organizations, groups and individuals. In other words, performance is behavior by determined indicators which can be evaluated positively or negatively for employees (Saravani & Abbasi, 2013). Job performance is one of the most important dependent variables and has been studies for a long decade. Borman & Motowidlo (1993) identified two types of employee behavior that are necessary for organizational effectiveness: task performance and contextual performance Viswesvaran (2005) Task performance is defined as 'the proficiency with which incumbents perform activities that are formally recognized as part of their jobs; activities that contribute to the organization's technical core either directly by implementing a part of its technological process, or indirectly by providing it with needed materials or services. Task performance entails the accomplishment of duties and tasks that are specified in a job description. Contextual performance consists of behavior that does not directly contribute to organizational performance but supports the organizational, social, and psychological environment. Contextual performance is different from task performance as it includes activities that are not formally part of the job description. It indirectly contributes to an organization's performance by facilitating task performance (Sonnentag et al., 2010). All concepts refer behaviors that go beyond the formally core work goals. Extra tasks, showing initiative, coaching newcomers on the job included in contextual performance. Contextual task performance included with the in direct activities related to the job. Cooperating with others, defending organizational objectives, volunteering to contribute more are included with the contextual performance. (Pine, Desa & Asaari 2016)

### 3.2 Job Design

Goncalves, (2015) Job design is a key element that defines the individual's relationship to their work and organization and has been suffering numerous changes over the years. In fact, in the early job design research, companies were only focused on job simplification in order to require less skilled and cheaper workforce, assuring the elimination of all unnecessary movement to execute a particular task, in order to achieve the most efficient ways of performing work activities. However, due to several reasons like technological revolution and changes of organizational demands, nowadays companies are designing and applying different kinds of work organization such as working in teams rather than individually and increasing the challenge inherent to every job. From a conceptual perspective, job design is defined as determining the specific job content, the methods used at work and the relationships between jobs to correspond the firm's technological and organizational and the employees' social and personal expectations (Kaymaz, 2010). Skill variety is to the extent to which the job requires the employee to draw from a number of different skills and abilities as well as on a range of knowledge. (Ajgaonkar et al., 2012) Skill variety is a job characteristic, which workers are required to perform a variety of skills to achieve in the assigned work (Tungkiatsilp, 2014). Task identity measures the degree to which a job requires the completion of an identifiable piece of work. This would involve doing a job from beginning to end with a visible outcome. Task identity is important for workers to find their work meaningful. Employees must feel that the work they perform is their own, and must feel personally responsible for whatever successes and failures occur as a result of the work. According to Ajgaonkar et al., (2012) task significance involves importance of the task. Task significance is the degree to which a job has substantial impact on the lives of other people either in the immediate organization or external environment. Feedback is the measure of the degree to which performing the work activities results in the job incumbents obtaining direct and clear information about the effectiveness of their performance. By providing information on task performance, feedback can increase knowledge acquisition for complex tasks (Folami & Jacobs, 2005).

### 3.3 Empirical Evidence

Study carried out by Malkanthi and Hussain (2016) Impact of job design on employees' performance in peoples' bank using 54 employees indicated that there were significant impact skill variety, task identity, task significance, autonomy, feedback on employee performance. When a job is designed to include or increase characteristics such as skill variety, task identity, task significance, autonomy, feedback, it is predicted to have positive effects on employee motivation, satisfaction and performance (Crane, 2012) The importance of job design in enhancing individual's productivity and performance has been discussed extensively in few studies. From the organizational aspect, job design plays vital part in supporting the employees' work performance in achieving organizational outcomes as it may directly or indirectly influence the manner they perform their responsibilities and tasks (Masrek, 2013). Phoomphong (2008) studied on the relationship between the perceived self-efficacy, job characteristics, job satisfaction, and job performance of employees in faculty of Agriculture, Chiang Mai University. The finding has showed that the overall job characteristics revealed the significant positive relationship job performance. Skill variety, task identity, autonomy and feedback showed the significant positive relationship with job performance. However task significance presented no relationship with job performance. Josephine (2014) study on effects of job design on employees' performance using 180 respondents indicated that there is positive significant impact task identity, autonomy and feedback on job performance. Impact of job design on employee performance, mediating role of job satisfaction: a study of FMCG's sector in Pakistan, research findings indicated positive impact of Skill variety, task identity, autonomy, task significance and feedback on employee performance. (Ali & Rehman, 2014)

Based on above evidence following hypothesis were developed for the study.

H1: There is positive impact of job design on managerial employees' performance in apparel industry in Matale District.

H2: There is positive impact of Skill variety on managerial employees' performance in apparel industry in Matale District.

H3: There is positive impact of task identity on managerial employees' performance in apparel industry in Matale District.

H4: There is positive impact of task significance on managerial employees' performance in apparel industry in Matale District.

H5: There is positive impact of feedback on managerial employees' performance in apparel industry in Matale District.

## 4. METHODOLOGY

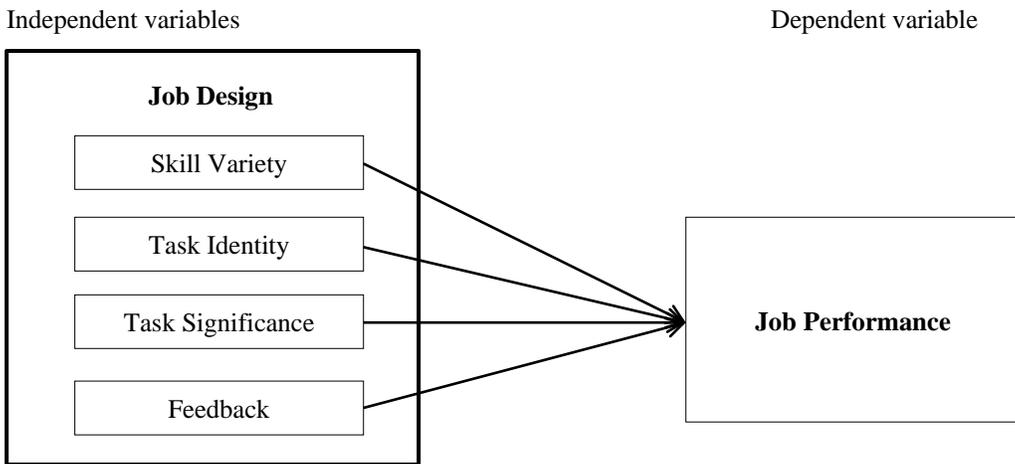
Objective of the study is to examine the impact of job design on job performance thus study is a hypothesis study and field of study is conducted within the natural environment in the garment sector under minimal interference within a non-contrived setting. The research is purely based on primary data, which was collected by giving a questionnaire to the managers in the apparel industry. Also, secondary data such as published research articles, books, annual reports issued by apparel sectors, government publications were used for the study. The unit of the study is individual, as data collected from each managerial employee in the garment sector in Malate District. Sample of the study was randomly selected 70 managerial employees in the apparel industry.

### 4.1 Conceptual Framework

A conceptual framework is one's beliefs on how certain variables or concepts are related to each other and an explanation of why those variables are associated with each other (Sekaran & Bougie, 2010).

The figure 4.1 shown below, described the relationship between Job design and Job performance. Following conceptual framework has developed based on the empirical evidence shown above and the purpose of the study is to examine the impact of job design on job performance.

Figure 4.1: Conceptual Framework



## 5. RESULTS AND DISCUSSION

### 5.1 Reliability Analysis

#### 5.1.1 Reliability of Job Design Questionnaire

To measure the reliability of the job design questionnaire inter item reliability test was used. Reliability level of job design measures are in range between 0.703 and 0.748. The table 5.1 shows the results of inter item reliability for each dimension of job design.

Table 5.1 – Cronbach Coefficient Alpha value for Job Design

Variables	Cronbach Coefficient Alpha	Number of Items
Skill variety	0.703	3
Task identity	0.724	3
Task significance	0.738	3
Feedback	0.747	3

#### 5.1.2 Reliability of Job Performance

Researcher has used inter item reliability test measure the consistency of the questionnaire. Cronbach alpha scores of job performance measures are 0.706 and 0.812. The table 5.2 shows the results of inter item reliability for each dimension of job performance.

Table 5.2 - Cronbach Coefficient Alpha value for Job Performance

Variables	Cronbach Coefficient Alpha	Number of Items
Task performance	0.706	7
Contextual performance	0.812	13

### 5.2 Demographic profile of the Respondents

Table 5.3 - Demographic profile of the Respondents

Gender	%	Educational Level	%
Male	53	G.C.E.A/L	67
Female	47	Diploma	18
	<b>100</b>	Degree	12
		Other	3
			<b>100</b>
Age	%		
Below 21	-		
21 – 30	69	Experience (Years)	%
31 - 40	23	Less than 1	15
41 – 50	8	Between 1 – 2	51
Above 51	-	Between 3 – 4	12
	<b>100</b>	More than 5	22
			<b>100</b>
Marital Status	%		
Single	51		
Married	49		
	<b>100</b>		

### 5.3 Descriptive statistics

Table 5.4: Descriptive statistics for Variables

	Mean	Std. Deviation
Skill Variety	3.5693	.58844
Task Identity	3.5946	.55744
Task Significance	3.2103	.61961
Feedback	3.5895	.53932
Job Performance	3.3094	.37831

Statistics revealed that, the Skill Variety, Task Identity and Feedback reported moderate mean scores as 3.5693, 3.5946 and 3.5895 respectively. Task Significance subscale reported slightly lower mean score as 3.2103. However, Task Significance cluster reported the highest standard deviation of .61961. The data shows that the mean value of Job Performance is 3.3094.

### 5.4 Correlation Analysis

Table 5.5 Results of Correlation Analysis

Variable	Correlation	Job Performance
Skill Variety	Pearson Correlation	.705**
	Sig. (1-tailed)	.000
Task Identity	Pearson Correlation	.644**
	Sig. (1-tailed)	.000
Task Significance	Pearson Correlation	.332**
	Sig. (1-tailed)	.004
Feedback	Pearson Correlation	.297**
	Sig. (1-tailed)	.008
Job design	Pearson Correlation	.758**
	Sig. (1-tailed)	.000

\*\* . Correlation is significant at the 0.01 level (1-tailed).

According to the data was reported in the above table, the Pearson correlation between Job Design and Job Performance was 0.758. It indicated that there was a strong positive relationship between Job Design and Job Performance. This relationship was statistically significant as the correlation was at 0.01 levels (1 –tailed). The associated significant value (p) is less than 0.05. Hence hypothesis can be accepted. These results explained that the Job Design is positively and significantly related to managerial employees Job Performance in apparel sector in Matala district.

According to the data was reported in the above table, correlation between Skill Variety and Job Performance was 0.705. It was indicated that two variables are positively correlated. It was statistically significant at 0.01 levels (1 –tailed). Table 5.5 indicated that the correlation between Task Identity and Job Performance was 0.644. It was indicated that two variables are positively correlated. It was statistically significant at 0.01 levels (1 –tailed). According to the data was reported in the above table, the Pearson correlation between Task Significance and Job Performance was 0.332. It indicated that there was a strong positive relationship between Task Significance and Job Performance. This relationship was statistically significant as the correlation was at 0.01 levels (1 –tailed). Correlation between Feedback and Job Performance was 0.297. It was indicated that two variables are positively correlated. It was statistically significant at 0.01 levels (1 –tailed), these results support the hypothesis of the study.

**5.5 Regression Analysis**

Table 5.6: Result of regression Analysis

Adj. R <sup>2</sup> = .618                      F Value = 21.630 Sig F = .000 <sup>a</sup>					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.812	.270		3.005	.004
Skill Variety	.305	.065	.474	4.702	.000
Task Identity	.214	.068	.315	3.164	.002
Task Significance	.071	.050	.117	1.436	.156
Feedback	.049	.062	.074	.788	.434

b. Predictors: (Constant), Skill Variety, Task Identity, Task Significance, Feedback

According to the table 5.6 R<sup>2</sup> value of .618 indicates that predictor variables (Skill variety, Task identity, Task significance and Feedback) for the test have ability to explain 61.8% variation of the dependent variable (Job Performance). According to the above table F value of 21.630 was significant at 0.000 (p = 0.001), researcher assume that linear relationship between the independent and dependent variable is not violated.

The major purpose of the study was to explore the impact of Job Design on Job Performance of managerial employees in apparel sector in Matala district. For the purpose of this study, the researcher hypothesized that there will be a positive and significant correlation between managerial employees as mentioned in the theoretical framework.

By considering the hypothesis one, the results indicated there is a significant positive relationship between Job Design and Job Performance. This finding empirically confirms the theoretical arguments given by (Ambrose, Geoffrey, Nehemiah & Augustine, 2013; Ivancevich, 1998; Al-Ahmadi, 2009; Garg&Rastogi, 2006; Aswathappa, 2006; Ali & Rehman, 2014; Campion et al., 2005)

**6. CONCLUSION AND RECOMMENDATION**

**6.1 Conclusion**

Main objective of this research was to examine the impact of job design and job performance. According to the research findings job design positively affected on job performance of the managers. The correlation analysis denotes that there is a significant positive relationship between job design and job performance(r = 0.758).

The second objective of this research was to examine the impact of each dimension of job design on job performance. The four dimensions comprised in job design were the skill variety, task identity, task significance and feedback. According to the results obtained from the calculations, effect of each dimension can be identified as follows.

There is a significant positive relationship between Skill Variety and Job Performance (r = 0.705), Task Identity and Job Performance (r = 0.644), The correlation analysis denotes that there is a weak positive relationship between Task Significance and Job Performance (r = 0.332), Feedback and Job Performance (r = 0.297). Therefore correlation analysis result has been accepted research hypothesis.

That means, most of the managerial employees job performance depends on their job designs. Based on the major findings related to two objectives of the thesis, it can come to the conclusion that managerial employees job performance depends on their job design.

## 6.2 Recommendation

Above results of the research verify that the job design significantly and positively affected on job performance of managerial employees in apparel sector. According to the results four dimensions of job design have shown positive impact on job performance of the managerial employees, up to the satisfactory level. Anyway, more steps can be taken to motivate the employees to be more satisfied with their jobs. Mainly, managerial employees should give the opportunity to actively participate in decision making. They should give the full responsibility. It really helps to enhance their self-confidence and to widen their capacity. Therefore their job performance will be significantly increased. In order to increase job performance of managerial employees, task identity and job feedback should be taken into consideration. Task identity could be formed through task combining and natural work units forming. Job should be designed identifying similar tasks to increase task identity. Giving feedback to the employees in order to acquiring knowledge and self-performance evaluation is much important. Company can organize different kind of functions, teamwork and competitions for increase the co-worker relationship and if there is a better co-worker relationship company can increase the job satisfaction of the employees, subsequently the job performance. According to that result researcher can conclude good job design may reason to increase job performance of respondents. The researcher has selected four dimensions to measure the job design. According to the research findings mean value of skill variety, task identity, task significance, and feedback indicate high.

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# Relationships The Role of Posyandu Sanitation in Improving Wasting Toddler's Mother Activity (In The Working Area of Liang Anggang Health Care, Landasan Ulin Barat Sub-District, Banjarbaru City)

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**Abstract-** Wasting is a malnourished group, directly caused by inadequate nutrition and poor sanitation. The results of the Riskesdas 2018 states that the prevalence of very thin children under five years of age in 2018 is still quite high, namely 3.5 percent, there is a decrease compared to 2013 (5.3%) and 2007 (6.2%). Banjarbaru City is one of the areas that has experienced an increase in cases of very thin and wasting nutrition for three consecutive years. According to the Banjarbaru City Health Office, the highest cases were in the Liang Anggang Health Care area, which was 35 percent, of which 33 percent were in the underweight category and 2 percent for the very thin category. This study aims to determine whether there is a relationship between the Role of Sanitation Posyandu in Increasing the Activity of Baduta Wasting's Mother (In the Working Area of Liang Anggang Health Care, Banjarbaru City). The research design used was cross-sectional with a population of 270 people and using random sample sampling. The results of the pretest and posttest for the knowledge variable in activities 1, 2, 3 and 4 with the Asymp Sig. <0.05  $H_0$  is rejected, meaning that there is a difference between the pretest and posttest on the knowledge variable. Whereas in the pretest and posttest results for the attitude variable in activities 3 and 4 with the Asymp Sig.  $\geq 0.05$   $H_0$  is accepted, it means that there is no difference between the pretest and posttest on the attitude variable. There is a need for cooperation with all parties as well as providing education to mothers of toddlers about wasting and sanitation posyandu.

**Index Terms-** Sanitation Posyandu, Toddlers, Wasting.

## I. INTRODUCTION

Child nutrition problems occur because of the wrong parenting styles of parents in choosing the food that is given to their children for consumption, which can lead to nutritional problems and lack of hygienic sanitation in children. As a result, children can suffer from chronic diseases, excess and underweight, pica, dental caries and certain food allergies that often occur in children (1).

Growth in toddlers can be monitored by weighing the child every month by the mother of baduta. The activity of the mother baduta in monitoring the growth of children under five which is carried out every month is very necessary in supporting her growth and development, especially regarding the condition of her sanitation and actively participating in the sanitation posyandu. The data shows that the percentage of children aged 6-59 months who have not been weighed in the last six months tends to increase from 25.5% (2007), 23.8% (2010) to 34.3% (2013) and in 2018 8.3 % but wasting data increased (2,3).

Wasting is a malnourished group, directly caused by inadequate nutrition and poor sanitation. The results of research conducted by Olofin et al. (2013) stated that losing significantly has a strong relationship with the increase in mortality rates in children under five (4).

The results of the Riskesdas 2018 stated that the prevalence of very thin under five children nationally in 2018 was still quite high, namely 3.5 percent, there was a decrease compared to 2013 (5.3%) and 2007 (6.2%). Likewise, the prevalence of wasting of 6.7 percent also shows a decrease from 6.8 percent in 2010 and 7.4 percent in 2007. South Kalimantan Province is one of the provinces where the prevalence of wasting is above the national rate, where in 2013 the prevalence is 12.8 percent and increased in 2018 to 13.2 percent (Riskesdas, 2018). Based on this prevalence rate, the Indonesian Ministry of Health makes long-term targets that are in line with the SDGs goals and targets. The target is to reduce the incidence prevalence rate by 40% in 2019 so that by 2019 the wasting prevalence rate will decrease to 9.5%. Meanwhile, by 2025, the prevalence of wasting is expected to decrease to less than 5% (2,3).

Banjarbaru City is one of the areas that has experienced an increase in cases of very thin and wasting nutrition for three consecutive years. In 2017, the percentage of baduta with underweight and very thin nutrition was 16.7 percent, in 2016 the percentage was smaller, namely 15.5 percent, but in 2015 it was 23.8 percent higher. Riskesdas data for 2018 cases of wasting were 10.98% and still high. According to the Banjarbaru City Health Office, the highest cases were in the Liang Anggang

Health Care area, which was 35 percent, of which 33 percent for the thin category and 2 percent for the very thin category, this data was taken from the sub-district only, namely West Landasan Ulin. The percentage of the incidence of wasting has increased from the previous year, where in 2016 the village was recorded at 9 percent. The thin category was 3 percent and very thin as much as 6 percent (5).

The sanitation posyandu activities are intended to help improve the health status of children under five through counseling and intervention in the provision of clean water, disposal of waste water that meets health requirements, disposal of household waste, absence of provision of food control facilities, and provision of housing facilities that meet health requirements.

## II. RESEARCH METHOD

The research design used was cross-sectional. Population is an area in general consisting of objects or subjects that are determined by the researcher to study and then draw conclusions. The population in this study were all children under five in the Liang Anggang Public Health Center, Banjarbaru City. The sample of this study was 35 children under five in the Liang Anggang Public Health Center, Banjarbaru City.

## III. FINDINGS

**Table 1. Distribution and Frequency of Age Toddlers in Liang Anggang Health Care**

Category	Frequency	Percent (%)
< 12 Month	12	34.3
12-36 Month	15	42.9
37-60 Month	8	22.9
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 2. Distribution and Frequency of Gender Toddlers in Liang Anggang Health Care**

Category	Frequency	Percent (%)
Boys	18	51.4
Girls	17	48.6
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 3. Distribution and Frequency of Nutritional Status Toddlers in Liang Anggang Health Care**

Category	Frequency	Percent (%)
Wasting	10	28.6
Normal	13	37.1
Gemuk	2	5.7
Obesitas	10	28.6

**Table 9. Distribution and Frequency Knowledge Score of Toddler's Mother in Liang Anggang Health Care**

Category	Activities 1		Activities 2		Activities 3		Activities 4	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Not Good	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Good	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Consistently (No increase)

Number of Respondents 35 Respondents

**Table 10. Distribution and Frequency Attitude Score of Toddler's Mother in Liang Anggang Health Care**

Category	Activities 1		Activities 2		Activities 3		Activities 4	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test

Total	35	100.0
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**Table 4. Distribution and Frequency Type of Work Toddler's Father in Liang Anggang Health Care**

Category	Frequency	Percent (%)
Buruh	6	28.8
Honoror	1	2.9
Karyawan swasta	10	28.6
Sopir	2	5.8
TNI	4	11.5
Wiraswasta	8	22.8
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 5. Distribution and Frequency Education Toddler's Father in Liang Anggang Health Care**

Category	Frequency	Percent (%)
S1/D4	1	2.9
SMA/MA	20	57.1
SMP/MTs	7	20.0
SD/MI	7	20.0
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 6. Distribution and Frequency Type of Work Toddler's Mother in Liang Anggang Health Care**

Kategori	Frekuensi	Persen (%)
Dosen	1	2.9
Ibu Rumah Tangga	30	85.7
Karyawan Swasta	1	2.9
PNS	1	2.9
Swasta	1	2.9
Wirausaha	1	2.9
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 7. Distribution and Frequency Education Toddler's Mother in Liang Anggang Health Care**

Kategori	Frekuensi	Persen (%)
S2	1	2.9
S1/D4	1	2.9
D3	2	5.7
SMA/MA	21	60.0
SMP/MTs	6	17.1
SD/MI	4	11.4
<b>Total</b>	<b>35</b>	<b>100.0</b>

**Table 8. Distribution and Frequency Family Income of Toddler's Family per Month in Liang Anggang Health Care**

Kategori	Frekuensi	Persen (%)
≤ 3.000.000	24	68.6
> 3.000.000	11	31.4
<b>Total</b>	<b>35</b>	<b>100.0</b>

Not Good	2,9 %	2,9 %	2,9 %	2,9 %	0 %	0 %	2,9 %	0 %
Good	97,1 %	97,1 %	97,1 %	97,1 %	100 %	100 %	97,1 %	100 %
	Consistently		Consistently		Consistently		Increase (2,9 %)	

**Number of Respondents** 35 Respondents

**Table 11. Distribution and Frequency Infrastructure and Health Related Information**

No.	Questions	Answer	
		Yes	No
1	Around your house there are health facilities such as health centers / health care / clinics / hospitals	30 respondents (85,71 %)	5 respondents (14,29 %)
2	Around your house there is a posyandu program	35 respondents (100%)	0 respondent (0%)
3	You get health information and education related to environmental health issues	35 respondents (100%)	0 respondent (0%)
4	You often use health facilities for your children	35 respondents (100%)	0 respondent (0%)
5	Officers from health facilities are always actively	32 respondents (91,43 %)	3 respondents (8,57 %)

No.	Questions	Answer	
		Yes	No
	reminding you to go and take advantage of health facilities in health care centers, especially for toddlers		

**Table 12. Family Support for Mother Toddlers in Liang Anggang Health Care**

No.	Questions	Answer	
		Yes	No
1	Did your family tell you how to prevent losing	27 respondents (77,14 %)	8 respondents (22,86 %)
2	The family explains to you to always keep the house clean	34 respondents (97,14%)	1 respondent (2,86 %)
3	The family always keeps the house clean	35 respondents (100%)	0 respondent (0%)
4	Families always remind to wash cooking utensils at home	35 respondents (100%)	0 respondent (0%)
5	The family always boils water before consumption	35 respondents (100%)	0 respondent (0%)

**Table 13. Results of the Pretest and Posttest Wilcoxon Signed Ranks Test on Knowledge and Attitudes of Toddler Mothers at Liang Anggang Health Center**

	N	Mean Rank	Sum of Ranks
<b>Skor_Postest_P_1 - Skor_Prestest_P_1</b>	Negative Ranks	1 <sup>a</sup>	15.50
	Positive Ranks	26 <sup>b</sup>	362.50
	Ties	8 <sup>c</sup>	
	Total	35	
<b>Skor_Postest_P_2 - Skor_Prestest_P_2</b>	Negative Ranks	0 <sup>d</sup>	.00
	Positive Ranks	27 <sup>e</sup>	378.00
	Ties	8 <sup>f</sup>	
	Total	35	
<b>Skor_Postest_P_3 - Skor_Prestest_P_3</b>	Negative Ranks	6 <sup>g</sup>	88.00
	Positive Ranks	20 <sup>h</sup>	263.00
	Ties	9 <sup>i</sup>	
	Total	35	
<b>Skor_Postest_P_4 - Skor_Prestest_P_4</b>	Negative Ranks	0 <sup>j</sup>	.00
	Positive Ranks	18 <sup>k</sup>	171.00
	Ties	17 <sup>l</sup>	

	Total	35		
<b>Skor_Postest_S_1 - Skor_Prestest_S_1</b>	Negative Ranks	0 <sup>m</sup>	.00	.00
	Positive Ranks	8 <sup>n</sup>	4.50	36.00
	Ties	27 <sup>o</sup>		
	Total	35		
<b>Skor_Postest_S_2 - Skor_Prestest_S_2</b>	Negative Ranks	0 <sup>p</sup>	.00	.00
	Positive Ranks	5 <sup>q</sup>	3.00	15.00
	Ties	30 <sup>r</sup>		
	Total	35		
<b>Skor_Postest_S_3 - Skor_Prestest_S_3</b>	Negative Ranks	0 <sup>s</sup>	.00	.00
	Positive Ranks	2 <sup>t</sup>	1.50	3.00
	Ties	33 <sup>u</sup>		
	Total	35		
<b>Skor_Postest_S_4 - Skor_Prestest_S_4</b>	Negative Ranks	0 <sup>v</sup>	.00	.00
	Positive Ranks	1 <sup>w</sup>	1.00	1.00
	Ties	34 <sup>x</sup>		
	Total	35		
a. Skor_Postest_P_1 < Skor_Prestest_P_1				
b. Skor_Postest_P_1 > Skor_Prestest_P_1				
c. Skor_Postest_P_1 = Skor_Prestest_P_1				
d. Skor_Postest_P_2 < Skor_Prestest_P_2				
e. Skor_Postest_P_2 > Skor_Prestest_P_2				
f. Skor_Postest_P_2 = Skor_Prestest_P_2				
g. Skor_Postest_P_3 < Skor_Prestest_P_3				
h. Skor_Postest_P_3 > Skor_Prestest_P_3				
i. Skor_Postest_P_3 = Skor_Prestest_P_3				
j. Skor_Postest_P_4 < Skor_Prestest_P_4				
k. Skor_Postest_P_4 > Skor_Prestest_P_4				
l. Skor_Postest_P_4 = Skor_Prestest_P_4				
m. Skor_Postest_S_1 < Skor_Prestest_S_1				
n. Skor_Postest_S_1 > Skor_Prestest_S_1				
o. Skor_Postest_S_1 = Skor_Prestest_S_1				
p. Skor_Postest_S_2 < Skor_Prestest_S_2				
q. Skor_Postest_S_2 > Skor_Prestest_S_2				
r. Skor_Postest_S_2 = Skor_Prestest_S_2				
s. Skor_Postest_S_3 < Skor_Prestest_S_3				
t. Skor_Postest_S_3 > Skor_Prestest_S_3				
u. Skor_Postest_S_3 = Skor_Prestest_S_3				
v. Skor_Postest_S_4 < Skor_Prestest_S_4				
w. Skor_Postest_S_4 > Skor_Prestest_S_4				
x. Skor_Postest_S_4 = Skor_Prestest_S_4				

**Table 14. Results of Pretest and Posttest Statistical Tests on Knowledge and Attitudes of Under-Five Mothers at Liang Anggang Health Center**

**Test Statistics<sup>a</sup>**

	Skor_Postest_P_1 - Skor_Prestest_P_1	Skor_Postest_P_2 - Skor_Prestest_P_2	Skor_Postest_P_3 - Skor_Prestest_P_3	Skor_Postest_P_4 - Skor_Prestest_P_4	Skor_Postest_S_1 - Skor_Prestest_S_1	Skor_Postest_S_2 - Skor_Prestest_S_2	Skor_Postest_S_3 - Skor_Prestest_S_3	Skor_Postest_S_4 - Skor_Prestest_S_4
Z	-4.284 <sup>b</sup>	-4.597 <sup>b</sup>	-2.254 <sup>b</sup>	-3.862 <sup>b</sup>	-2.828 <sup>b</sup>	-2.236 <sup>b</sup>	-1.414 <sup>b</sup>	-1.000 <sup>b</sup>
Asymp. Sig. (2-tailed)	.000	.000	.024	.000	.005	.025	.157	.317

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

From the table above shows that the results of the pretest and posttest for knowledge variables in activities 1, 2, 3 and 4 with the Asymp Sig.  $<0.05$   $H_0$  is rejected, meaning that there is a difference between the pretest and posttest on the knowledge variable. In the pretest and posttest results for the attitude variable in activities 1 and 2 with the Asymp Sig.  $<0.05$   $H_0$  is rejected, it means that there is a difference between the pretest and posttest on the attitude variable. Whereas in the pretest and posttest results for the attitude variable in activities 3 and 4 with the Asymp Sig.  $\geq 0.05$   $H_0$  is accepted, it means that there is no difference between pretest and posttest on the attitude variable.

#### IV. DISCUSSION

##### 1. Difference of Pre-Test and Post-Test Knowledge

Based on the results of data analysis, it shows that there is a difference between the knowledge before being given the material and after being given the material. This is in line with Himawaty's research in 2020 which shows that there is an increase in knowledge about providing nutritious food and the incidence of stunting in toddlers. Comparative analysis of the pre-test before the implementation of socialization and the post-test after the implementation of socialization using the Wilcoxon signed rank test, the significance of the increase in maternal knowledge was 0.005 ( $p < 0.05$ ) with a confidence level of  $\alpha = 0.05$ , which means that there is a significant difference between mother's knowledge during the pre-test and post-test (28).

According to Notoatmodjo in 2010, said that one of the factors that influence a person's behavior is knowledge, because knowledge will result in changes or increased knowledge. The better the level of knowledge, the better insight or information about posyandu and mothers are also more active in posyandu activities (23). Factors that affect a person's knowledge according to Wawan and Dewi in 2010 suggest that a person's knowledge is influenced by several factors, including internal factors, education, occupation, age and external factors, environmental and socio-cultural (24).

##### 2. Difference of Pre-Test and Post-Test Attitude

Based on the results of the data analysis, there was a difference between the attitudes before being given the material and after being given the material in activities 1 and 2. Whereas in activities 3 and 4 there was no difference between the attitudes before being given the material and after being given the material. This is in line with the research of Suryagustina et al. In 2018 that there is a difference between attitudes before (pre-test) and after (post-test) being given health education (29).

Attitude according to Notoatmodjo in 2010 is a reaction or response of someone who is still closed to a stimulus or object (25). According to Sunaryo in 2004, there are two factors that influence the formation and change of attitudes, namely internal factors that come from the individual himself and external factors that come from outside the individual in the form of stimuli to change and shape attitudes.

#### V. CONCLUSION

The results of the pretest and posttest for the knowledge variable in activities 1, 2, 3 and 4 with the Asymp Sig.  $<0.05$   $H_0$  is rejected, meaning that there is a difference between the pretest and posttest on the knowledge variable. Whereas in the pretest and posttest results for the attitude

variable in activities 3 and 4 with the Asymp Sig.  $\geq 0.05$   $H_0$  is accepted, it means that there is no difference between pretest and posttest on the attitude variable. There is a need for cooperation with all parties as well as providing education to mothers of toddlers about wasting and sanitation posyandu.

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# The Effect of The Implementation of The Key Environmental Health System With The Event of Dengue Hemorrhagic Fever (DHF)

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**Abstract-** Dengue Hemorrhagic Fever (DHF) is one of the major public health problems around the world. Malaria is still endemic in certain areas, especially in tropical countries such as Asia and Africa. This disease is also one of the biggest killers, 86% of deaths occurred in groups with high risk factors such as infants, children under five and pregnant women. The purpose of this study was to assess environmental management of the incidence of DHF in Banjar Regency, South Kalimantan.

**Index Terms-** *Dengue Hemorrhagic Fever (DHF), Environmental Health, Banjarbaru*

## I. INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is one of the major public health problems around the world. Malaria is still endemic in certain areas, especially in tropical countries such as Asia and Africa. This disease is also one of the biggest killers, 86% of deaths occurred in groups with high risk factors such as infants, children under five and pregnant women (Kemenkes RI, 2011).

Children under 5 years and pregnant women are the most affected population groups. Dengue Hemorrhagic Fever (DHF) can cause serious disorders and anemia in pregnancy which can cause maternal death, low birth weight (LBW) which is a risk factor for infant mortality. Besides death, Dengue Hemorrhagic Fever (DHF) causes pain such as fever, weakness, malnutrition, anemia, abnormalities in the spleen, and susceptibility to other diseases. According to Bremen in Pattanayak (2003), people with dengue hemorrhagic fever (DHF) experience asymptomatic parasitemia, acute fever, chronic debility, and complications in pregnancy.

According to WHO reports, around 250 million new cases of Dengue Hemorrhagic Fever (DHF) are found every year with nearly 880,000 death cases. The incidence of Dengue

Hemorrhagic Fever (DHF) throughout Indonesia tends to decrease from 4.10% (in 2005) to 1.38% (in 2013), but has not reached the target yet that set at 1.25%. In addition to the progress that has been made, there are still many obstacles that must be faced, including the access to services in remote areas, considered as neglected diseases, epidemiological disparities, management weaknesses, especially limited in competent resources, inadequate funding, weak cross-sectoral cooperation and community independence in controlling Hemorrhagic DHF (DHF).

DHF in Indonesia tends to increase the number of sufferers and is increasingly widespread. In 1968 the disease was only infected in Jakarta and Surabaya. Twenty years later, DHF has plagued 2011 Dati II throughout Indonesia. The increase in the number of sufferers occurs periodically every 5 years. The last extraordinary incident was in 1988 with the number of patients hospitalized for 47,573 people, with the number who died was 1,527 (CFR 3.2%). Initially it was thought that DHF only occurs in urban areas but it this assumption is wrong, because now it is found in many rural areas.

There are 424 districts in Indonesia that are endemic to Dengue Hemorrhagic Fever (DHF) from 576 existing districts, it is estimated that 45% of Indonesia's population is at risk of contracting Dengue Hemorrhagic Fever (DHF). The number in 2009 was 1,143,024 clinical Dengue Hemorrhagic Fever (DHF), 200,000 were examined with confirmation. This number may be smaller than the actual situation because malaria endemic locations are remote villages with difficult transportation facilities and low access to health services (Kemenkes RI, 2010).

Based on the data, if compared to 2016, the trend of dengue cases has decreased. Because, in January 2016, there were 1,890 cases of DHF in South Kalimantan, which took 14 people dead. Then, February 2017 there were 1,358 cases with 5 fatalities. It was recorded that until early April 2016, the number of dengue cases that occurred had reached 3,359 cases, with the death toll increasing to 22 people.

The number of DHF sufferers rose sharply by 1,350 cases when it is compared to the previous month. The areas where DHF are most affected include Banjarbaru, Banjar Regency, Tabalong, Tanah Bumbu, Hulu Sungai Selatan, and Hulu Sungai Tengah. In 2015, the number of dengue cases was 3,668 with the deaths case reaching 40 people. Apart from DHF, South Kalimantan is also an area prone to malaria attacks. The Health Office of South Kalimantan noted that there were 155 villages and sub-districts or about 10 percent of the number of villages / kelurahan prone to or in the red category of malaria.

Increased attack Dengue Hemorrhagic Fever (DHF) in South Kalimantan it is quite confusing to the public, the problem is this region constantly taking control of contagious diseases even spent a billion rupiah to eradicate the contagious diseases. Another confusion grew again after seeing the attack of Dengue Hemorrhagic Fever (DHF) now it is not only in rural communities but is spreading in urban areas. A comprehensive approach to the incidence of DHF in South Kalimantan, especially in Banjarbaru needs to pay attention to aspects of the physical environment, social environment and aspects of management consisting of programs or policies, regulations, technical operations and public awareness as an effort to reduce the incidence of DHF.

## II. RESEARCH METHOD

### Research design

This research is an observational study with a case control study design, while the type is explanatory that is to explain the causal relationship between variables through hypothesis testing and by using a survey method, when the researcher takes a sample from population data and uses a questionnaire as a tool for collecting the data through on line.

### Population and Sample

The population in this study were the people of Banjar Regency which were spread over 19 Districts, There are Aluh-Aluh District, Beruntung Baru District, Gambut District, Kertak Hanyar District, Tatah Makmur District, Sungai Tabuk District, Martapura Barat District, Martapura Timur District, Martapura Kota District, Karang Intan District, Astambul District, Mataraman District, Simpang Empat District, Pangaron District, Sambung Makmur District, District Sungai Pinang, Telaga Bauntung District, Aranio District, and Peramasan District. 19 districts details are divided into 284 kelurahan / villages. The smallest population unit is the households (KK). The number of households in Banjar Regency is 170,859 households (KK), with a total population of 542,204 people.

The sample of this study were households in endemic areas, non-endemic areas and officers who handled DHF prevention at the Banjar District Health Office. The minimum sample size is calculated based on the formula:

$$n = N Z^2 p (1-p) / N d^2 + z^2 p (1 - p)$$

Information :

n = Sample size

N = population size

Z = Standard Value (1.96 =  $\alpha$  = 5%)

d = the deviation that can be tolerated (0.1)

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P = probability of an event (0.5)

By using this formula, the sample size is 96 samples.

### Research variable

The independent variable in this study is a variable density of inhabitants, humidity, breeding places, resting places, the presence of larvae, the habit of draining the landfill, the habit of closing the landfill tightly, the habit of getting rid or recycling used items, putting up wire netting, the habit of hanging clothes, the habit of sleeping using mosquito nets, the habit of using anti mosquitoes, napping habits, yard cleaning habits, and environmental management. Meanwhile, the dependent variable in this study was the incidence of DHF.

### Research Tools and Data Collection Methods

The tools and materials used in this study were stationery, computers to process data, and questionnaire sheets. The questionnaire is a list of questions arranged in a structured manner based on the variables studied. The data collected is secondary data by conducting a document study / archive of routine Puskesmas reports in the working area of the Banjar District Health Office. Meanwhile, primary data is obtained by means of observation / observation.

Interviewers who have been trained to take measurements using a questionnaire to determine habits and a hygrometer to measure temperature and humidity against the condition of the respondent's house by visiting each respondent's house and also by making observations or observations. Interviewers who have been trained to take measurements using a questionnaire to determine habits and a hygrometer to measure temperature and humidity against the condition of the respondent's house by visiting each respondent's house and also by making observations or observations on line and through health center officers.

### Data Processing and Analysis Techniques

Existing data were analyzed using:

1. Univariate analysis to determine the description of the research variables.
2. Bivariate analysis to determine the significance of the relationship (P) and the amount of risk (OR) as well as to select the variables to be analyzed Multivariate (P <0.05).

## III. FINDINGS

### A. Univariate Analysis

This analysis aims to obtain an overview of the frequency distribution data for each variable, there are the dependent variable (incidence of DHF) and the independent variable (occupancy density, humidity, breeding places, resting places, the presence of larvae, habit of draining the landfill, habit of closing the landfill, habit of getting rid or recycling used items, putting gauze, hanging clothes, sleeping using mosquito nets, using mosquito repellent habits, napping habits, cleaning the yard, and environmental management). The description of the independent and dependent variables is as follows:

1. **Distribution of the frequency of DHF incidence and the characteristics of respondents and the variables in Banjar Regency**

DHF incidence	Frequency (Person)	Percentage (%)
Yes	30	100
Not	0	0
<b>amount</b>	<b>30</b>	<b>100</b>

Age	Frequency (Person)	Percentage (%)
10-15	3	10
16-20	2	6.6
21-25	6	20
26-30	2	6.6
31-35	7	23.3
36-40	5	16.7
41-45	4	13.4
46-50	1	3.3
<b>amount</b>	<b>30</b>	<b>100</b>

Profession	Frequency (Person)	Percentage (%)
Housewife	10	33.3
Civil servants	3	10
Student	6	20
College student	2	6.7
General employees	3	10
Entrepreneur	6	20
<b>amount</b>	<b>30</b>	<b>100</b>

Occupancy Density	Frequency (Person)	Percentage (%)
Qualify	25	83.3
Not qualify	5	16.7
<b>Amount</b>	<b>30</b>	<b>100</b>

Humidity	Frequency (Person)	Percentage (%)
Moist	5	16.7
Not Moist	25	83.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Missing Mosquitoes	Frequency (Person)	Percentage (%)
Yes	26	86.7
Not	4	13.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Mosquito Rest	Frequency (Person)	Percentage (%)
Yes	27	90
Not	3	10
<b>Amount</b>	<b>30</b>	<b>100</b>

The existence of larva	Frequency (Person)	Percentage (%)
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The existence of larva	Frequency (Person)	Percentage (%)
Yes	22	73.3
Not	8	26.7
<b>Amount</b>	<b>30</b>	<b>100</b>

The habit of draining the landfill	Frequency (Person)	Percentage (%)
Yes	26	86.7
Not	4	13.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Habit of Closing TPA Meetings	Frequency (Person)	Percentage (%)
Yes	26	86.7
Not	4	13.3
<b>Amount</b>	<b>30</b>	<b>100</b>

The habit of getting rid of / recycling used goods	Frequency (Person)	Percentage (%)
Yes	11	36.7
Not	19	63.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Installing Wire Mesh	Frequency (Person)	Percentage (%)
Yes	16	53.3
Not	14	46.7
<b>Amount</b>	<b>30</b>	<b>100</b>

Hanging clothes	Frequency (Person)	Percentage (%)
Yes	26	86.7
Not	4	13.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Sleeping Habits Using a Mosquito Net	Frequency (Person)	Percentage (%)
Yes	14	46.7
Not	16	53.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Habit of Using Anti Mosquito Drugs	Frequency (Person)	Percentage (%)
Yes	29	96.7
Not	1	3.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Nap Habits	Frequency (Person)	Percentage (%)
Yes	20	66.7

Nap Habits	Frequency (Person)	Percentage (%)
Not	10	33.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Page Cleaning Habits	Frequency (Person)	Percentage (%)
Yes	23	76.7
Not	7	23.3
<b>Amount</b>	<b>30</b>	<b>100</b>

Environmental Management	Frequency (Number of Selects)	Percentage (%)
Fogging	18	40
Extension	6	13.3
Larva Inquiry	7	15.6
Giving Abate Powder	11	24.4
There is no	3	6,7
<b>Amount</b>	<b>45</b>	<b>100</b>

### B. Bivariate Analysis

This analysis is needed to examine the relationship of the dependent variable, there are the incidence of DHF with each of the independent variables, namely occupancy density, humidity, breeding places, resting places, the presence of larvae, the habit of draining the landfill, the habit of closing the landfill, the habit of getting rid of or recycling used goods, putting gauze, the habit of hanging clothes, the habit of sleeping using a mosquito net, the habit of using mosquito repellent, the habit of taking a nap, the habit of cleaning the yard, and environmental management.

#### 1. The relationship between the incidence of DHF and the variables

DHF incidence	Occupancy Density				Total		<i>p-value</i>
	Qualify		Not eligible		N	%	
	n	%	n	%			
Yes	14	93.3	1	6,7	15	100	0.330
Not	11	73.3	4	26.7	15	100	

DHF incidence	Moisture				Total		<i>p-value</i>
	Moist		Not Moist		N	%	
	n	%	n	%			
Yes	1	6,7	14	93.3	15	100	0.330
Not	4	26.7	11	73.3	15	100	

DHF incidence	Missing Mosquitoes				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	13	86.7	2	13.3	15	100	1,000
Not	13	86.7	2	13.3	15	100	

DHF incidence	Mosquito Rest		Total		<i>p-value</i>		
	Yes	Not	N	%			
	n	%					
Yes	14	93.3	1	6,7	15	100	1,000
Not	1	6,7	14	93.3	15	100	

	N		%		N		%		<i>p-value</i>
	n	%	n	%	N	%			
Yes	15	100	0	0	15	100	0.224		
Not	12	80	3	20	15	100			

DHF incidence	The existence of larva				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	11	73.3	4	26.7	15	100	1,000
Not	11	73.3	4	26.7	15	100	

DHF incidence	The habit of draining the landfill				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	13	86.7	2	13.3	15	100	0.651
Not	11	73.3	4	26.7	15	100	

DHF incidence	Habits of Closing the landfill				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	13	86.7	2	13.3	15	100	0.651
Not	11	73.3	4	26.7	15	100	

DHF incidence	The habit of getting rid of / recycling used goods				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	6	40	9	60	15	100	0.705
Not	5	33.3	10	66.7	15	100	

DHF incidence	Installing Steel Wire				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	8	53.3	7	46.7	15	100	1,000
Not	8	53.3	7	46.7	15	100	

DHF incidence	The Habit Of Hanging Clothes				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	13	86.7	2	13.3	15	100	1,000
Not	13	86.7	2	13.3	15	100	

DHF incidence	Sleeping Habits Using a Mosquito Net				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	7	46.7	8	53.3	15	100	1,000
Not	7	46.7	8	53.3	15	100	

DHF incidence	Habit of Using Anti Mosquito Drugs				Total		<i>p-value</i>
	Yes		Not		N	%	
	n	%	n	%			
Yes	14	93.3	1	6,7	15	100	1,000
Not	1	6,7	14	93.3	15	100	

<b>Not</b>	<b>15</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>15</b>	<b>100</b>
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DHF incidence	Nap Habits				Total		p-value
	Yes		Not		N	%	
	n	%	n	%			
Yes	9	60	6	40	15	100	0.439
Not	11	73.3	4	26.7	15	100	

DHF incidence	Home Page Cleaning Habit				Total		p-value
	Yes		Not		N	%	
	n	%	n	%			
Yes	11	73.3	4	26.7	15	100	1,000
Not	12	80	3	20	15	100	

#### IV. CONCLUSION

Based on the results of research that has been conducted in the Banjar Regency area on "The Effect of Key Environmental Health Systems with the Incidence of Dengue Hemorrhagic Fever (DHF)" it can be concluded that:

1. There is no relationship between the incidence of DHF and occupancy density (p-value: 0.330)
2. There is no relationship between the incidence of DHF and humidity (p-value: 0.330)
3. There is no relationship between the incidence of DHF and mosquito breeding sites (p-value: 1,000)
4. There is no relationship between the incidence of DHF and mosquito resting places (p-value: 0.224)
5. There is no relationship between the incidence of DHF and the presence of larvae (p-value: 1,000)
6. There is no relationship between the incidence of DHF and the habit of draining the landfill (p-value: 0.651)
7. There is no relationship between the incidence of DHF and the habit of closing TPA (p-value: 0.651)
8. There is no relationship between the incidence of DHF with the habit of getting rid of or recycling used goods (p-value: 0.705)
9. There is no relationship between the incidence of DHF and installing wire mesh (p-value: 1,000)
10. There is no relationship between the incidence of DHF and the habit of hanging clothes (p-value: 1,000)
11. There is no relationship between the incidence of DHF and the habit of sleeping using a mosquito net (p-value: 1,000)
12. There is no relationship between the incidence of DHF and the habit of using mosquito repellent (p-value: 1,000)
13. There is no relationship between the incidence of DHF and napping habits (p-value: 0.439)
14. There is no relationship between the incidence of DHF and the habit of cleaning the house yard (p-value: 1,000)

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# Improving the Community Participation in Safe Management of Disinfectant and Plastic Waste During the Covid 19 Pandemic in Banjarbaru

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**Abstract-** Covid-19 prevention and controlling with the behavior of wearing masks continuously during activities outside of home and reinforced by healthy living behavior (PHBS) before and after activities outside of home. This activity has started in early April 2020 until now. With 262,719 population of Banjarbaru, It is estimated that the volume of mask waste every day is 44,072,745 kg / day. While in every month is 1,322,182.35 kg / month. Then another problem is the use of hand washing soap with 1 to 2 ml, that usage of that about 6 ml every day, and daily is 25,823,874 ml. The strategy used in this program is the ABG community approach (Advocacy, Community Development and Community Movement). Activities through the Whatsapp Group containing participants of the Kemuning Village, Banjarbaru. The media used in socialization are booklets and leaflets that are delivered to participants. The pre-post test results of 20 people had an increase in knowledge which increased from 5.45 to 8.55.

**Index Terms-** Covid-19, solid waste, liquid waste.

## I. INTRODUCTION

The SARS-CoV-2 (COVID-19) virus pandemic, which was first discovered in the Chinese city of Wuhan at the end of 2019, now has spread to 210 countries and 2 international cruise ships. Reported positive cases of the corona virus in the world, have infected around 3.4 million people with the death of nearly 240 thousand people and it is predicted that this number will continue to grow (Worldometer, 2020).

In Indonesia, the corona virus was found that have started to spread in early March 2020 and currently there have been 10,551 positive cases with the death of 800 people (Worldometer, 2020). The corona virus spreads through droplets of positive people's fluids when coughing or sneezing and this corona virus can last up to 9 days on the surface of objects. That explained how the corona virus can quickly spread. Many efforts that have been made by the government to decrease the spread of the corona virus, for an example is social distancing

Covid-19 prevention and control activities with the behavior of wearing masks continuously during activities outside of home and reinforced by healthy living behavior (PHBS) before and after activities outside of home. This activity has started in early April 2020 until now. It is assumed that the weight of 1 medical mask is 3.2 grams, with a population of Banjarbaru that is 262,719 people, the estimated volume of mask waste every day is 44,072,745 kg / day. And every month is 1,322,182.35 kg / month.

Then another problem is the use of hand washing soap with different chemical content with 90% surfactant content. With 1 to 2 ml usage of 1 to 2 ml and daily usage of that about 6 ml every day is 25,823,874 ml.

The impact of that thing is expected to be experienced by human health and the environment due to the process of human behavior that associated with waste that is corrosive to the skin, eroding the skin layer, hormonal imbalance and increasing the incidence of breast and ovarian cancer, the negative impact on water can reduce the quality of water and odor from the soil reduce the nutrients so the plants cannot grow as they should. Impact on air quality, if the results of combustion from both the incinerator and non-incinerator are not suitable, it will cause new problems in the form of air pollution due to dioxins and other dangerous compounds and anticipate disasters due to waste during the Covid-19 pandemic.

In addition, it is necessary to make efforts in waste management before it is destroyed, because besides containing hazardous materials such as B3 it is also can be a media of transmission as well as the transmission of micro-organisms, therefore it is necessary to know how to handle it properly and so it will not have an impact on human also the environment.

Based on the description above, it is necessary to have continuous attention and understanding of environmental hygiene and health through health education activities about the management of disinfectant waste from hand washing and plastic through management and collaboration by carrying out community-based management activities so that all problems can be handled properly and produce a healthy environment and not become a covid 19 transmission.

## II. RESEARCH METHOD

The strategy used in this program is the ABG community approach (Advocacy, Community Development, and Community Movement). Conducting socialization via WhatsApp to work groups and the community online because of paying attention to the Covid 19 protocol so that people will get the information about the process and management methods, especially the management of disinfectant waste from hand washing and plastic through media that shared by online.

The supporting media that we used for work groups and the community due observance of the Covid 19 protocol are the booklets and leaflet about the process and management of disinfectant waste from hand washing and plastic waste , especially the management method in pandemic Covid 19.

The participants that involved are 20 people of Banjarbaru are live on Kemuning village. They are agree to be participant and join in WhatsApp group that already made and actively involve in socialization, also fill all of questionnaire that are made.

Short-term evaluation was assessed to determine public knowledge about the application of environmental health principles in the management of disinfectant waste from hand washing and plastic waste in Pandemic Covid19 are using a pre-test and post-test questionnaire which then the result will compared to see are the media that given will effect or not.

## III. FINDINGS

Table 1. Distribution of Respondents Age

Respondent Age	Amount (n)	Percent (%)
17-25 years	6	30
26 - 35 years	4	20
36 - 45 years	4	20
46 - 55 years	6	30
<b>amount</b>	20	100

Table 2 Distribution of Respondents Gender

Gender	Amount (n)	Percent (%)
Male	9	45%
Women	11	55%
<b>Amount</b>	20	100%

Table 3 Distribution of Respondents Education

Education	Amount (n)	Percent (%)
Elementry scchool	1	5
Middle school	1	5
High school	10	50
D1 / D2 / D3 / S / M	8	40
<b>amount</b>	20	100%

Table 4. Distribution of Knowledge Score on Pre Test

Category	Amount (n)	Percent (%)
Bad	11	55

Category	Amount (n)	Percent (%)
Good	9	45
<b>amount</b>	20	100%

Table 5. Distribution of Knowledge Score on Post Test

Category	Amount (n)	Percent (%)
Bad	0	0
Good	20	100
<b>amount</b>	20	100%

Table 6 Distribution of Respondents Knowledge Level Table

Category	Average
Pre-test	5.45
Post-test	8.55
<b>Amount</b>	10

## IV. DISCUSSION

Before the activity was carried out, it was known that the estimation of Banjarbaru waste from the results of the Banjarbaru Environmental Service Agency report in 2020 was 166 tons / day, there were 144 tons to the TPA (handling), 20 tons of reduction and 2 tons of unserved. Organic waste (food waste and leaves) as much as 61.67%, plastic waste as much as 14.08% as much as 14.08%, cloth / textile waste as much as 11.60%, paper waste as much as 8.74%, glass / glass waste as much as 1 , 98%, metal waste as much as 0.94%, rubber waste as much as 0.44%, electronic waste as much as 0.31%, wood waste as much as 0.21% and other waste as much as 0.03%.

Based on table 1, it is known that the age of the respondents for the service of waste management efforts during the Covid-19 pandemic in the Kemuning Village consists of 4 age categories according to the category of the Indonesian Ministry of Health in 2009, namely 6 people (30%) in the late adolescent category (17-25 years), 4 people (20%) in the category of early adulthood (25-35 years), 4 people (20%) in the category of late adulthood and 4 people (30%) in the category of early elderly (46-55 years) .

Based on table 2 shows that the gender of male respondents is 9 people (45%), and the gender of female respondents is 11 people (55%).

Based on table 3, it shows that the education of the respondents who graduated from Elementary School was 1 person (5%), 1 person (5%) are Middle School graduates, High School graduates are 10 people (50%) and 7 people are D1 / D2 / D3 / Bachelor / Masters graduates (40%).

Based on table 4, it shows that the frequency of knowledge scores on Pre Test is 11 people (55%) are Bad, and the frequency of good knowledge scores on Pre Test are 9 people (45%).

Based on table 5, it shows that the frequency of knowledge scores on Post Test is none of people (0%) is Bad, and the frequency of good knowledge scores on Post Test are 20 people (100%).

The level of knowledge based on the correct answer chosen by the respondent when filling out the pre-post test questions. By the 10 questions, the level of knowledge is good if it answer 6-10 questions correctly, and bad if you answer 1-5 questions correctly.

Based on table 6, it shows that all 20 respondents have increased knowledge. This can be seen from the increase in the respondents' knowledge average score from only 5.45 to 8.55 after the socialization.

## V. CONCLUSION

Based on the research, it was concluded that in socialization on disinfectant and plastic waste management, the media that are booklets or pocket books and leaflets were used. From the results based on the results of the pre and post test questionnaires that were filled in by the respondents, it can be seen that the media has an effect on increasing the respondents' knowledge. After there is an increase in knowledge by the respondents, it is hoped that this can affect the attitude of the respondents in managing disinfectant waste and plastic waste during the Covid-19 Pandemic.

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# The Effect of Organizational Culture on Job Performance: The Intervening Role of Organizational Commitment

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## Abstract

**Purpose**—Though extensive research work has been done by organizational researchers about organizational culture and job performance in general, there is huge theoretical and empirical research gap about the specific cultural orientation that affects performance within Ghana's rural banking framework. This paper addresses the gap in literature by using the Competing Value Framework (CVF) organizational cultural typology to identify which cultural orientation influence job performance in Ghana's Rural Banking Sector as well as the mediating role of organizational commitment within the organizational culture and job performance relationship

**Design/methodology/approach**—This study designed a model that had organizational culture as the independent variable, organizational commitment as a mediator variable, and job performance as the dependent variable. The study employed a quantitative survey and sampled responses from 601 staffs from seven rural banks in the western region of Ghana.

**Findings**—The empirical results from hierarchical multiple linear regressions revealed that organizational culture (clan, market and adhocracy) had positive effects on job performance but hierarchy culture had no effect. Also, organizational culture had positive effect on organizational commitment whilst organizational commitment positively predicted job performance. The outcome of the study further shown that organizational commitment acts as a mediator in the relationship between organizational culture and job performance.

**Originality/value**—This research work is essential for administrative and management practices especially within the rural banking concept whilst the conceptual framework presents a different perspective on the effect of organizational culture on employee job performance.

**Index Terms**—organizational culture; organizational commitment; job performance

## 1. INTRODUCTION

Rural banks in Ghana are operating in extremely volatile and competitive financial environment characterized by commercial banks who are comparatively more resourced financially and

savings and loans companies as well as credit unions with very huge committed customers. This makes it imperative for rural banks to monitor and improve the performance of their staff to be able to achieve the overall organizational objective of providing the financial needs of the local people in order to alleviate poverty within the rural communities. This is made even more urgent due to the huge expectations of their shareholders, workers and customers. According to Thompson, Strickland, & Gamble (2008) performance correlates with the output, outcome or results that key management of an organization intends or aspires to achieve. Borman & Motowidlo (1997) defined job performance (JP) as "effectiveness with which job occupants execute their assigned tasks, that realizes the fulfillment of organization's vision while rewarding organization and individual proportionately."

Organizational culture has been recognized as a significant intangible organizational resource that has strong influence on employee performance. Consistent with this line of thinking some organizational researchers argue that workers attitude and behaviour within the organization is shaped by the organizational culture (Desson & Clouthier, 2010). Colyer (2000) thus argue that, by examining organizational culture, workers performance can be best understood as institutions respond to evolving circumstances based on their existing corporate culture. Organizational culture is the basic factor to consider not only in achieving the overall organizational objective, but also establishing a public image that is also key in enticing and retaining committed employees as well as creating a cordial working relationship with all relevant stakeholders (Desson & Clouthier, 2010; Levering, 2016; Ahmady, Nikooravesh, & Mehrpour, 2016) In the nutshell organizational culture defines how an organization executes its job since it's fundamental to the beliefs, values, attitudes as well as the inter-personal behaviours within the organization.

Many scholars in this research field postulate that workplace culture has a substantial positive effect on productivity and performance (Ojo, 2009; AL-Nsourr, 2012 & Uddin & Hossian, 2013; Chatman et. al, 2014; Joesph&Kibera, 2019). In other words organizational culture positively predict employee job performance. A very good culture will lead to improved employee performance but a bad culture will result in low level

job performance by workers. A significant number of organizational researcher advance the argument that organizational culture in general has effect on employee commitment (Aranki et. al, 2019; Dwinfour, et al., 2017; Shim, Jo, and Hoover; 2015 & Acar, 2012). That is to say that the type of corporate culture within the organization determines the level of commitment of the employees within the organization. Akintayo (2010) believes that the commitment of an individual within an institution is a measure of dedication that an employee exhibits towards that organization.

Organizational scholars assert that organizational commitment serves as an important mechanism through which organizational culture affects job performance of employees (Nikpour, 2017; Dewi, Syaifuddin, & Adam 2019). In that employee commitment is an intervening variable to help us understand the circumstances and the mechanism through which organizational culture predict employee job performance. Many studies in extant literature has also shown that organizational commitment positively predict workers performance (Nirushan, 2017; Hafiz, 2017; Bandula & Jayatilake, 2016; Ireferin & Mechanic, 2014; Khan, et al., 2010). This means that employees who are committed to their job are more likely to exhibit behaviours that lead to high level performance and for that matter the achievement of the organizational goal. In this regard, one can advance the argument that a very strong organizational culture is needed within the rural banks in Ghana, to be able to ensure that workers are committed to the objectives of the banks in order to meet the financial needs and expectation of the rural folks which can only be achieved when workers exhibit high level performance.

These scholars' theoretical and empirical works have greatly added to the current literature on the effect of organizational culture on job performance. However, research works aimed at investigating the effect of various forms of organizational culture on job performance has yielded different results. This is because for a number of years, the study of organizational culture has attracted a multitude of epistemological views. This study uses the Competing Value Framework (CVF) to identify and assess the organizational culture in the rural banks. The reason being that, there is huge theoretical and empirical gap in extant literature about the type of cultural values that significantly affect job performance within Ghana's rural banking sector. Also, no study in extant literature has explored the mediating role of organizational commitment in the relationship between organizational culture and workers performance within Ghana's rural banking sector. Previous research works that explored these relationship were done outside the rural banking framework of Ghana and mostly in Asian context which has different organizational environment and national culture to that of Ghana (Nikpour, 2017; Dewi, Syaifuddin, & Adam 2019). Therefore, it is worth analyzing what kind of cultural values affect the output of the workers within Ghana's rural banks and also the mediating effect of organizational commitment on this relationship.

The objectives of this study is as follows: (a) investigate the effect of organizational culture dimensions on job performance; (b) investigate the effect of organizational culture on organizational commitment; (c) investigate the effect of organizational commitment on job performance; (d) to test the

mediating role of organizational commitment on the relationship between organizational culture and job performance.

## 2. Literature Review and Hypotheses Formulation

### 2.1 Organizational Culture and Job Performance

Organizational culture plays a primary role through the collaborative actions of individual members of the organization in modelling the organization's behavior and performance. A strong organizational culture shapes the worker's commitment, organizational identity, shared beliefs as well as the employees' behavior (Azizollah, Abolghasem & Amin, 2016). Bennett, Fadil, and Greenwood (1994) clarify that an organization's performance depends on successful coordination between policy, structure, and culture. Cooper, Cartwright, and Earley (2001) have documented more evidence to support the effect of organizational culture on performance, suggesting that culture serves as a stabilizer of individual actions within an organization. According to Ezirim, Nwibere, and Emecheta (2012), leaders need to build and nurture an organizational culture that benefits both workers and the company because it is very necessary for the overall organizational vision to be accomplished.

Many organizational cultural types have been espoused by researchers to assist our comprehension of organizational culture because different cultural types creates a different outcome and an organization's success is to some extent dependent on the degree to which cultural traits are widely expressed (Ogbonna & Harris, 2000). In literature, there are many organizational culture typologies and related aspects, such as Deshpande & Farley, Cooke and Lafferty's, Deal and Kennedy and the Competing Values Framework (CVF). One of the commonly used frameworks in organizational cultural studies, however, is the CVF, which Cameron and Quinn (2006) developed as a model for investigating and understanding organizational culture. This paradigm relates to the predominance of the internal or external orientation of an entity and whether it strives for flexibility and individuality or stability and control. According to Tseng (2010), the framework also focuses on six organizational culture dimensions and classifies organizational culture into four culture classes, such as clan, adhocracy, market, and hierarchy.

Clan Culture (CC): is focused on shared values and collective goals, an atmosphere of teamwork and mutual support, with a specific emphasis on employee empowerment and advancement. A kind of corporate culture, where there is a strong sense of "family." Teamwork and the role of the leader as a mentor is emphasized. The Culture of Adhocracy (AC): is a culture of organization that allows people far more flexibility to develop in their own way as long as they are aligned with the organization's goals. Leaders are described as businessmen who are driven by new ideas and innovation. The organization's mission is to gain as much as it can from the external environment. Individuals would be considered accomplished and successful if they could create and enhance new ideas and innovations. Market Culture (MC): focuses on revenue outside the company, rather than internal operations. The organizational goal is to benefit from a competitive market. It is a type of culture that focuses on achieving the effectiveness of the project. Competition is a common necessity for people to develop, which provides less flexibility in personal relationships. Progress

metrics are based on the objective priorities of individuals, which are usually carried out through activities connecting the company to its market or (external) stakeholders. The Culture of Hierarchy (HC): has a structure, uniform rules and procedures, strict oversight and well-defined duties. Consistency is a key orientation within the organisation, and can be maintained by a set of defined and tight rules and regulations. Success standards are based on the degree to which people are able to efficiently conduct their duties in compliance with the protocols laid down by organizations.

However, it must be emphasized that studies aimed at exploring the effects on job performance by different types of organizational culture have yielded numerous results. The empirical works of Tseng (2010) showed that the culture of hierarchy and adhocracy have a positive impact on performance, which is comparable to the results of Calciolari, Prenestini, and Lega (2018). Interestingly, Fekete and Bocskei (2011) recognized adhocracy culture and clan culture as significant predictors of performance, but report that hierarchy culture has a detrimental impact on performance. Zhang and Zhu (2012) found conflicting evidence in terms of hierarchical culture, but reported important positive effects of both adhocracy and market cultures on performance. Morgan and Vorhies (2018) support the indirect positive link between market culture and market performance through customer satisfaction. However, they show that market culture has a direct positive effect on financial performance and, through innovation, an indirect influence. Joseph and Kibera(2019), stated that the dominant performance predictors in the micro finance industry in Kenya were clan culture and hierarchy culture. They have also described market culture as being inversely linked to the equity or debt ratio. In addition, in line with Choi et al. (2010), who argue that all forms of culture are significant performance predictors, Chatman et al. (2014) argue that organizational cultural typologies (clan, adhocracy, market and hierarchy) based on CVF are important performance predictors. In empirical literature, such contradictions do not unambiguously rule out the effect of context-specifics with respect to the variables of concern to the study. It is not easy to confirm the presence and essence of the impact of organizational culture on performance as a result of these inconsistencies, without sufficient evidence in different contexts and over time. Our study thus adopts the CVF organizational cultural typology to study its effect on job performance within the framework of Ghana's rural banks. On the basis of the above, we formulate the following hypotheses:

**Hypothesis 1:** *Organizational culture will have positive effect on job performance*

**Hypothesis 1a:** *Clan culture will have positive effect on job performance*

**Hypothesis 1b:** *Market culture will have positive effect on job performance*

**Hypothesis 1c:** *Adhocracy culture will have positive effect job performance*

**Hypothesis 1d:** *Hierarchy culture will have positive related job performance*

## **2.2 Organizational Culture and Organizational Commitment**

The importance of organizational commitment in organizational behaviour literature is highlighted by the numerous research works undertaken by organizational researchers in this field. According to Hanaysha (2016) scholars have tried to comprehend organizational commitment, its form, implications, effects as well as the factors that predict it. Mowday et al. (2013) believes that commitment can be conceptualized in terms of the degree of acceptance and the trust an employee repose towards the organizational vision; the desire to make significant contributions for the success of the organization; and the seriousness with which the employee desires to be and remain part of the organization. Organizational culture is an essential instrument that helps to articulate the organization's vision, gives members of the organization a common identity, and deepens employee commitment (Cameron and Quinn, 2006).

Meyer and Allen (1991) noted that employee commitment comes in three forms: (a) Affective commitment (CC): which looks at the emotional connection between the individual, his engagement and affiliation to the organization; (b) Continuance commitment (CC): where the worker puts into perspective the risk of leaving the organization. Workers stay with the organization under this type of commitment, because they need to; and (c) Normative commitment (NC): workers here find it a sense of responsibility to stick around and continue working with their organization. Workers with a strong normative degree of commitment have an intrinsic urge to stay with their organization.

According to Tuna et al. (2016) the zeal and enthusiasm with which a person identifies with an organization is an indication of the devotion of the individual to the organization. The foundation for individual self-realization can be organizational commitment and can have an impact on turnover, absenteeism and performance (e.g. Jung & Yoon, 2012; Tuna et al., 2011; Ghazzawi, 2008). Organizational culture is a crucial factor behind the longevity of workers within an organization (Desselle, Raja, Andrews & Lui, 2018). Acar (2012), argues that achieving continuous and desirable work outcomes of employees have strong relations with their commitment to their organizations and that workers who are committed to their organization are addicted to the organization's objectives and organization itself when they adopt the organizational culture. In line with this assertion, in a study that explored the effects of organizational culture and leadership on employees' commitment in Turkish logistic industry, Acar (2012) concluded that organizational culture has effect on employee commitment. Messner (2013) investigated the effect of organizational culture on employee commitment in the Indian IT services sourcing industry and reported that organizational culture has effect on employee commitment.

Also, Dwinfour, et al. (2017) in a study to determine the impact of organizational culture on employees' organizational commitment in ensuring job satisfaction among some staff in the Legal Services sector in Ghana revealed that organizational culture has an impact on commitment. Furthermore, Aranki, Suifan, & Sweis (2019) investigated the relationship between organizational culture and organizational commitment, in Information Technology (IT) companies in Jordan and reported a positive correlation between organizational culture and employee commitment. Carvalho et al. (2018), studied the relationship between organizational culture, organizational commitment and

job satisfaction in the Brazilian banking sector and concluded that clan culture (CC) has significant relationship with affective, normative and continuance commitment and the three dimensions of job satisfaction. However, hierarchy culture (HC) had no significant relationship with affective commitment (AC) but had significant relationship with normative (NC) and continuance commitment (NC) and the dimensions of job satisfaction. Adhocracy culture (AC) had no significant relationship with continuance commitment (CC) and job satisfaction but had significant relationship with affective and normative commitment. Finally, the researchers reported that market culture (MC) had significant effect on continuance commitment (CC) but had weak correlation with affective and normative commitment as well as the dimensions of job satisfaction. Ch et al. (2013) conducted a comparative study on the impact of organizational culture on organizational commitment in both public and private sector and reported that clan culture (CC) had the most significant relationship with organizational commitment dimensions (affective, normative and continuance). Adhocracy and market culture dimensions were found to have a weak but statistically significant relationship with normative commitment only. Hierarchy culture on the other hand had no statistically significant effect on all dimensions of commitment (affective, normative and continuance). In the context of the rural banks in Ghana, we hypothesize that:

**Hypothesis 2:** *Organizational culture will have a positive significant influence on organizational commitment.*

**Hypothesis 2a:** *Organizational culture will have positive effect on affective commitment*

**Hypothesis 2b:** *Organizational culture will have positive effect on normative commitment*

**Hypothesis 2c:** *Organizational culture will have positive effect on continuance commitment*

### 2.3 Organizational Commitment and Job Performance

Organizational commitment has been identified as a major factor in achieving high performance among employees. Corporate institutions put maximum premium on employee commitment because it is fundamental to the achievement of the core objectives of the institution. Lo et al. (2009) indicated that commitment of employees is essential because (a) the probability of a committed employee to engage in counterproductive behaviour is minimal; (b) less committed employees may divert their commitment into certain activities which may not be beneficial to the organization. It's thus imperative to create an enabling working environment that inculcates into the employees the virtue of commitment and job retention; (c) workers who demonstrate great loyalty to the organization continue to be extremely happy and have their work fulfilled; (d) employees within the hierarchical structure must support the process of organizational change because it's imperative in modern competitive organizational environment. Khan et al. (2010) investigated the impact of organizational commitment on employee job performance from a sample of 153 private and public sector employees of oil and gas sector in Pakistan and reported a positive correlation between organizational commitment and employees' job performance in a comparative analysis of the three dimensions of organizational commitment

(affective, normative and continuance). Normative commitment particularly was reported to have positive and significant relationship with job performance. Rafiei, Amini, & Foroozandeh (2014) examined the effect of three components of organizational commitment; namely affective, continuance and normative commitment, on employee's performance. The study sampled 244 employees of cooperatives, labor and social welfare department of Markazi Province in Iran using a single-stage cluster sampling and reported that organizational commitment positively relates to job performance. The study further showed that all three dimensions of commitment (affective, normative and continuance commitment significantly affected job performance. Nirushan, (2017) investigated the impact of organizational commitment on employee performance in banks in Trincomalee District, a positive relationship was reported between the variables. In a comparative analysis, the researcher demonstrated that the relationship between organizational commitment and job performance within public banks was higher than the non-public banks among others.

Bandula & Jayatilake, (2016) examined the impact of organizational commitment on employee job performance based on leasing companies in Sri Lanka and concluded that employee commitment is significantly correlated with job performance and that continuance commitment had the most effect on job performance. Hafiz (2017) investigated the relationship between the dimensions of organizational commitment and employee's performance in banking sector of Lahore. Data was collected from 213 employees of private and public banks located in Lahore and the results showed that affective, normative, and continuance commitment positively predict employee's performance separately and jointly. On the basis of the above empirical evidence, we formulate the following hypothesis that:

**Hypothesis 3:** *Organizational commitment will have positive influence on job performance.*

**Hypothesis 3a:** *Affective commitment will relate positively with job performance*

**Hypothesis 3b:** *Normative commitment will relate positively with job performance*

**Hypothesis 3c:** *Continuance commitment will relate positively with job performance*

### 2.4 The Mediating Role of Organizational Commitment

The mediating function of organizational commitment is gaining much attention in relation to organizational culture and performance relationship (Farzanehet al., 2014; Iraqat, 2016; Nickpour, 2017; Dewiet al., 2019; and Suparthaet al., 2019). According to Baron & Kenny (1986) the interaction between an independent variable and an outcome or dependent variable is explained by a mediator variable. The effect of the independent variable on the outcome or dependent variable and why such an influence occurs are best explained by mediators. Organizational commitment as a mediator in the organizational culture and employee job performance relationship will help us to understand better the mechanism through which organizational culture (independent variable) influences or affects job performance (dependent variable). However, to be able to establish and understand the mediating role of organizational commitment in

the relationship between organizational culture and employee job performance, we first establish the relationship between organizational culture and organizational commitment and also the relationship between organizational commitment and job performance.

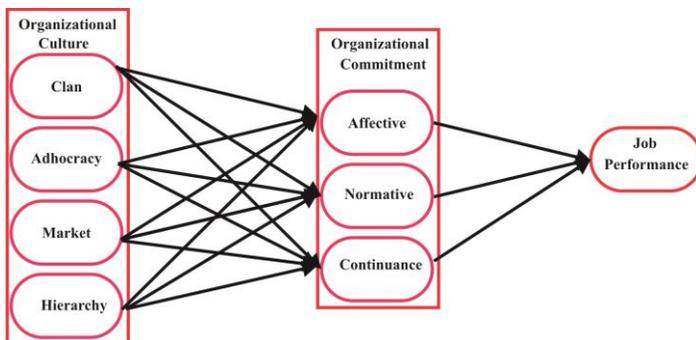
Iriqat, (2016) investigated the impact of organizational culture dimensions (organizational values, beliefs, norms and expectations) on job satisfaction and the mediating role of organizational commitment in Palestine. The results of this empirical study showed that there was direct effect of organizational values on job satisfaction as well as indirect effect when organizational commitment mediated this relationship. In the same study however, there was no indirect effect of organizational culture dimensions of organizational beliefs, norms and expectations on job satisfaction when organizational commitment mediates this relationship. Nikpour (2017) reported that beyond the direct effect of organizational culture on organizational performance, the indirect effect of organizational culture on organizational performance through the mediating role of organizational commitment was significantly greater than the direct effect. This was in a study in the Kerman province in Iran that assessed the mediating role of organizational commitment in the relationship between organizational culture and organizational performance. Furthermore, Dewi, Syaifuddin, & Adam (2019) investigated the mediation function of organizational commitment on the influence of organizational culture and leadership on employees' performance in Indonesia, and reported among others that organizational commitment mediates the relationship between organizational culture and employees' performance. Based on the above empirical studies, we hypothesized that:

**Hypothesis 4: Organizational commitment will mediate the relationship between organizational culture and job performance.**

*Hypothesis 4a: Affective commitment will mediate the relationship between organizational culture and job performance*

*Hypothesis 4b: Normative commitment will mediate the relationship between organizational culture and job performance*

*Hypothesis 4c: Continuance commitment will mediate the relationship between organizational culture and job performance*



**Figure 1 A conceptual framework showing the relationships among organizational culture, organizational commitment and job performance**

The conceptual framework for this paper is made up of the constructs which comprehensively explain the correlation between the variables of interest to the study and how they

practically relate to each other. The relationships between the variables in this conceptual framework are premised basically on Social Exchange Theory (Blau, 1964). In this regard this study advances the argument that high level social exchange relationship between the organization (rural banks) and the staff will lead to better organizational culture within the banks, better employee commitment and improved job performance. This is because when the staff of the banks have the course to believe or perceive a high level of support from the banks or have a better-quality exchange with their leadership (management) they will feel a sense of belonging, a form of indebtedness to the organization (banks) and will be obliged to reciprocate or exchange by demonstrating affective commitment and supportive attitudes towards their work within the banks. On the contrary, when they perceive the institution (banks) as being unsupportive to their needs, a situation where the exchange relationship is not favorable to the staff, they will not be supportive of the organizational vision and this will result in weak organizational culture, low employee commitment and job performance. In the framework organizational culture (clan, market, adhocracy and hierarchical) is hypothesized to have effect or influence on the job performance of employees within the rural banks. That is to say the performance of the employees within the banks is influenced by the corporate organizational culture. A very good organizational culture is likely to enhance workers' commitment and improve their job performance. We also hypothesized that organizational culture will have effect on organizational commitment and organizational commitment will in turn have positive effect on workers performance. We use organizational commitment of the employees as an intervening variable to help us understand better the mechanism through which the organizational culture within the rural banks influences the performance of the staff.

### 3.0 Method

#### 3.1 Participants, sample and procedures

The participants for this study are workers from seven rural banks in Western Region of Ghana. They are made up of branch managers, operations managers, credit officers and cashiers. Given the complexity of the survey sample, we used a multi-stage sampling method (three main stages) Simple random sampling to select 7 out of the 8 rural banks. Secondly, proportionate sampling to select representatives from each of the selected rural banks and finally because the rural banks are made up of various departments, proportionate sampling is used to select representative participants from each of the different departments within each of the selected 7 rural banks in the region. We distributed 730 serial numbered questionnaires to respondents and received 601 questionnaires indicating 82% response rate. Out of the 601 participants surveyed for the study, 1.72% were branch managers, 31.22% were operations managers, 43.01% were credit officers and 24.05% were cashiers. Males represented 53.40% while females represented 46.60%. Furthermore, 12.13% aged 30 years or below, 37.24%, 32.12% and 20.51% were between 31-40years, 41-50years and 51-60 years respectively.

### 3.2 Measures

The study used three sets of questionnaires which are organizational culture assessment instrument (OCAI) adapted from Cameroun and Quinn (2006) a 24 item scale, 6 each measuring clan, adhocracy, market and hierarchical cultures. Organizational commitment questionnaire (OCQ) adapted from Meyer and Allen (1997) an 18 item scale, 6 each measuring affective, normative and continuance commitment and job performance scale adapted from William and Anderson (1991). These scales were adapted for the following reasons. Firstly, in the literature, the instruments are widely accepted and used as valid and reliable for measuring the variables used in this study. Cameroun & Quinn (2006) using the OCAI reported 0.85 reliability coefficient for the scale. Belias et al (2014) also reported a Cronbach's alpha of 0.808, 0.759, 0.855 and 0.953 respectively for the various cultural dimensions using a Greek sample. Using OCQ, Allen and Meyer (1997) recorded 0.87 for affective, 0.75 for continuance, and 0.79 for normative commitment. For the measure an alpha coefficient of 0.748 was reported while for the same scale 0.748 alpha coefficient was also stated by Donald, Bertha & Lucia (2016). Secondly, the development of the instruments was influenced by theoretical underpinnings of organizational culture-performance studies. Thirdly, they address multidimensional nature of the variables used in this study. Every item on the scales were measured on five point Likert scale ranging from 1 – 5. In line with literature, the reliability results from the pilot testing of the instruments were consistent with the reliabilities established in the literature. The Cronbach alpha ' $\alpha$ ' for the scales were Job performance ( $\alpha=0.84$ ), clan culture ( $\alpha=0.87$ ), market culture ( $\alpha=0.80$ ), adhocracy culture ( $\alpha=0.79$ ), hierarchy culture ( $\alpha=0.81$ ), affective commitment ( $\alpha=0.83$ ), continuance commitment ( $\alpha=0.79$ ) and normative culture ( $\alpha=0.80$ ).

### 3.3 Data collection

Considering the comprehensive nature of the instruments and the desire to obtain reliable data, data was collected in three phases following repeated cross-sectional approach. In phase one, data on organizational culture was collected. In phases two and three, data on organizational commitment and job performance respectively were collected from the same participants involved in phase one. To ensure that the same respondents participated in all of the phases, we followed three approaches. First, we coded each of the distributed questionnaires with the sampled rural banks and specific departments/units codes. For instance, codes 010101 represented respondent one (01) from credit department (01) of rural bank one (01) and 020101 represented respondents one (01) from credit department (01) of rural bank two (02) respectively. Second, in all the phases, data on demographic characteristics were collected to allow for crosscheck. Finally, we matched each of the questionnaires from the three phases to become one. Data collection took approximately five months with roughly one-month interval after each phase. Ethical issues were considered especially using informed consent approach and participants' confidentiality.

### 3.4 Data Analysis

Data was analyzed using STATA version 15.0 and Amos version 22.0. We followed five key processes in analyzing the data. Firstly, we integrated the data from the three phases to become a complete dataset for each of the participants by using their unique codes while crosschecking with their demographic characteristics. Questionnaires from respondents who were not involved in all the three phases were not included in the final dataset. Secondly, we verified the consistency and stability of the data by calculating the coefficient of the fractal dimension using STATA software. Thirdly, we established the authenticity and relevance of the construct validity of the scales by conducting confirmatory factor analyses (CFA) using AMOS software. Fourthly, yet importantly, we tested the hypotheses of the study by performing hierarchical regression analysis using STATA software. Finally, we followed Baron and Kenny's (1986) procedures which is generally accepted as standard and widely used to test for mediation analysis (Grotta&Bellocco, 2013).

## 4.0 Results

### 4.1 Preliminary Results

In addition to the frequencies of the demographic data, we performed descriptive statistics for the variables using STATA version 15.0. In addition, we performed validity and reliabilities for the scales using AMOS version 22.0. Tables 1 and 2 present the results for the descriptive statistics.

**Table 1.** Mean and Standard Deviations

Variable	Obs.	Mean	Std. Deviation	Mini mum	Maxim um
Continuance commitment	601	3.067	.907	1	5
Normative commitment	601	3.201	.848	2	5
Affective commitment	601	3.290	.626	2	4
Clan culture	601	3.581	.931	2	5
Adhocracy culture	601	3.426	.865	2	5
Market culture	601	3.408	.860	1	5
Hierarchy culture	601	3.171	.700	2	5
Job performance	601	3.626	.794	2	5

According to Table 1, there were 601 observations used for the analysis. The mean values for the variables ranged between 3.067 (SD=0.907) for continuance commitment to 3.626 (SD=0.794) for job performance suggesting that the mean values for the variables are moderate to high level given that the likert scales ranged from 1-5 ratings.

**Table 2.** Composite Reliability, Average Variance Extracted and Inter-Factor Correlations

Variable	CR	AVE	CON	NC	AC	CC	ADH	MC	HC	JP
CON	0.893	0.748	<b>0.865</b>							
NC	0.881	0.727	0.158	<b>0.853</b>						
AC	0.752	0.514	0.147	0.173	<b>0.717</b>					
CC	0.794	0.582	0.128	0.326	0.199	<b>0.763</b>				
ADH	0.788	0.568	0.105	0.131	0.163	0.171	<b>0.754</b>			
MC	0.784	0.551	0.154	0.127	0.136	0.179	0.438	<b>0.742</b>		
HC	0.787	0.634	0.297	0.120	0.182	0.209	0.168	0.130	<b>0.796</b>	
JP	0.816	0.639	0.192	0.377	0.156	0.624	0.321	0.272	0.334	<b>0.799</b>

CR: composite reliability; AVE: average variance extracted; CON: continuance commitment; NC: normative commitment; AC: affective commitment; CC: clan culture; ADH: adhocracy culture; MC: market culture; HC: hierarchy culture; and JP: job performance.

The outcome of the correlation analysis showed that each of the four dimensions of organizational culture significantly and positively correlated with the dimensions of organizational commitment and job performance. In addition, the dimensions of organizational commitment correlated significantly and positively with job performance. Thus, the correlation results provide prior supports for hypotheses of this study to be tested. The composite reliabilities of the scales for organizational culture dimensions ranged between 0.784 for market culture and 0.794 for clan culture; 0.816 for job performance and that of organizational commitment dimensions ranged between 0.752 for affective commitment and 0.893 for continuance commitment.

In addition, the validity analysis revealed that the average variance extracted (AVE) for the scales ranged from 0.514 – 0.748 indicating that the values are above the recommended threshold (0.50) for acceptable AVE (Gaskin and Lim, 2016) indicating evidence of convergence validity. Also, we followed Fornell and Larcker’s (1981) and established that the square root of the AVE values ranged from 0.726 - 0.879. This values were high above the inter-factor correlations among the constructs providing strong evidence of discriminant validity (Gaskin and Lim, 2016). These were all above the reliability threshold generally recommended for using an instrument.

Furthermore, the model fits results from CFA analysis using AMOS version 22.0 revealed that overall goodness of fits indices including goodness-of-fit index (GFI) 0.951, adjusted goodness-of-fit index (AGFI) 0.939, comparative fit index (CFI) 0.964, root mean square error of approximation (RMSEA) 0.049 and  $\chi^2/df$  were within the acceptable level for model fit. We further confirmed this results using STATA version 15.0 with coefficient of determination (CD) and PCLOSE values all within the generally acceptable standard for model fit. Thus, the results indicate that our models are fit and hence provide further support for analyzing the proposed hypotheses.

#### 4.2 Hypothesis testing

##### 4.2.1 Testing the main effect

The results in Table 3 show that in model 2, conditioning on other job performance determinants such as age,

educational background and location, clan culture, adhocracy culture and market culture had significantly positive effects on job performance. Thus, the results in model 2 provide support for hypotheses 1a, 1b and 1c. Overall, the results partly support hypothesis 1, which hypothesized that organizational culture will exert positive effects on job performance.

**Table 3.** The effects of organizational culture on job performance.

Variable	Job Performance	
	Model 1	Model 2
Constant	1.582*** (0.350)	0.704*** (0.289)
Gender	0.241*** (0.058)	0.149*** (0.053)
Age	-0.176*** (0.029)	-0.086*** (0.030)
Educational Background	0.636*** (0.077)	0.597*** (0.073)
Rural Bank Type	0.125*** (0.039)	0.117*** (0.037)
Location	-0.062*** (0.011)	-0.045*** (0.011)
Position	0.124*** (0.036)	0.109*** (0.035)
Clan Culture		0.415*** (0.064)
Adhocracy Culture		0.406*** (0.077)
Market Culture		0.301*** (0.071)
Hierarchy Culture		0.089 (0.068)
F-test	41.86***	39.02***
R-squared	0.314	0.517
Adj R-squ	0.306	0.507
Obs	601	601

\*\*\*,\*,\* indicate significant at 10%, 5% and 1% levels of significance.

The results in Table 4 show the effects of organizational culture on organizational commitment as well as that of organizational commitment on job performance. Concerning affective commitment as the dependent variable, the results in model 2 of Table 4 show that conditioning on other organizational commitment determinants, all the form dimensions of organizational culture had significantly positive effects on affective commitment. Using continuance commitment as a dependent variable, the results in model 4 show that organizational culture dimensions had significant positive effects

on continuance commitment. With normative commitment as the dependent variable, the results in model 6 of Table 4 show that all the four dimensions of organizational culture had significant positive effects on normative commitment while controlling for other organizational commitment determinants such as gender, age, educational background and position of employees. Generally, the results support hypothesis 2 that states that organizational culture exert positive effects on organizational commitment.

Furthermore, model 8 of job performance results show that all the three constructs of organizational commitment had significantly positive effects on job performance accounting for other job performance determinants such as age, educational background, location and position. The findings in model 8 provide strong support for hypothesis 3, which states that organizational commitment has positive effects on job performance among the rural banks in Ghana.

**Table 4.** Analysis of organizational culture, organizational commitment and job performance relationship.

Variable	Affective Commitment		Continuance Commitment		Normative Commitment		Job Performance	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	2.746*** (0.250)	2.596*** (0.300)	2.988*** (0.409)	0.913** (0.455)	4.354*** (0.355)	0.832*** (0.309)	1.582*** (0.350)	-0.418 (0.384)
Gender	0.130*** (0.042)	0.117*** (0.041)	0.246*** (0.068)	-0.158** (0.062)	0.136** (0.059)	0.002 (0.042)	0.241*** (0.058)	0.138** (0.064)
Age	0.061*** (0.021)	-0.056** (0.023)	0.170*** (0.034)	-0.040 (0.034)	-0.146*** (0.030)	0.033 (0.023)	0.176*** (0.029)	0.116** (0.028)
Educational Background	0.144*** (0.055)	0.143** (0.056)	0.313*** (0.090)	0.355*** (0.085)	-0.177** (0.078)	-0.058 (0.058)	0.636*** (0.077)	0.648** (0.074)
Rural Bank Type	0.080*** (0.028)	0.082*** (0.029)	0.184*** (0.046)	0.145*** (0.043)	-0.121*** (0.040)	-0.134*** (0.029)	0.125*** (0.039)	0.029 (0.038)
Location	0.021*** (0.008)	-0.019** (0.009)	0.062*** (0.013)	-0.038*** (0.013)	-0.045*** (0.011)	0.003 (0.009)	0.062*** (0.011)	0.043** (0.011)
Position	0.002 (0.026)	-0.004 (0.027)	0.155*** (0.042)	-0.200*** (0.041)	0.152*** (0.037)	0.062*** (0.028)	0.124*** (0.036)	0.080** (0.035)
Clan		0.141*** (0.050)		0.249*** (0.075)		0.142*** (0.051)		
Adhocracy		0.148** (0.060)		0.154** (0.070)		0.136** (0.061)		
Market		0.117** (0.055)		0.144** (0.063)		0.373*** (0.056)		
Hierarchy		0.122** (0.053)		0.295*** (0.080)		0.172*** (0.054)		
Affective							0.240** (0.057)	
Continuance							0.093** (0.039)	
Normative							0.296** (0.044)	
F-test	8.47***	5.64***	16.28***	21.15***	16.16***	68.60***	41.86***	43.03***
R-squared	0.384	0.592	0.351	0.580	0.350	0.557	0.314	0.515
Adj R-squ	0.347	0.577	0.342	0.566	0.341	0.549	0.306	0.505
Obs	601	601	601	601	601	601	601	601

\*\*\*, \*\*, \* indicate significant at 10%, 5% and 1% levels of significance.

**4.2.2 Testing the mediating role of organizational commitment**

As indicated earlier, we followed Baron and Kenny's (1986) procedures which is generally accepted and widely used to test for mediation analysis. Table 5 presents the results of the mediating role of organizational commitment in the relationship between organizational culture and job performance.

**Table 5.** The mediating effects of organizational commitment on the relationship between organizational culture and job performance.

Variable	Job Performance		Job Performance			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	1.582*** (0.350)	0.704*** (0.289)	-0.069 (-0.404)	0.620 (0.389)	0.479 (0.383)	-0.119 (0.399)
Gender	0.241*** (0.058)	0.149*** (0.053)	0.084 (0.052)	0.164*** (0.054)	0.049 (0.052)	0.078 (0.052)
Age	-0.176*** (0.029)	-0.086*** (0.030)	-0.070** (-0.029)	-0.083*** (0.029)	-0.095*** (0.029)	-0.080*** (0.029)
Educational Background	0.636*** (0.077)	0.597*** (0.073)	0.554*** (0.072)	0.564*** (0.074)	0.613*** (0.072)	0.573*** (0.072)
Rural Bank Type	0.125*** (0.039)	0.117*** (0.037)	-0.008 (-0.036)	0.003 (0.037)	0.053 (0.037)	0.025 (0.037)
Location	-0.062*** (0.011)	-0.045*** (0.011)	-0.039*** (-0.011)	-0.041*** (0.011)	-0.046*** (0.011)	-0.041*** (0.011)
Position	0.124*** (0.036)	0.109*** (0.035)	0.050 (0.034)	0.067* (0.036)	0.032 (0.035)	0.037 (0.035)
Clan		0.415*** (0.064)	0.415*** (0.063)	0.392*** (0.065)	0.377*** (0.063)	0.384*** (0.063)
Adhocracy		0.406*** (0.077)	0.388** (0.075)	0.400*** (0.077)	0.415*** (0.076)	0.399*** (0.075)
Market		0.301*** (0.071)	0.266*** (0.069)	0.305** (0.071)	0.200*** (0.072)	0.192*** (0.071)
Hierarchy		0.089 (0.068)	0.082 (0.066)	0.116* (0.069)	0.136** (0.067)	0.120* (0.067)
Affective			0.298*** (0.054)			0.248*** (0.056)
Continuance				0.092** (0.036)		0.082** (0.038)
Normative					0.270*** (0.053)	0.215*** (0.056)
F-test	41.86***	39.02***	40.13***	36.41***	39.49***	36.13***
R-squared	0.314	0.517	0.748	0.724	0.744	0.864
Adj R-squ	0.306	0.507	0.738	0.712	0.733	0.851
Obs	601	601	601	601	601	601

\*\*\*, \*\*, \* indicate significant at 10%, 5% and 1% levels of significance.

When affective commitment is used as the mediator variable, the results in model 3 of Table 5 revealed that that affective commitment significantly mediate the relationship between organizational culture constructs (clan, adhocracy and market cultures) and job performance. With the exception of hierarchy culture, all the other constructs of organizational culture is significant but with a relatively lower coefficients compared with the results in model 2 indicating partial mediation of affective commitment for clan, adhocracy and market culture and job performance but a full mediation for hierarchy culture and job performance relationships. In model 4, with continuance commitment as the mediator variable, the results revealed that continuance commitment significantly mediate the relationship between all the constructs of organizational culture and job performance. However, the mediation is partial. Similarly, in model 5, the results show that normative commitment significantly mediate the relationship between all the constructs of organizational culture and job performance. In addition, the results exhibit partial mediation of normative commitment. The results support hypothesis 4, which hypothesized that organizational commitment have a mediating effect in the relationship between organizational culture and job performance. Model 6 presented combined mediating effects of the organizational commitment constructs and revealed that consistent with the results of the first three models, all the three organizational commitment constructs significantly had mediating effects in the relationship between organizational culture and job performance.

## 5.0 Discussion

The study was intended to achieve four main objectives; firstly investigate the effect of organizational culture on job performance using CVF; secondly, investigate the effect of organizational culture on organizational commitment; thirdly investigate the effect of organizational commitment on job performance; and finally test the mediating role of organizational commitment on the relationship between organizational culture and job performance.

### 5.1 Effect of Organizational Culture on Job Performance

The results of the study indicate that CVF organizational cultural dimensions of clan, adhocracy and market had significant positive influence on the job performance of rural banks employees. This findings is at variance with the earlier research findings of Chatman et al. (2014) which claims that all four forms of CVF-based organizational cultural types have significant positive influence on performance. It is also inconsistent with the earlier research findings of Choi et al. (2010) who argues that all types of culture are important predictors of performance. The outcome of our study also has similarities with the research findings of Joseph and Kibera (2019) with the major differentiation on the effect of hierarchy culture on performance. This is because contrary to their findings we did not find support for hierarchy culture. In this regard, our findings is consistent with earlier research by Fekete and Bocskei (2011) which identified hierarchy culture as having adverse effect on performance. As stated earlier, our research findings showed that hierarchy does not predict employee job performance. This is because as indicated by Cameron and Quinn (2006) hierarchy culture is characterized by strict laid down procedures and which at times make it difficult for the organization to adjust to changes within their environment which adversely affects performance. In a developing country like Ghana, administrative bureaucracies sometimes militates against organizational effectiveness especially in private institutions were strict bureaucratic processes are stringent. The reason being that, many Ghanaians are uncomfortable with strict bureaucratic and administrative processes which is a feature akin to hierarchy culture. Rigid, strict bureaucratic processes are alien to the traditional Ghanaian way of life. In a typical Ghanaian context familiarity and human face most of the time replace rigid laid down procedures. The underlining factor in most social relationships and interaction is about who you know. It is therefore not surprising that we identified clan culture as the dominant cultural type that enhances performance within the rural banks since it focuses on human relationships. Clan culture as the name connotes is synonymous with the extended family or clan system which is the dominant family type in Ghana.

The identification of clan culture as the dominant cultural type that positively predicts employee job performance in the rural banks in Ghana is consistent and in line with the earlier research findings of Berrio (2003) and Ch et al. (2013) which found clan culture as the most preferred culture as against adhocracy, market and hierarchy cultures because it relates positively with employee attitudes and behaviour. Many employees within the rural banks preferred clan culture because it values team work, participation, consensus building and has deep concern for employees welfare. Steyrer, Schiffinger, and

Lang (2008) argue that clan culture lays emphasis on social cohesion, collective responsibility and loyalty as well as promotes working environment that focuses on the employees. In the nut shell as the name suggest clan culture operates like a family. Shahzad, Iqbal & Gulzar (2013) established the importance of workplace culture in influencing performance and argues that a good organizational culture is a means for achieving excellent performance and consistent accomplishments that support our findings.

### 5.2 Organizational Culture and Organizational Commitment

Theoretical and empirical argument in organizational behaviour literature suggest that organizational culture is an essential tool for achieving employee commitment (Acar, 2012; Messner, 2013; Shim, Jo, & Hoover; 2015; Dwinfour, et al. 2017). This implies that the way of life of the members within an organization, their shared beliefs and practices as well as the organizational environment positively predict their dedication and commitment to their organization. The outcome of the current study showed that organizational culture (clan, adhocracy, market and hierarchy) all had significant positive effect on affective, normative and continuance commitment. This findings corroborates earlier research findings of these scholars and provides further empirical validation on the effect of organizational culture on employee commitment.

However, these findings are at variance and contrary to previous research findings of Ch. et al. (2013) and Carvalho et al. (2018) where only clan culture had statistically significant relationship with all three dimensions of organizational commitment namely affective, normative and continuance commitment. This shows that in the context of the rural banks in Ghana, the ability of the Chief Executive Officers (CEOs) and management to create and sustain an organizational culture which is well coordinated, characterized by flexible formal rules and policies, a highly competitive culture where the achievement of organizational goal is the “glue” that holds the employees and the organization together is crucial towards retaining committed employees. In this regard to ensure employee commitment within the rural banks, CEOs and management members who are leaders of the banks must create an organizational culture that creates a friendly and “cozy” working environment, where the working force is perceived as an extended family and the superiors are perceived as mentors; employees are characterized by high job performance with the underlining principle that employees within the rural banks are emotionally attached to the organization (affective commitment) and are willing and ready to go beyond their normal work duties to ensure that the banks succeed (exhibit citizenship behaviour). In developing this culture the leadership (CEOs/management) should take into consideration the philosophy of the organization and the employee’s shared beliefs, values, behaviors and symbols, as it strongly affects individual decisions and group actions. However, it must be emphasized that though our findings were at variance with Ch. et al. (2013) and Carvalho et al. (2018) on the effect of CVF organizational cultural dimensions of clan, adhocracy, market and hierarchy on organizational commitment (affective, normative and continuance), we had similar result with respect to the effect of clan culture on organizational commitment. This is because, we all reported statistically

significant effect of clan culture on affective, normative and continuance commitment which further validates the huge contributions of clan culture in achieving employee commitment. The outcome of our research work clearly shows that organizational culture positively predict employee commitment and thus provides further empirical support to previous research works and researchers who asserted that organizational culture positively influence organizational commitment of employees (Acar, 2012; Messner, 2013; Shim, Jo, & Hoover; 2015; Dwinfour, et al. 2017 and Aranki, Suifan & Sweis; 2019). On the basis of the above, it is evidently clear that for the rural banks in Ghana to achieve their constitutional mandate of providing the financial needs of the rural folks to stimulate rural production activities in an attempt to alleviating poverty, strong organizational culture needs to be built within the banks since it has the potential of increasing the commitment of employees since committed employees work selflessly towards the achievement of organizational vision.

### 5.3 Organizational Commitment and Job performance

The findings of the study indicate that, organizational commitment dimensions of affective, normative and continuance commitment all had significant positive effect on job performance of employees within the rural banks in Ghana. This result is consistent with the findings of Rafiei, Amini, & Foroozandeh (2014) which found positive relationship between the three dimensions of organizational commitment and performance. The result is also similar with the findings of Khan et al. (2010) but differ on the impact of normative commitment on performance. In their analysis of the impact of the three dimensions of commitment on performance, they reported normative commitment as having the most significant relationship with performance. Furthermore, the findings of this study corroborate the earlier research findings of Bandula & Jayatilake, (2016) on the effect of organizational commitment on employee job performance, however as in the case of Khan et al. (2010), we are at variance in respect of the dimension of organizational commitment that has the most effect on employee job performance. Whilst Khan et al. (2010) and Bandula & Jayatilake, (2016) found support for normative and continuance commitment respectively as having the most effect on employee job performance, this study found affective commitment as having the most effect on job performance.

The contrasting research findings on which organizational commitment dimension is most effective in influencing employee performance raises a number of contextual issues that cannot be overlooked since a particular geographical, economic, cultural and organizational environment can produce a specific result. The research works of Khan et al (2010) and Bandula & Jayatilake, (2016) for example were done in Pakistan and Sri Lanka in Asia which is a completely different context from the Ghanaian context with different cultural and organizational environment. By identifying affective commitment as the most effective organizational commitment dimension in influencing employee job performance in the context of the rural banks in Ghana, this study highlights the important role that different geographical, economic, cultural and organizational context play in establishing which organizational commitment dimension will affect job performance most.

According to Demirel and Goc (2013) employees who are dedicated to their institutions are very productive, loyal to their work and responsible in their line of duty which is a competitive advantage to the institution. This further highlight the importance of having committed employees since organizational scholars have demonstrated that there is a positive correlation between organizational commitment and employee job performance. Sungu, Weng, & Xu (2019) assert that affective commitment generally positively relate to job performance but the relationship varies with the employees occupational commitment and supervisors leadership style. Consistent with this line of argument, we postulate that it is the primary responsibility of CEOs who are the leaders of the rural banks to put in place measures that will motivate their employees in order to improve performance. That is to say that CEOs showing effective leadership styles will have highly committed workers who will achieve high performance within the rural banks. The findings of the study therefore provide further empirical support and validation for earlier research works that postulate that organizational commitment generally have positive effect on job performance (Irefin & Mechanic, 2014; Bandula & Jayatilake, 2016; Nirushan, 2017; Hafiz, 2017; Sungu, Weng, & Xu, 2019).

### 5.4 Mediating Role of Organizational Commitment

To establish the mediating effect of organizational commitment on the relationship between organizational culture and job performance, we first find out the effect of organizational culture on organizational commitment and that of organizational commitment on employee job performance. In this research we have shown that organizational culture generally affects job performance since three (clan, market and adhocracy) out of the four CVF organizational cultural dimensions positively predicted job performance. It is also established that all three dimensions of organizational commitment (affective, normative and continuance) positively affected job performance.

However, the results of the mediation analysis revealed that all three dimensions of organizational commitment (affective, normative and continuance) mediated the relationship between organizational culture and job performance. This gives the clearest indication that organizational commitment is a mediator in the organizational culture and job performance relationship. This result thus gives further empirical support to earlier research findings that reported that organizational commitment mediates the relationship between organizational culture and performance (Nikpour, 2017; Dewi, Syaifuddin, & Adam, 2019). The outcome of the study thus gives an indication that commitment of the employees of the banks is an important mechanism through which we can understand the effect of the corporate culture within the rural banks have on job performance of the workers. A strong organizational culture will likely lead to higher levels of commitment and performance as against a weak organizational culture. Organizational environment that promotes team work, consensus building and prioritizes the welfare of the workers in a family-like manner will largely result in high levels of commitment and enhanced job performance since the findings of the research identified clan culture as the dominant cultural value that affects employee job performance within the rural banks.

According to Wambui&Gichanga (2018) organizational culture is fundamental in determination of organizational commitment as well as employee satisfaction that is positively linked to their task performance. Organizational culture is therefore essential in building and sustaining employee commitment and performance in an organization. This is because once the employees accept and share the core values and norms of the organization they exhibit greater commitment and performance. In this study, it is shown that the connection between organizational culture and organizational commitment is supported theoretically and empirically, there is also enough evidence about the positive relationship between organizational commitment and employee job performance which further strengthens the argument that organizational commitment serves as a mediator between organizational culture and job performance. In other words, we have provided empirical validation to the assertion that organizational culture correlates with organizational commitment and organizational commitment does same with job performance. The outcome of this study has demonstrated that in the context of the rural banks organizational commitment mediates the relationship between organizational culture and job performance. A serene working environment which promotes strong corporate culture within the rural banks in Ghana is an essential tool for better employee commitment and task performance.

**6.0 Theoretical and Practical Contributions**

Our research findings provide further empirical support to the fact that a balanced CVF typologies of clan, adhocracy, market and hierarchy culture is essential for better employee job performance. The study showed that clan culture is the most significant culture for achieving high level employee job performance in the rural banks in Ghana. However, hierarchical culture was identified as militating against workers’ job performance. These results are innovative and contributes substantially to knowledge and theoretical literature by highlighting the type of cultural orientation that influences employee performance within the rural banking framework of Ghana whilst bringing to the fore the type of cultural orientation that militates against job performance within the same context. This result is even made more essential since there is no theoretical and empirical evidence in literature with respect to the cultural orientation that substantially affect job performance of workers within Ghana’s rural banking framework. Furthermore, previous studies by Calciolari, Prenestini, and Lega (2018) for example, found substantial support for hierarchical culture in terms of its effects on performance in a study conducted in Italy that differs from our findings. This brings to light the relevance of the cultural background in which a study is carried out, since this study was carried out in a Western context, which has a different national culture and working atmosphere from the Ghanaian context. In Western countries, most organisations typically have strict administrative procedures that are a dominant feature of their workplace and national culture and suit the way of life of their employees. This partially explains why a number of studies have found support for the culture of hierarchy in advanced countries. On the contrary, people are allergic to rigid bureaucratic processes in most developing countries including Ghana, where rigid bureaucratic

processes are a little foreign to the conventional Ghanaian way of life. Familiarity and human face replace rigid existing procedures most of the time, so it is not surprising that we identified clan culture as the dominant cultural type that improves performance. We make a significant contribution to literature by illustrating the significant contributions of national culture and organizational context in determining which cultural orientation will affect performance.

Also, this study has shown that organizational commitment mediates the relationship between organizational culture and job performance. The intermediary role of organizational commitment in aiding our comprehension of the processes through which CVF-based organizational culture typologies influence job performance is an innovative contribution to extant literature. This is because it gives researchers in-depth understanding of the role of commitment in explaining culture and job performance relationship in an African context especially Ghana since no study has explored this relationship within Ghana’s rural banking framework. With regards to theory, the results of the study provide further empirical support for the theoretical argument that an important factor in improving job performance is organizational commitment.

In reality, we have shown that culture management can bring about major improvement in the performance of rural banks employees in Ghana. Rural banks in Ghana tend to have structural rigidities and bureaucratic processes which make it difficult for them to adapt internally and react quickly to alterations in their environment and thus inhibit their employee's output. In this respect, ARB Apex Bank, the Association of Rural Banks and Bank of Ghana should have a second look at the rigid administrative procedures within the rural banks as it impedes the ability of the staff to perform effectively. Secondly, looking at the towering role of clan culture in enhancing employee performance in our findings, we recommend the creation of an organizational environment that is cozy, family like and encourages consensus building where employee’s welfare issues is a priority to be one of the major focus of CEOs and management of the rural banks.

*6.1 Research Limitations and Future Research Prospects*

Our research adds greatly to current literature on organizational culture and work performance but there are shortcomings. Firstly, the data for the survey were obtained exclusively from rural bank employees in the Western Region of Ghana that could limit the study’s generalizability. Also, future research can include data from public and commercial banks for a comparative analysis of the variables and how they relate from the perspective of both the public and private sectors.

APPENDIX

**Questionnaire**

Construct	Question
<b>Clan Culture (CC)</b>	
CC1	This organization is a personal place, it is like an extended family, people seem to share a lot of themselves
CC2	The leadership in this organization is generally considered to exemplify mentoring, facilitating, or nurturing
CC3	The management style in this organization is

	characterized by teamwork, consensus and participation.	AC4	I do not feel 'emotional attached' to this organization
CC4	The 'glue' that holds this organization together is loyalty and mutual trust. Commitment to the organization runs high	AC5	This organization has a great deal of personal meaning for me
CC5	This organization emphasizes human development. High trust, openness and participation persist.	AC6	I do not feel a great sense of belonging to this organization
CC6	This organization defines success on the basis of the development of human resources, teamwork, employee commitment and concern for people	<b>Continuance Commitment (CON)</b>	
<b>Adhocracy Culture (ADC)</b>		CON1	It would be very hard for me to leave my job at this organization right now even if I want to
ADC1	This organization is a dynamic place. People are willing to stick their necks out and take risks.	CON2	Too much of my life will be disrupted if I leave my organization
ADC2	The leadership in this organization is generally considered to exemplify entrepreneurship, innovation, or risk-taking.	CON3	Right now, staying with my job at this organization is a matter of necessity as much as desire
ADC3	The management style in this organization is characterized by individual risk-taking, innovation, freedom and uniqueness	CON4	I believe I have too few options to consider leaving this organization
ADC4	The 'glue' that holds this organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.	CON5	One of the few negative consequences of leaving my job at this organization would be the scarcity of available alternative elsewhere
ADC5	This organization emphasizes acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.	CON6	One of the major reasons I continue to work for this organization is that leaving would require considerable personal sacrifice
ADC6	This organization defines success on the basis of having unique, or the newest way of delivering social services. It is a service leader and innovator.	<b>Normative Commitment (NC)</b>	
<b>Market Culture (MC)</b>		NC1	I do not feel any obligation to remain with my organization
MC1	This organization is results orientated. A major concern is with getting the job done. People are very competitive and achievement orientated.	NC2	Even if it were my advantage, I do not feel it would be right to leave
MC2	The leadership in this organization is generally considered to exemplify a no-nonsense, aggressive, results-orientated focus.	NC3	I would feel guilty if I left this organization now
MC3	The management style in this organization is characterized by hard-driving competitiveness, high demands and achievement.	NC4	This organization deserves my loyalty
MC4	The 'glue' that holds this organization together is the emphasis on achievement and goal accomplishment.	NC5	I would not leave my organization right now because of my sense of obligation to it
MC5	This organization emphasizes competitive actions and achievement. Hitting stretch targets and providing social services are dominant.	NC6	I owe a great deal to this organization
MC6	This organization defines success on the basis of providing quality social services to the people and outpacing other MMDAs. Competitive market leadership is the key	<b>Job performance (JP)</b>	
<b>Hierarchical Culture (HC)</b>		JP1	I adequately complete assigned duties
HC1	This organization is a controlled and structured place. Formal procedures generally govern what people do.	JP2	I fulfil responsibilities specified in job description
HC2	The leadership in this organization is generally considered to exemplify co-coordinating, organizing, and smooth-running efficiency.	JP3	I perform tasks that are expected of me
HC3	The management style in this organization is characterized by security of employment, conformity, predictability and stability in relationships.	JP4	I meet formal performance requirement of the job
HC4	The 'glue' that holds this organization together is formal rules and policies. Maintaining a smooth-running organization is important.	JP5	I engage in activities that will directly affect my performance evaluation
HC5	This organization emphasizes permanence and stability. Efficiency, control and smooth operations are important	JP6	I neglect aspects of the job I am obligated to perform ®
HC6	This organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling and value for money are critical.	JP7	I fail to perform essential duties ®
<b>Affective Commitment (AC)</b>			
AC1	I would be very happy to spend the rest of my career in this organization		
AC2	I really feel as if this organization's problem are my own		
AC3	I do not feel like 'part of my family' at this organization		

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# Population Parameters of Green Mussel, *Perna viridis* (Linnaeus, 1758) from Ye Estuary, Mon Coastal Area, Myanmar

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**Abstract** - Green mussel, *Perna viridis* samples which inhabit in the subtidal bed of Ye Estuary were monthly collected from March 2016 to February 2017 to estimate the population parameters using length-frequency data based analysis of FiSAT II software. Asymptotic length ( $L_{\infty}$ ), growth coefficient ( $K$ ) and growth performance index ( $\Phi'$ ) were calculated as 162.75 mm, 0.87 year<sup>-1</sup> and 4.363 respectively. Total mortality ( $Z$ ), natural mortality ( $M$ ) and fishing mortality ( $F$ ) were estimated at 1.86 year<sup>-1</sup>, 0.81 year<sup>-1</sup> and 1.05 year<sup>-1</sup>. The calculated exploitation level ( $E$ ) of the population was 0.44 and it ( $< 0.50$ ) suggests that the stock of *P. viridis* shows the potential for exploitation in Ye Estuary. More exploitation is possible and could be an option for the livelihood of the coastal communities of the area. The recruitment pattern was continuous with one major peak in the months of June-July. The present results could serve as a baseline information for the management of mussel population in Ye Estuary.

**Keywords:** Exploitation, *Perna viridis*, population parameters, Ye Estuary, Myanmar

## I. INTRODUCTION

Green mussel, *Perna viridis*, is one of the popular edible bivalve molluscs inhabited along rocky shore of Sitaw and in the subtidal area of Ye Estuary, Mon coastal area, Myanmar. It is one of the most important bivalves for daily income of local fishermen and it stands second price to the oyster *Crassostrea belcheri*. According to the local mussel fishermen, though the population of *P. viridis* was abundantly observed on the rocky shore of Sitaw last 20 years ago, it is being reduced and the settlement of spats on the rocky substrate cannot support to initiate the mussel farming in the present study area. This may be because of harvesting them before they reached the maturity state. However, rich mussel beds are on the subtidal rocks under about 10 meters below surface water. The mussel fishermen from Zeephuthaung village collect the mussels from the subtidal mussel bed in Ye River Mouth by using diving equipment and chisel. For any given population in an area, the resources available are limited. Hence, a correct understanding of the interactions between the population and its resources is very essential for the sustenance of the population.

*P. viridis* meat is a valuable source of food for human consumption due to its high quality protein as well as well-balanced nutritional composition such as essential amino acids (Saritha et al., 2015). It is an ideal candidate for aquaculture and commercial cultivation of green mussel is extensively carried out in tropical countries to supply of affordable protein to coastal community (Rajagopal et al.,

2006). A proper management of this stock in Ye Estuary is, therefore, essential for its being commercially important aquaculture organism for human consumption and for the initiation of commercial mussel farming in this area. A thorough knowledge of various growth parameters and sustainable levels of exploitation could go a long way in the scientific management of these valuable bounties. For the management of mollusc resources, knowledge of various population parameters and exploitation level ( $E$ ) of that population is required. The study of mortality (death rate) and natality (birth rate) are very useful in the estimation of mussel stocks. The estimation of mortality rate is the basic requirement in bivalve stock assessment studies and it can give us an idea about the level of stock available for exploitation.

Although several works have been conducted on fish and prawns in Myanmar, there is still no detailed report regarding the population dynamics and exploitation status of green mussel fishery in Myanmar. The population parameters such as length-frequency distribution, asymptotic length ( $L_{\infty}$ ), growth coefficient ( $K$ ), growth performance index ( $\Phi'$ ), recruitment pattern, mortality rates ( $Z$ ,  $F$  and  $M$ ), and exploitation level ( $E$ ) of *P. viridis* in Ye River Mouth was, therefore, estimated in this study to generate baseline information, which will be essential for future studies and also crucial for sustainable management of the mussel population and to initiate the mussel culture in Ye Estuary.

## II. MATERIALS AND METHODS

To study the population parameters of *Perna viridis* which inhabits in the subtidal water of Ye Estuary (Lat. 15° 11' N, Long. 97° 48' E), the samples were randomly collected from the subtidal natural mussel beds during March 2016 - February 2017 (Figure 1). The collected samples were cleaned and directly transferred to the laboratory of Marine Science Department, Mawlamyine University, by using cool box under humid condition. The shell-length (i.e. maximum distance along the long axis of the valves) of each specimen was measured to the nearest 1mm with digital Vernier Calipers. The data were then grouped into total shell length classes by 10 mm intervals. Subsequently the data were analyzed using the FiSAT software as explained in detail by Gayanilo et al., (1996). Asymptotic length ( $L_{\infty}$ ) and growth coefficient ( $K$ ) of the von Bertalanffy growth function (VBGF) were estimated by means of ELEFAN-1 (Pauly & David, 1981).  $K$ -scan routine was conducted to assess a reliable estimate of the  $K$  value. The estimates of  $L_{\infty}$  and  $K$  were used to estimate the growth performance index ( $\Phi'$ ) of *P. viridis* using the equation:  $\Phi' = 2 \log_{10} L_{\infty} + \log_{10} K$  (Pauly and Munro, 1984).

The theoretical age at zero length ( $t_0$ ) was calculated as:  $\text{Log}_{10}(t_0) = 0.392 - 0.275 \text{Log}_{10} L_{\infty} - 1.038 \text{Log}_{10} K$  (Pauly,

1979). Longevity ( $t_{max}$ ) of the population was estimated according to the equation:  $t_{max} = 3/K$  (Pauly, 1984). The inverse von Bertalanffy growth equation (Sparre & Venema, 1992) was used to find the lengths of the *P. viridis* at various ages. Then VBGF was fitted to estimates of length-at age curve using non-linear squares estimation procedures. The VBGF is defined by the equation:  $L_t = L_{\infty}[1 - e^{-K(t-t_0)}]$  (Pauly et al., 1992), where  $L_t$  is the mean length at age  $t$ ,  $L_{\infty}$  the asymptotic length,  $K$  the growth coefficient,  $t$  the age of the *P. viridis* and  $t_0$  is the hypothetical age at which the length is zero (Newman, 2002).

The total mortality ( $Z$ ) was estimated by a length converted catch curve method (Pauly, 1984). Natural mortality rate ( $M$ ) was estimated using the empirical relationship of Pauly (1980):  $\log_{10}M = -0.0066 - 0.279 \log_{10}L_{\infty} + 0.6543 \log_{10}K + 0.4634 \log_{10}T$ , where  $M$  is the natural mortality,  $L_{\infty}$  the asymptotic length,  $K$  refers to the growth coefficient of the VBGF and  $T$  is the mean annual habitat temperature ( $^{\circ}C$ ) of the water in which the stocks live. Once  $Z$  and  $M$  were obtained, then fishing mortality ( $F$ ) was estimated using the relationship:  $F = Z - M$ , where  $Z$  is the total mortality,  $F$  the fishing mortality and  $M$  is the natural mortality. The exploitation level ( $E$ ) was obtained by the relationship of  $E = F/Z$  and  $Z = F + M$  (Gulland, 1965).

The recruitment pattern which describes how new individuals are added onto the population was determined by the backward projection onto the length axis of the length-frequency data as described in FiSAT. This routine reconstructs the recruitment peak pulses from a time series of length-frequency data to determine the number of peak pulses per year and relative strength of each peak pulse (Al-Barwani et al., 2007). Input parameters are  $L_{\infty}$ ,  $K$ , and  $t_0$ , and the normal distribution of the recruitment pattern was determined by NORMSEP in FiSAT (Pauly & Caddy, 1985; Al-Barwani et al., 2007).

### III. RESULTS AND DISCUSSION

#### A. Growth parameters

The present study represents the very first report on the population parameters of *Perna viridis* in the study area as well as in Myanmar. Growth parameters ( $L_{\infty}$ ,  $K$ ,  $t_0$ ) are helpful in comparison of growth rates between and within species inhabiting different habitats. The comparison with population parameters of *P. viridis* estimated from VBGF at Ye Estuary differ from those of the same species from other different areas in the world (Table 1). In the present study, a total of 599 *P. viridis* was analyzed for their size-frequency distribution, and the mussel population had a shell length range of 50mm to 163mm. The overall size-frequency distribution (Figure 2) showed a modal shell length of 100-110mm.

Estimated values of growth parameters such as asymptotic length ( $L_{\infty}$ ) of the VBGF and the hypothetical age of birth at zero length ( $t_0$ ) for *P. viridis* were 162.75 mm and -0.70246. The computed growth curve using these parameters is shown over the restructured length distribution in Figure 3. Asymptotic length ( $L_{\infty}$ ) is the maximum theoretical length an organism can attain under the given rate of growth (Hemachandra et al., 2017). The lowest value of  $L_{\infty}$  (75.40 mm) is from India (Thejasvi, 2016) and the highest value (194.30 mm) is in Bangladesh (Nural Amin et al., 2005). In



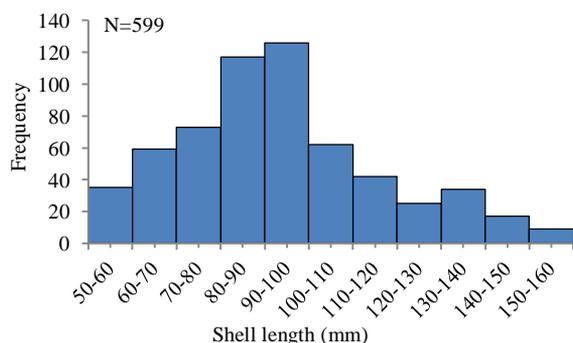
Figure 1. Sampling station of *Perna viridis* in Ye Estuary

the present study, the value of asymptotic length ( $L_{\infty}$ =162.75 mm) of the mussel from Ye Estuary was relatively smaller than that recorded for *P. viridis* ( $L_{\infty}$ =184.60mm) from Kakinada Bay, India (Narasimham, 1981) and ( $L_{\infty}$ =194.30 mm) from intertidal region of Moheskhal Channel, Bangladesh (Nural Amin et al., 2005). This value was higher compared to those in India waters at 75.4 mm, 85 mm, 110 mm 117.50 mm, 136.9 mm (Thejasvi, 2016; Rivonkar et al., 1993; Chatterji et al., 1984; Thejasvi, 2016; Hemachandra et al., 2017), in Bangladesh waters at 124.65 mm, 136.5 mm (Kamal & Khan, 1998; Khan et al., 2010), in Thailand waters at 112 mm Tuaycharoen et al., 1988, in Malaysia waters at 89.4 mm, 102.4 mm, 113.4 mm, 120.75 mm (Choo & Speiser 1979; Al-Barwani et al., 2007; Taib et al., 2016; Kassim et al., 2017) and in Hong Kong waters at 101.9 mmm (Lee, 1985), respectively.

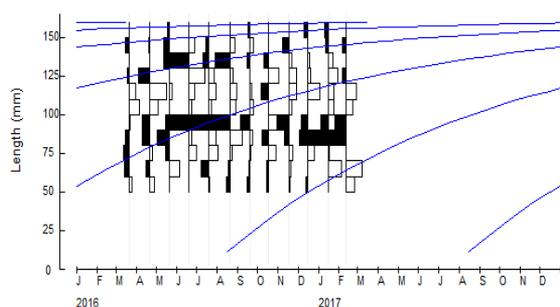
The observed maximum length was 155 mm and the predicted maximum length estimated from the present study was 163.28 mm (Figure 4). The confidence interval was 157.33–169.24 mm (95% probability of occurrence). The best estimated value of growth coefficient ( $K$ ) was 0.87 year<sup>-1</sup> and the growth performance index ( $\Phi'$ ) was 4.363 (Figure 5). The coefficient  $K$  is the rate at which the animal approaches to the theoretical maximum length and it can be used to compare between the growth of related species or some species in varied habitats. The highest  $K$  value (2.14 year<sup>-1</sup>) was obtained in Malaysia Choo & Speiser 1979 and the lowest value (0.1 year<sup>-1</sup>) was reported from Zuari estuary, India (Rivonkar et al., 1993). It was observed that the  $K$  value (0.87 year<sup>-1</sup>) of *P. viridis* in the present study was higher than those of *Perna viridis* in India waters (except the result of Thejasvi, 2016), Bangladesh waters (except the result of Khan et al., 2010) and in Hong Kong waters (Lee, 1985) but the value  $K$  is more or less closed to those of *P. viridis* reported from Thailand waters (Tuaycharoen et al., 1988). Highest  $K$  values (2.14 year<sup>-1</sup> and 1.7 year<sup>-1</sup>) were from Malaysia waters (Choo & Speiser, 1979; Taib et al., 2016) which are higher than the results of present study (Table 1).

The growth performance index ( $\Phi'$ ) allows inter-and intra-specific comparison of growth performance in bivalve species of different stock (Abohweyere & Falaye, 2008; Adjei-Boateng & Wilson, 2012). The growth performance index value of *P. viridis* ( $\Phi'=4.363$ ) at Ye Estuary in the present study was the highest value in the results reported from other countries (Table 1). The high  $\Phi'$  values were reported from Thailand at  $\Phi'=4.0984$  (Tuaycharoen et al., 1988) and from Malaysia waters at 4.1965, 4.2331 and 4.3425, respectively (Al-Barwani et al., 2007; Choo & Speiser 1979; Taib et al., 2016).

Growth performance of bivalves could be as a result of influences of environmental factors, and thus, bivalves found at different geographical locations may have different growth performance indices which could be as a result of the prevailing environmental conditions (Krampah et al., 2019). Most of the lower  $\Phi'$  values were reported from *P. viridis* inhabiting along the intertidal regions of India and Bangladesh waters. The mussels in the intertidal zone are exposed to atmosphere during low tide and hence are under stress continuously when compare to the subtidal natural population of Kakinada Bay, and Ye Estuary (present study) and the subtidal cultured mussels of Thailand and Malaysian waters (Table 1).



**Figure 2.** Length frequency distribution of *Perna viridis* from Ye Estuary

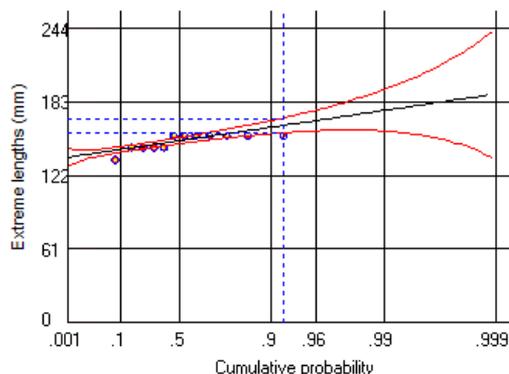


**Figure 3.** Restructured length–frequency distribution with growth curves superimposed using ELEFAN-1 ( $L_{\infty} = 162.75$  mm and  $K = 0.87$  year<sup>-1</sup>)

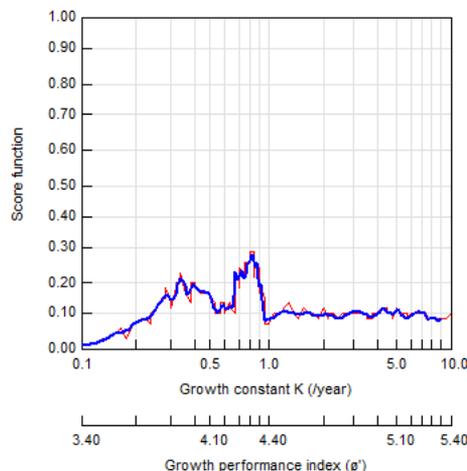
### B. Age and growth

The von Bertalanffy's growth equation substituted with the growth parameters ( $L_{\infty}$ ,  $K$  and  $t_0$ ) estimated from the length frequency data of *Perna viridis* from Ye Estuary could be expressed as  $L_t = 162.75 [1 - e^{-0.87(t - (-0.70246))}]$ . Therefore, the size attained by *P. viridis* were 86.34, 96.66, 105.58, 113.30,

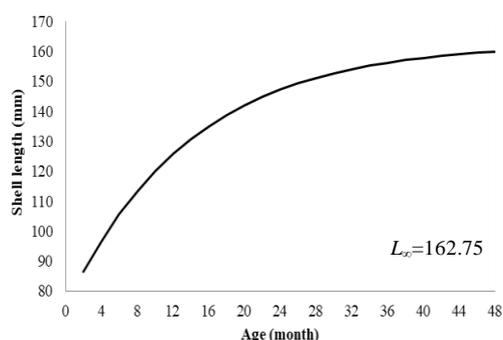
119.97 and 125.74 mm at the end of 2,4,6,8,10,12 months of age, respectively and 125.74 mm in 1 year, 147.25 mm in 2year, 156.26 mm in 3 year and 160.03 mm in 4 year of age from the theoretical age of fish at birth in its life. The absolute increase has been represented in Figure 6. The calculated average growth rate of *Perna viridis* for the first 6 months was 17.60 mm/month and in the following 6 months was 3.36 mm/month.



**Figure 4.** Estimation of maximum length *Perna viridis*



**Figure 5.** Growth constant ( $K$ ) and growth performance index ( $\Phi'$ ) of *Perna viridis*



**Figure 6.** Derived growth curve of *Perna viridis* from Ye Estuary

The longevity ( $t_{max}$ ) of *P. viridis* was approximately 4 years was estimated for the mussel population in Ye Estuary. From the von Bertalanffy growth equation, the length of *P. viridis* from Ye Estuary at age 1 was 125.74 mm, which suggests that the mussel grows at an average length of

10.48 mm per month. The observed lifespan (4 years) of *P. viridis* from Ye Estuary is higher than approximately 2 years of lifespan reported from the offshore waters of Naf River Coast Bangladesh (Khan et al., 2010) and coastal waters of Malacca, Peninsular Malaysia (Al-Barwani et al., 2007) and also higher than average lifespan of 3 years for *P. viridis* in Hong Kong waters (Lee, 1985). However, Thejasvi (2016) estimated the age of *P. viridis* inhabiting in the subtidal bed of Amdalli was approximately 14 years while mussels inhabiting along the intertidal region of Mukka had a lifespan of 2.25 years in India waters. However the species *Perna perna* from Iture rocky beach, Ghana, India, has a relatively longer lifespan of 6 years with smaller asymptotic length of  $L_{\infty}=80.10$  mm (Krampah et al., 2019). The lifespan for the tropical species of the genus *Perna* has been reported to be 4-6 years (Lutz, 1980).

C. Mortality and exploitation

Figure 7 illustrates the length-converted catch curve of *P. viridis* which estimated the total mortality rate ( $Z$ ) of the populations based on mussels that were fully exploited. The annual mean surface temperature during the sampling period was 30.0°C. In the present study, the total mortality ( $Z$ ) of *P. viridis* based on the length converted catch curve was 1.86 year<sup>-1</sup>. The estimated natural mortality ( $M$ ) was 1.05 year<sup>-1</sup> and fishing mortality ( $F$ ) was 0.81 year<sup>-1</sup>. Mortality is an important aspect in the population dynamics of mussels (Fabens, 1965) and it could vary enormously depending on environmental conditions. Higher natural mortality versus fishing mortality observed for *P. viridis* in this study indicates an imbalance in the stock. The observation of higher natural mortality in the present study is similar to the findings of the workers from Bangladesh and Malaysia (Nural Amin et al., 2005; Al-Barwani et al., 2007; Khan et al., 2010) and it suggests that mortality based on natural causes was higher than that of exploitation of the mussel in those areas. On the other hand, higher fishing mortality was observed than natural mortality for *P. viridis* in India (Thejasvi, 2016; Hemachandra et al., 2017), indicating that mortality based on exploitation was relatively higher than that based on natural cause. It is undoubtful that predation is the most significant unique source of natural mortality (Karayücel & Karayücel, 1999). Nevertheless, cause for mortality is also attributable to the rampant amount of metabolic stress in relation with spawning (Emmet et al., 1987; Tremblay et al., 1998).

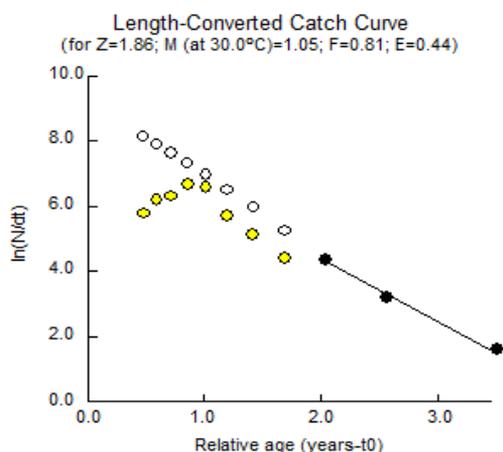


Figure 7. Length converted catch curve of *Perna viridis* from Ye Estuary

The estimated exploitation level ( $E$ ) of *P. viridis* in Ye Estuary was 0.44. According to Gulland (1965), the yield is optimized when fishing mortality ( $F$ ) is equal to natural mortality ( $M$ ); therefore, when the exploitation rate ( $E$ ) is more than 0.5, the stock is over-fished. Theoretically when  $E=0.50$ , then the stock of any aquatic species is at the optimum level. The lower value of exploitation level ( $E=0.44$ ) in the present study indicates the 'under-fishing' condition of *P. viridis* in the study area. The lower  $E$  values were also estimated from the population of *P. viridis* at  $E=0.04$  in Moheskhal channel of Bangladesh water Nural Amin et al., 2005 and at  $E=0.32$  from the coastal region of Malaysia water (Al-Barwani et al., 2007). However the high exploitation rates of *P. viridis* reported at  $E=0.67$  from intertidal region at Mukka Thejasvi, 2016, at  $E=0.77$  from subtidal bed at Amdalli (Thejasvi, 2016) and at  $E=0.64$  from intertidal region of St. Mary's group (Hemachandra et al., 2017) in India waters indicating that 'over-fishing' of this species at those areas.

D. Recruitment pattern

The recruitment pattern of *P. viridis* from FiSAT II software for the population at Ye Estuary is shown in Figure 8. The recruitment pattern of *P. viridis* in the present study was continuous throughout the year with the only major peak which observed during June-July. The peak pulse produced 15.51% of the observed recruitment during the study period. The Recruitment has been described as a continuous phenomenon for tropical species because of the relatively stable and elevated water temperatures allowing year-round breeding (Adjei-Boateng & Wilson, 2012; Qasim, 1973; Weber, 1976). The observation of one seasonal pulse of recruitment pattern in the present study is similar to the findings by Al-Barwani et al., (2007) who also observed one seasonal peak (July-August) in the recruitment pattern of *P. viridis* in the coastal waters of Malacca, Peninsular Malaysia and also by Thejasvi (2016) who observed one seasonal peak (April-June) in the recruitment pattern of the same species in the intertidal region at Mukka and in the subtidal bed at Amdalli, India. Two seasonal pulses, however, were observed from Moheskhal channel (March-May & August-October) and Naf river coast (March-June & July-September) in Bangladesh waters (Nural Amin et al., 2005; Khan et al., 2010) and also from Maruda Bay (July & February), Malaysia (Taib et al., 2016).

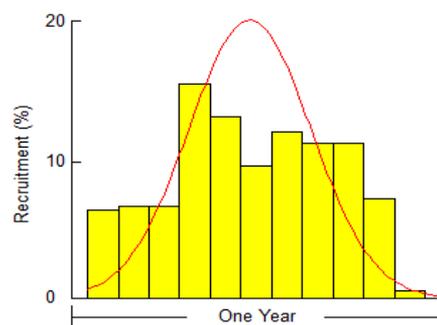


Figure 8. Recruitment pattern of *Perna viridis* from Ye Estuary

**Table 1.** Comparison on growth parameters of *Perna viridis* reported from different countries

Location	Habitat	$L_{\infty}$ (mm)	$K$ ( $yr^{-1}$ )	$\Phi'$	Temp.	Source
India	subtidal bed, Kakinada Bay	184.6	0.25	3.9304		Narasimham, 1981
	Raft culture, Dona Paula, Goa	110	0.11	3.1336		Chatterji et al., 1984
	Raft culture, Zuari estuary, Goa,	85	0.1	2.8648		Rivonkar et al., 1993
	Intertidal region at Mukka	75.4	1.51	3.5758		Thejasvi, 2016
	Subtidal bed, Amdalli	117.50	0.28	3.5872		Thejasvi, 2016
	Intertidal region at Coconut Island of St. Mary's group of Islands off Malpe	136.9	0.42	3.8960		Hemachandra et al., 2017
Bangladesh	Piers of Moheshkhali jetty, Bay of Bengal	124.65	0.1	3.1938		Kamal & Khan, 1998
	Intertidal region at Cox's Bazaar, Moheshkhali Channel	194.3	0.56	2.32	28	Nural Amin et al., 2005
	Naf river coast	136.5	1.3	2.38	30.2	Khan et al., 2010
Thailand	Pole culture, Upper Gulf	112	1.00	4.0984		Tuaycharoen et al., 1988
Malaysia	Suspended plastic cage, Penang	89.4	2.14	4.2331		Choo & Speiser 1979
	Coastal region, Malacca	102.4	1.5	4.1965	29.44	(Al-Barwani et al., 2007)
	hanging rope method, Maruda Bay	113.4	1.7	4.3425		Taib et al., 2016
	hanging rope method, Kesang coastal water	120.75	0.66	3.9810		Kassim et al., 2017
Hong Kong	Victoria Harbor	101.9	0.30	3.5411	24 - 29	Lee, 1985
Myanmar	subtidal bed, Ye Estuary	162.75	0.87	4.363	30	present study

IV. CONCLUSIONS

The high asymptotic length ( $L_{\infty}=162.75$  mm) and growth constant value ( $K=0.87$  year<sup>-1</sup>) estimated from the present study indicates that the growth of *Perna viridis* from Ye Estuary is higher than those of other countries. The stock of *P. viridis* in the study area is underexploited since natural mortality is higher than fishing mortality. It could be concluded that the stock of the green mussel shows the potential for exploitation in Ye Estuary. More exploitation is possible and could be an option for the livelihood of the coastal communities of the area. However, the exploitation rate ( $E=0.44$ ) is closed to the optimal level ( $E=0.5$ ). Therefore, the population of *P. viridis* in Ye Estuary would require the initial action to manage this valuable fishery and ecological resource and to initiate the culture of this species.

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# Leadership Styles Demonstrated by CEOs and their Impact on Company Performance within Diverse Organizational Cultures: A Study Based on the Private Sector Apparel Manufacturing Firms in Sri Lanka

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**Abstract-** Leadership styles, particularly demonstrated by the CEOs of the private sector apparel manufacturing industry in Sri Lanka is a sparsely explored phenomena. Therefore, the objective of the researcher in undertaking the current study is to determine the impact of leadership styles adopted by the CEOs of private sector apparel manufacturing companies in Sri Lanka on the performance of these respective organizations.

In the main, since the study explores a behavioral aspect of leadership an Explanatory Sequential Mixed Method, where an embedded case study is conducted in the research. The quantitative analysis of the study was performed with a sample of 30 medium to large scale apparel manufacturing entities operating in Sri Lanka by administering a structured questionnaire among ten direct subordinates of the CEOs of each of the thirty companies. The leadership styles were measured through Full range leadership model of Avolio and Bass (2001) [1] and organizational performance was measured through the Balanced Score Card model of Kaplan and Norton (2005) [2]. In conducting the qualitative analysis, ten individuals of the sample were selected based on the performance criteria in conducting the semi-structured interviews on leadership styles adopted by their CEOs and the resultant impact on organizational performance. Further, the business case evaluations were conducted with ten identified CEOs based on the established performance criteria. The data collected through the questionnaire was quantitatively analyzed and the insights drawn were further reinforced through the content analysis of qualitative data.

The findings revealed that none of the CEOs confined themselves to a single leadership style, rather adopted an integrative approach where attributes of different leadership styles were adopted based on the situational demands, performance readiness of the subordinates, time and resource constraints and the impact toward the organizational bottom-line. Further, the leadership style has a significant impact on organizational performance. Research findings also established that under all the above leadership styles demonstrated organizational culture plays a strong moderating role in influencing organizational outcomes.

**Index Terms-** Leadership Styles, Organizational Culture, Organizational Performance.

## 1. INTRODUCTION

### 1.1 Background

In the past five decades, the most significant and histrionic social changes in the apparel industry has been the transition of the manufacturing constituent from the affluent nations to the developing countries. This shift of global demand presents many challenges to the offshore manufacturers through the exertion of cost cutting pressure, proliferation of products to meet complex customer requirements with fast turnaround and sustainable manufacturing [3]). Drucker (2001) asserted that with the transition of economies from a production to a knowledge and information era presents modernistic challenges in terms of interactive team work, knowledge integration, strategic alliances, co-production of solutions with customers and suppliers, digital modeling, industrial robotics and additive manufacturing which are absolutely distinct to the challenges of the production era. In the wake of these challenges, strategic leaders mainly the C suites need the capacity to have an encyclopedic view and the capability and competence to facilitate changes in leading organizations in the right direction [4]

## 1.2. The Privately-Owned Apparel Manufacturing Industry in Sri Lanka

The liberalization of the economy and the guaranteed but restricted access of apparel exports facilitated through the Multi Fiber Agreement (MFA) accelerated the growth prospects for Sri Lanka [5]. The apparel industry has demonstrated a positive trajectory of growth over the past four decades, securing its position as the primary export exchange earner for over two decades [6].

According to the Labour Force Survey conducted by the Department of Senses and Statistics Sri Lanka (2018) [7] the employment offered by the apparel industry which is entirely privately-owned amounts to 15% of the country's employed population, implying its economic significance. The country's export-oriented apparel manufacturers currently numbers 350 ranging from large to small scale entities [6]. The Sri Lankan apparel industry has evolved from an era of traditional exports and tailoring to a much-sophisticated pipeline of apparel Solutions from design to delivery.

## 1.3. Research problem

Preliminary investigations on leadership styles displayed by the CEOs of the apparel manufacturing companies revealed varying leadership attributes ranging from transformational to Laissez-Faire, which exceedingly depended on situational circumstances. While transformational leadership attributes were dominant in managing the pertinent changes that facilitated accurate and timely business decisions, stereotype leadership attributes with no consideration of situational circumstances tend to be the leadership characteristics of poorly performing companies. The organizational culture of the organization also had a significant association with the leadership styles adopted by the CEOs and also the performance of the organization.

Even though the Sri Lanka's largest export market is the United States, based on the US import statistics, the exports from Sri Lanka to the US has dropped by 11.2% YoY (2018 vs 2017) whereas the four major competitors; Bangladesh, Vietnam, India and China have grown by 6.7%, 5.8%, 3.3% and 1.4% respectively [8]. The above statistics together with the results of the preliminary findings signify an appalling performance and reflects poorly of the industry in Sri Lanka. A study conducted by McCann (2007) [9] on leadership styles adopted by apparel manufacturing CEOs evaluated their impact on firm performance in the United States. The study revealed that situational leadership adopted by the CEOs contributed to a 7%-8% gain in productivity. This however has not been researched in a Sri Lankan context. Even though the Sri Lankan companies have made significant investments in this domain. Therefore, this study attempts to address the void in research to ascertain the outcomes of such initiatives in terms of increased business value. Hence, the aim of this study is to identify the prevalent leadership styles adopted by the CEOs of the Private Sector Apparel Manufacturing Companies in Sri Lanka and to find how those leadership styles affect the performance of the respective companies. Further, the study attempts to identify the moderating effect of organizational culture on the relationship between leadership styles and organizational performance.

## 2. LITERATURE REVIEW

### 2.1. Leadership Theories

The history of research on leadership, discloses distinctive phases through which leadership theories evolved. Leadership literature reveals that theories have been refined and modified with passage of time and none of the theories is completely irrelevant. As mentioned earlier, relevance depends on the context in which it is applied. The type of leadership applied in functions entailing very high degree of precision, confidence level, sensitivity, care and technical expertise may be different than in simple management-oriented portfolios, as one that does not fit all heads [10].

#### 2.1.1. The Great Man Theory

The primeval belief was that there are only a very few, unique individuals in society who could assume the role of leadership, supported by the ideology that leaders are born and only those bequeathed with heroic potential could emerge as leaders [11].

#### 2.1.2. Trait Theories of Leadership

Jenkins (1947) [12] deduced two categories of traits: emergent and effectiveness traits. Whilst emergent traits were heavily dependent on heredity such as intelligence the latter was deemed to be associated with experience and learning [13]. The trait theory of leadership came under criticism due to the challenges faced in categorizing and endorsing common traits.

#### 2.1.3. Style & Behavior Theories

Yukl (1981) [14] presented three behavioral leadership styles. The democratic leaders respected consultative decision making, involving their subordinates, who enjoyed a high degree of satisfaction, in executing their work with enthusiasm and energy even in the absence of the leader. Conversely, autocratic leaders focus on the abundance of output and made decisions with no involvement of their subordinates. Laissez faire leadership is only deemed pertinent in leading a team of exceedingly skilled and motivated people with an excellent track-record. These leaders allow subordinates to make decisions.

The outcome of the Scandinavian research studies established a key premise that successful leaders demonstrated development-oriented behaviors that were biased towards experimentation, pursuit of new ideas and identification of the need for change ([15].

#### 2.1.4. Contingency (Situational) Theories

Hersey et al.(1996) [16] presented the situational leadership theory which was built on the premise that the level of direction given by the leader, through task behavior and the empathetically driven support demonstrated through relationship behavior should be altered depending on the situational context and the level of maturity of the follower, referred to as the performance readiness of the employees. The model established that there was no ideal leadership style and the success of the leader was defined in terms of his/her ability to flex between the leadership styles. They identified four situational leadership styles, namely; telling, selling, participating and delegating. [17].

#### 2.1.5. Leader Member Exchange Theory (LMX)

LMX is a dyadic theory which explains how a leader maintains his/her position through the development and the exchange of a series of tacit agreements with the members. The theory assumes that leaders exert influence on the members through the quality of the relationships they build through the phases of role taking, role making and clarifying routine tasks. The relationship is of high quality when it is characterized by trust, affinity, loyalty and professional respect [18].

The in and out groups are two informal groups where leaders clearly differentiate between their followers. The leaders establish a distinct relationship with an inner circle of trusted members belonging to the in group to whom they assign high levels of responsibility and influence over decision-making. Conversely, the members of the out-group are given less choice and influence over decisions and their relationships are often governed within the narrow constraints of their formal employment contracts [19].

Wang, et al., (2005) [20] empirically established the mediation effect of LMX on the relationship between transformational leadership and subordinate performance. The findings disclose that a high-quality LMX relationship is vital in achieving increased organizational outcomes.

#### 2.1.6. Full Range Leadership Model (FRLM)

The FRLM proposed by Avolio and Bass (2001) [1], presents a spectrum of leadership styles. According to Avolio and Bass transactional leaders are viewed as having a greater aptitude in the accomplishment of task-oriented outcomes but are less proficient in situations that demand change management and organizational development.

The underlying principle in the application of the FRLM is the ability of the transactional leader to alter the equilibrium through the utilization of the transformational leader attributes based on the situational demands to optimize organizational performance and vis a versa. The revised FRLM presents nine leadership factors.

##### 2.1.6.1 Transformational leadership

Transformational leadership demonstrates proactive leadership behaviors. Avolio (1999) [21] outlines the five first order factors.

###### Idealized Influence (Attributed)

The social personality of the leader, perceived as one who is determined, strong, committed, powerful and possesses higher order morale and ethical convictions that are comparable to those of their followers.

###### Idealized influence (Behavior)

The leader demonstrates behavior of charismatic nature, committed to a segment of values shared through an idealized vision which are behaviorally and emotionally aligned with their followers.

###### Inspirational Motivation

The transformational leaders' declarations of the future take an optimistic stance, in articulating an ambitious vision, stressing on organizational goals. They lead followers through inspiration and motivation.

###### Intellectual Stimulation

The leader enhances the followers' intellectual creativity by emphasizing on problem solving through creative thinking, challenging the followers to utilize innovative ideas that are appealing to the follower's sense of logic and analysis.

###### Individualized Consideration

The leader actively gets involved in the capacity of a mentor on an individual basis providing advice, support and individual attention towards the needs of the followers. The leader satisfies the followers through personal growth, development and self-actualization.

##### 2.1.6.2. Transactional Leadership

Transactional leadership is a process of exchange constructed on the fulfillment of contractual obligations. Bass & Avolio (1990) [22] established the transactional leader attributes as follows:

###### Contingent Reward

Based on the contractual commitment the leaders predominantly assume an expounding role in detailing task requirements and in rewarding the employees on the fulfillment of contractual obligations.

###### Management by Exception – Active

Actively engages in monitoring and controlling outcomes through vigilance to ensure compliance to standards and task accomplishment. Therefore, the leader has the discretion and the information to take corrective action immediately if the performance falls short of the standard.

###### Management-by-Exception -Passive

The leader intervenes only after the noncompliance has occurred and errors have taken place, assuming a passive role where intervention happens only if the problem intensifies.

### 21.6.3. Laissez-Faire Leadership (LF)

Demonstrates passive or avoidant behavior. The absence of leadership is typified through the avoidance of decision making, the abdication of responsibility and non-exertion of the authority.

## 2.2. Organizational Culture and Leadership

Schein (1985) [23] defines organizational culture as a shared set of fundamental assumptions that was studied and acquired by a group of individuals as capable of solving problems concerned with external adaptation and internal integration that has yielded positive outcomes so as to be endorsed as valid and qualified to be taught to new members as the correct way to perceive, feel and think in relevance to the problem encountered.

Kilmann (1975) [24] views leadership as fundamental in managing and controlling cultures as they evolve, which if unattended would eventually become dysfunctional or destructive. Tsui (2006) [25] presents three different perspectives. Under the functionalist perspective a culture is presented as an outcome of visionary and charismatic leadership. The attribution perspective establishes a strong positive relationship between the employee perception of leader behavior and the interpretations of organizational culture. Finally, the contingency perspective purports that the organizational culture could either restrict or provide opportunities for leaders to exert their abilities in influencing organizational outcomes under varying situations.

### 2.2.1. Organizational Culture Assessment Instrument (OCAI)

The OCAI was developed by Quinn and Cameron (2011) [26] based on the Competing Value Framework (CVF). The pertinent institutional cultures are thus;



Figure 1: Organizational Culture Assessment Instrument (OCAI)

#### 2.2.1.1 Clan Culture

Community or clan cultures demonstrate strong employee loyalty and commitment to a strong leader and strives for cohesion and congruence through teamwork, consensus and participation.

#### 2.2.1.2. Competitive Culture (Market Cultures)

The main objective is the achievement of organizational goals under the leadership of an aggressive, tenacious and competitive leader whose measure of success is the competitive advantage over their peer institutions. The binding glue is their winning attitude.

#### 2.2.1.3. Hierarchy Culture

Hierarchy cultures are highly formalized, structured and are regulated by policies and procedures. Success is defined through efficiency, predictability, stability and consistency of achieving goals. Formal rules and policy documents bind the organization together.

#### 2.3.1.4. Adhocracy Culture

These cultures are typified by dynamic, innovative, flexible and entrepreneurial environments. Leaders and members of these organizations are risk takers. The binding force is their commitment to experimentation and creativity. These leaders are the trendsetters in society.

## 2.3. Organizational Performance

Organizational performance can be evaluated based on many financial as well as non-financial indicators. Balance score card is a model commonly followed in evaluating organizational performance.

### 2.3.1. Balanced Score Card (BSC)

The Balanced Score Card was developed by Kaplan and Norton (2005) [2] as a set of measures to enable top managers to get a comprehensive view of the organization's performance. Over reliance on a single performance metric can be fatal given the complexity of managing an organization that necessitates senior management to review performance across several areas concurrently. A balanced scorecard provides this flexibility. The balanced scorecard philosophy is predominantly applied at organizational level. Kaplan and Norton outlined four important perspectives under the balanced Score Card as Customer perspective, Internal business perspective, Innovation and learning perspective and Financial perspective. It was further established that strategic alignment is achieved through affiliating the organization or industry specific pertinent KPIs with the four perspectives outlined under the Balanced Score Card.

### 2.4. The Link between Organizational Culture, Leadership Behavior and Organisational Performance

Two schools of thought: the 'constraints school' and the 'leadership school' aid in comprehending the above association [27]. The constraints school advocates that leaders exert limited impact and influence over performance as contextual constraints, either internal or external to the organization take dominance. Conversely, the leadership school of thought asserts that strategic leaders, particularly C Suites and above have a greater influence on performance in shaping organizations through strategy, structure, and culture [28]. Villa, et al., (2003) [29] proposed that organizational culture and values can be employed as situational variables with the potential to moderate the effects of the various leadership constructs on organizational performance. A study conducted by Voirin, et al., (2010) [30] ascertained that a favorable culture for innovation moderates the relationship between transformational leadership and employees' adaptive performance within the organization.

### 2.5. Justification of the theories chosen for the study.

The FRLM forms the theoretical foundation for the current study. This model was preferred over Yukl's three behavioral leadership styles and the situational leadership model as the FRLM presents a comprehensive continuum of leadership styles with universality encompassing all leadership attributes that are fragmented among the other models. Further, the MLQ 5X short form is an empirically validated research instrument constructed in measuring the FRLM, which aids in the development of the questionnaire for the current study.

In 2002, Dumdum [31] empirically tested the relationship between leadership styles and organizational performance based on the FRLM using the MLQ 5X short form as the research instrument, which revealed that both transformational and transactional leadership positively and significantly correlated to organizational outcomes, whereas Laissez-faire leadership established a strong negative correlation to organizational outcomes. In conceptualizing the dependent variable, the Balanced Score Card developed by Kaplan and Norton (2005) [2] is acknowledged as pertinent due to its aptness in comprehensively apprehending the most appropriate KPIs in holistically assessing organizational performance of the apparel industry. Many other models have evolved in this domain such as the triple bottom line developed by John Elkington (1999) [32].

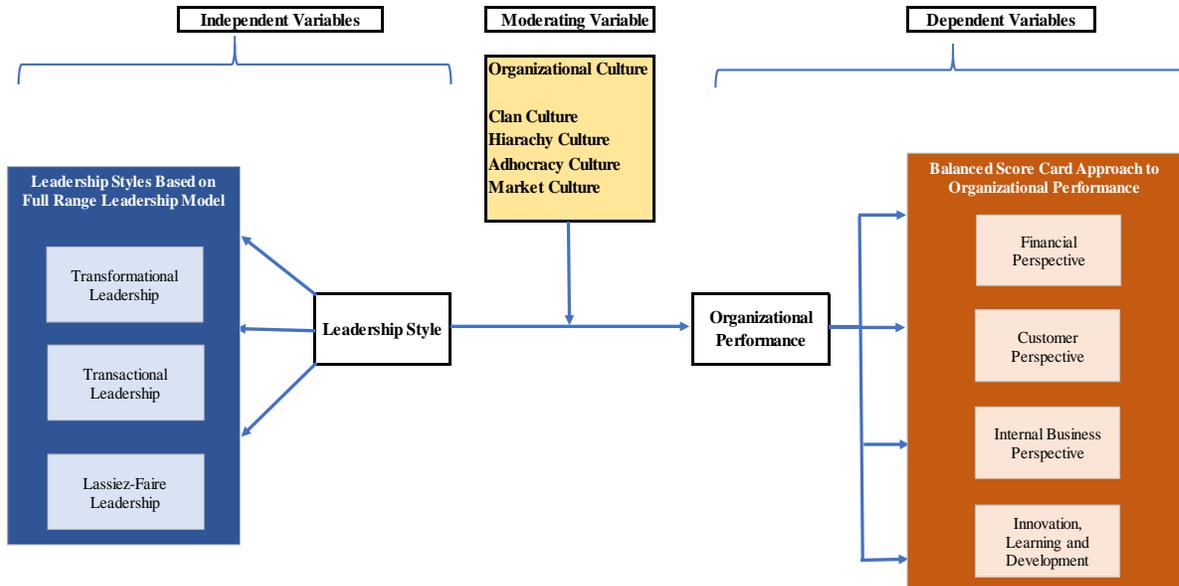
Milaloza (2015) [33], empirically tested the impact of leadership styles on organizational performance using the balance scorecard concluding that it proved to be an effective instrument in holistically measuring organizational performance and that authoritarian leadership style had a negative impact on the performance of the Croatian companies, in the field of knowledge management. Alternatively, democratic leadership style had a positive effect on the performance, in the financial perspective. The OCAI forms the conceptual foundation with respect to the moderating variable, which is preferred over the Organizational Culture model developed by Schein (1985) [23]. The classification under the OCAI is more relatable in capturing the cultural dynamics of the apparel manufacturing firms. Moreover, the OCAI is an empirically validated instrument developed to assess the culture model which has been extensively applied in research.

## 3. METHODOLOGY

### 3.1. Conceptual Framework and hypothesis

The conceptual framework for the study is developed reflecting leadership style through FLRM developed by Bass and Avolio (2001) [22], the organizational culture identified through the culture model of Quinn and Cameron (2011) [26] and the organizational performance measured through the Balanced Score Card developed by Kaplan and Norton (2005) [2].

Figure 2: Conceptual Framework



Based on the conceptual framework in figure 1, the following hypothesis has been developed

- H1 A significant relationship exists between the leadership style demonstrated by the CEOs and the organizational performance of apparel manufacturing companies
- H2 Organizational culture moderates the relationship between the leadership styles of the CEOs and the organizational performance of apparel manufacturing companies

### 3.2. Operationalization of Variables

The leadership style, organizational culture and the organizational performance are operationalized with appropriate indicators as presented in table 1.

Table 1: Operationalization of variables

Concept	Variable	Measurement of Indicator
Transformational Leadership	<i>Leaders' Character Traits</i>	The level of pride instilled through the association of the leader
		The leader readiness to go beyond his/her self-interest for the collective interest of the group
		The degree to which leader behavior commands employee respect
Idealized Influence - Behavioral Type - II(B)	<i>Promotes Idealization</i>	The extent to which the leader displays power, authority and control in instilling confidence
	<i>Sensible Risk Taking</i>	The degree to which the leader takes calculated risk
	<i>Sense of Integrity</i>	The extent to which the leader considers integrity as a core component in business decisions & undertakings
Idealized Influence - Attributed Type -II(A)	<i>Ethical Consideration</i>	The degree of importance placed on morale and ethical consequences of business decisions
	<i>Clear Sense of Purpose</i>	The level of significance placed on having a clear sense of purpose The degree of emphasis placed on a collective sense of mission
Inspirational Motivation - IM	<i>Develops &amp; Promotes Attainment of Mission</i>	The leader converses optimistically about the future
		The leader expresses drive and enthusiasm about what needs to be accomplished
		The extent to which the leader articulates an enthralling vision
	<i>Readiness for Change</i>	The degree to which the leader instills confidence in the achieving organizational goals

Individualized Consideration -IC	<i>Develops Others</i>	The extent of time dedicated by the leader in teaching and coaching subordinates
	<i>Supports Others on an Individual Basis</i>	The degree to which the leader helps subordinates to develop skills
	<i>Supports Others on an Individual Basis</i>	The extent to which the leader treats subordinates as individuals rather than members of a group
	<i>Supports Others on an Individual Basis</i>	The degree to which the leader considers the subordinates as having different needs, abilities and aspirations from others
Intellectual Stimulation - IS	<i>Encourage Innovation</i>	The extent to which the leader challenges the status quo
	<i>Encourage Innovation</i>	The extent of striving for different perspectives in problem solving
	<i>Demonstrates Innovation</i>	The extent to which the leader encourages employees to view problems from several perspectives
	<i>Demonstrates Innovation</i>	The extent to which the leader compels the subordinates to consider novel and innovative approaches to completing tasks effectively
Transactional Leadership  Contingent Reward	<i>Constructive Transaction</i>	Extension of assistance by leader in exchange for effort
	<i>Constructive Transaction</i>	The leader's ability to specifically outline who is responsible for achieving targets
	<i>Constructive Transaction</i>	Clearly outlines the expectations in return for achieving performance goals
	<i>Constructive Transaction</i>	The degree to which the leader rewards employees when expectations are met
Management By Exception (Active) - A	<i>Active Participation in problem solving</i>	The level of proactive scrutiny on anomalies, mistakes, and deviation from standard on the achievement of future goals
	<i>Active Participation in problem solving</i>	The degree of proactive concentration of attention on dealing with errors, complaints and failures
	<i>Active Participation in problem solving</i>	The extent to which the leader trails an error or mistake through continuous monitoring and control
	<i>Active Participation in problem solving</i>	The degree to which the leader directs attention and advice on course correction
Management By Exception (Passive) - P	<i>Passive Intervention in Problem Solving</i>	The degree of absence of leader interference until problems become severe
	<i>Passive Intervention in Problem Solving</i>	The extent to which actions are taken after things go wrong
	<i>Passive Intervention in Problem Solving</i>	The extent of reacting to a situation than preventing an error
	<i>Passive Intervention in Problem Solving</i>	The extent to which the leader establishes that problems must become compulsive before taking any action
Laziness – Faïre Leadership	<i>Absence of Leadership</i>	Advocates an avoidance strategy when important issues arise
	<i>Absence of Leadership</i>	The absence of leadership when needed
	<i>Absence of Leadership</i>	The extent to which the leader shies away from making and committing to decisions
	<i>Absence of Leadership</i>	The degree to which the leader delays or does not respond to urgent enquiries

Operationalization of Dependent variable

Performance Outcomes	KPIs	Measure
Financial	NP Margin	NP Margin
	Air Frights & Claims	AF & Claims as a Percentage of Sales
Customer	OTD	Rating of OTD
	Vendor Scorecard	Vendor Score Card Rating
Internal business	Cut to Ship Ratio	Cut to Ship Ratio
	Efficiency	Rating of Efficiency
Innovation, Learning and Growth	Direct: Indirect Ratio	Direct to indirect ratio due to the reduction in FTEs through automation
	Standard Minute Value	SMV reduction

Operationalization of the Moderating Variable

Dominant Culture	Dimensions of	Measurement of Indicator
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Types	Organizational Culture	
Clan Culture	Dominant Characteristics	The extent to which the organization provides a personal place comparable to an extended family
	Organizational Glue	Loyalty, mutual trust and commitment to the organization
	Criteria of Success	Development of human resources, teamwork, employee commitment and concern for people
Adhocracy Culture	Dominant Characteristics	The level of dynamism, entrepreneurial nature and excessive risk taking
	Organizational Glue	Level of commitment for innovation and development
	Criteria for Success	The level of uniqueness in its products and services, product leadership and innovation
Competitive Culture	Dominant Characteristics	The extent to which the organization is results oriented
	Organization Glue	The degree of emphasis on achievement and goal accomplishment
	Criteria for Success	The extent to which winning in the market place, outpaces competition
Hierarchy Culture	Dominant Characteristics	The existence of structure, control and formalities
	Organizational Glue	The importance of formal rules & policies in maintaining a smoothly running organization
	Criteria for Success	The level of efficiency, smooth scheduling and low-cost production

### 3.3. Research Design

Research design is defined as a strategy that deliberates how the research will be carried out in a structured manner which can be achieved through the Research Onion framework developed by Saunders et. al (2007). This study was conducted with an ontological position with both objective and subjective viewpoints and regards pragmatism as the underpinning philosophy. Pragmatism is defined as a research philosophy that concentrates on the practical outcome of the research by excluding the “forced selection” among the research paradigms and focuses on “what works best” in answering the research question [34]. The development of theory could be either through deduction or induction. Deductive reasoning begins by advocating a theory and designing a research method to test the theory. Inductive theory-building commences with data collection through specific observations through which patterns and relationships are established to form theory [35]. The present study assumes a deductive perspective while attempting to explain the concepts in detail thereby displaying an inductive element as well. An embedded case study strategy is followed which firstly incorporate a survey carried out through a questionnaire, aimed at the direct subordinates of the CEOs. The questionnaires can be applied for either descriptive or explanatory research [36]. Secondly, a series of semi-structured interviews were carried out with selected direct subordinates of the CEOs and finally a qualitative business case evaluation was conducted with the relevant CEOs. Stemming from a pragmatist paradigm, the pluralistic and integrative view advocates that rather than viewing quantitative and qualitative methods as opposites they should be perceived as complementary. The combination of qualitative and quantitative methods annuls the weaknesses of both [37]. The methodological choice of this study can be identified as mixed method. According to Creswell (2012) [38] the current study is classified as explanatory sequential mixed methods where quantitative data is gathered and statistically analyzed to test the set hypothesis in the first phase and subsequently qualitative data is assembled in reinforcing the interpretations and findings of the quantitative study. The data collection for the intended study happened during a single, specified time period. According to Sekaran and Bougie (2015) [39], the current undertaking is cross sectional in nature.

### 3.4 Data Collection Methods

#### 3.4.1. Primary Data Sources

Data collection under the survey strategy entailed an online questionnaire and semi structured interviews combined with a business case evaluation as the primary data sources. As per Evans & Mathur (2005) [40] prompt delivery, wider access, cost efficiency, receipt of a higher rate of response, lower risk of missing data and the high rate of validity assigned to the approach are the benefits of delivering the questionnaire online. The insights gained through the interviews validated a content analysis. Moreover, the qualitative business case evaluation process reinforced the findings by assimilating the insights from the CEOs.

#### 3.4.2 Data Analysis Methods

Data analysis was carried out using SPSS 22.0 and Microsoft Excel 2010 software tools. A range of analysis were performed to test the objectives and the hypothesis, such as descriptive analysis, factor analysis, correlational analysis and regression analysis.

#### 3.4.3 Sampling

Thirty companies operating within the private sector apparel manufacturing industry in Sri Lanka were selected based on purposive sampling in order to conduct the cross-sectional study. All the selected companies were medium to large scale apparel manufacturers in the industry, employing over 2,000 employees and are entirely export oriented with the main export markets being US and Europe. The companies selected were geographically dispersed and located across the country. The customer portfolios of these companies were world renowned retail brands such as “Victoria Secret”, “Calvin Klein”, “Levis”, “Lane Bryant”, “Nike”, “GAP”, “NEXT”, “Old Navy”, “ZARA”, “PUMA” and “H&M”.

Since each of the strategic business units (SBUs) operate as independent business units, the responses could be expected to provide the foundation for cluster sampling, where the unit of analysis was each organization (SBU) headed by the respective CEO. Out of the thirty companies identified, ten companies were selected based on the performance rating of the organizations (calculated based on criteria in table 8) representing very high, high, low and very low levels of organizational performance, for the qualitative analysis. One individual from each of the 10 companies were selected based on judgement sampling to fairly represent the apparel value chain. The work experience in the apparel industry was the other key consideration in the selection. Semi structured interviews were conducted with those individuals. The simulated business case evaluation was conducted with the ten CEOs of the above identified companies based on the performance rating criteria.

### 3.5 Research Instruments

The responses for the survey were obtained on a Likert scale expressing agreement with respect to the level of leadership attributes of the CEOs as perceived by the direct subordinates of the CEOs. Each selection under the Likert scale was assigned a number as follows; “Strongly Disagree = 1”, “Disagree = 2”, “Neutral = 3”, “Agree = 4” and “Strongly Agree = 5” which facilitated the quantification of the attributes and also data analysis. The above scale was adopted with respect to the independent and moderating variables. With respect to the dependent variable, the responses were obtained on a Likert scale of “Very Low=1”, “Low=2”, “Moderate=3”, “High=4”, “Very High=5” where the questions were developed based on BSC framework depicting the organizational performance. The questionnaire was developed based on the indicators developed in operationalization. A brief description of the KPIs under the dependent variable is presented under Appendix 1 of this paper. The organizational performance measured in line with the Balanced Score Card under each perspective has been computed into a composite mean value with respect to the performance of the organization in the Financial Year 2018/19.

Supplementary to the questionnaire semi-structured interviews were conducted to obtain further insights of the CEO’s leadership styles and the general perception among the subordinates in relation to the leadership styles adopted by their leaders. The questions focused on impact of each leadership style on the organizational performance and the moderating role of the culture.

The business case evaluation in relation to the apparel industry were presented to the selected CEOs themselves. The business cases were simulated in line with the performance criteria outlined under the BSC framework through the most applicable KPIs of the apparel industry. The objective of the business case analysis was to gather insights on the leadership styles the CEOs themselves would adopt in response to a simulated business case under varying contexts. The respondents were requested to elaborate on the reasons for adopting a particular approach.

### 3.6 Method of analysis

Survey findings were initially analysed to identify the primary components, tested for reliability and validity and each leadership style was statistically analysed using SPSS. Hypothesis were tested with correlation and regression analysis. Qualitative data were thematically analysed to identify the patterns and themes emerging from the data.

### 3.7 Methods for testing reliability and validity of data

The quantitative data collected through questionnaire were tested for unidimensionality following a factor analysis and the identified constructs were tested for reliability and validity. Internal consistency or reliability was measured with Cronbach’s alpha. A per Kline (2011), 0.7 was considered as acceptable value of alpha in reliability analysis. The validity of data can be tested through face validity, criterion validity and congruent content validity, validity. The operationalization of the variables through appropriate indicators ensured all aspects of validity except the construct validity which required statistical computations. Campbell & Fiske (1959) have categorized construct validity in to two types; convergent validity and the discriminant validity. The degree of confidence that can be placed on the indicators to correctly measure a trait is ensured through convergent validity. Discriminant validity is the degree to which the measures of different traits are unrelated. Average Variance Extracted (AVE), which measures the level of variance captured by the construct against the measurement error and Composite reliability (CR), a less biased estimator of reliability than Chronbach’s alpha can be considered as measures of convergent validity [41]. According to Fornell and Larcker, AVE should be above 0.5 and CR above 0.7 for convergent validity to be satisfactory. In addition, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), is also suggested to be a measure of convergent validity. KMO values above 0.5 are considered satisfactory [39]. The strength of relationships among the indicators of a measure is ensured through the Bartlett’s test of sphericity [42]. This test can be conducted at a predetermined level of significance where, the p-value of the results can be compared with the level of significance to

arrive at a conclusion. Commonly used level of significance is .05. Reliability and validity of qualitative findings were ensured by selecting trustworthy and knowledgeable individuals in the field following the instructions of Lincoln and Guba (1985) [43]. In addition, constant data comparison, comprehensive data use and reputational analysis suggested by Silverman (2013) [44] were considered.

#### 4. Data analysis

##### 4.1. Factor Analysis to identify dimensions of leadership

The resultant factor loading of independent variables generated through SPSS is presented in table 2.

Table 2: Factor Loadings

Leadership Style		Component			
		1	2	3	4
 Transformational Leadership -Idealized Influence -Behavioral Type (II(B)) -Idealized Influence -Attributed Type (II(A)) -Inspirational Motivation (IM) Intellectual Stimulation (IS)	Transf 3	0.736			
	Transf 4	0.729			
	Transf 6	0.721			
	Transf 10	0.717			
	Transf 8	0.716			
	Transf 20	0.715			
	Transf 5	0.711			
	Transf 12	0.697			
	Transf 7	0.694			
	Transf 19	0.692			
	Transf 9	0.687			
	Transf 11	0.661			
	Transf 18	0.658			
	Transf 13	0.648			
	Transf 1	0.631			
Transf 2	0.595				
 Transactional Leadership -Management By Exception -Active (A) -Management By Exception -Passive (P)	Transac 5		0.821		
	Transac 6		0.799		
	Transac 7		0.785		
	Transac 12		-0.777		
	Transac 10		-0.771		
	Transac 11		-0.761		
	Transac 9		-0.737		
	Transac 8		0.711		
Laissez – Faire Leadership	LF4		-0.695		
	LF1		-0.647		
	LF3		-0.603		
 Transformational Leadership -Individualized Consideration (IC)	Tranf 16			0.799	
	Tranf 17			0.773	
	Tranf 15			0.698	
	Tranf 14			0.519	
 Transactional Leadership -Contingent Reward (CR)	Transac 2				0.784
	Transac 3				0.767
	Transac 4				0.694

The leadership styles Transformational, transactional and Laissez- Faire were coded as transf, transact and LF respectively. The factor loading output demonstrates that responses in relation to transformational leadership style have two aspects. Questions Transf 1-13

and Transf 18-20 have one facet whereas questions Transf 14- 17 have another aspect. Hence those questions were prudently analyzed and separately categorized based on the leadership attributes as follows.

**Transformational 1 Leadership:** Idealized Influence -Behavioral Type and Attributed Type (II(B) and II(A)),  
Inspirational Motivation (IM), Intellectual Stimulation (IS)

**Transformational 2 Leadership:** Individualized Consideration (IC)

In further analyzing the questions pertaining to the above segregation it was noted that in the main whilst the first four leadership attributes pertaining to transformational leadership were solely demonstrated by transformational leaders, the fourth transformational leadership attribute of individualized consideration was at certain instances demonstrated by non-transformational leaders as well. Therefore, the responses pertaining to the attributes of Individualized Consideration was distinctly grouped under a separate component.

Furthermore, the factor loadings demonstrate that the questions pertaining to transactional leadership also have two aspects. The Transac 2-4 establishes one aspect whereas Transac 5-12 demonstrates a different aspect. Those questions were carefully analyzed and grouped according to the leadership attributes as follows.

**Transactional 1 Leadership:** Contingent Reward (CR)

**Transactional 2 Leadership:** Management By Exception -Active (MBE(A))  
Management By Exception -Passive (MBE(P))

On further analyzing the factor loading, it is evident that the factor loadings for the questions pertaining to Management By Exception -Passive (MBE(P)) shows a negative loading under the same component of Management By Exception -Active (MBE(A)). The reason underpinning such loading is that the questions under the two attributes tested the exact opposite attributes of leadership. A similar negative loading was observed under the same component with regard to the questions pertaining to Lassiez – faire Leadership which were observed to be inverse to the characteristics of Active Management By Exception but were analogous to Passive Management By Exception. Three questions were eliminated from analysis as those questions did not group with the rest of the questions.

Table 3: Questions Eliminated from the Reliability and Validity Testing Process

Question No	Question	Reason for elimination
27	The CEO Extends assistance in exchange for effort by the subordinates	Some respondents interpreted the word assistance as support on personal grounds above and beyond work engagements, whereas other respondents generalized the word assistance to mean extra support confined to work. Therefore, due to inconsistency of the responses stemming from the ambiguity of the question, this was eliminated.
40	The CEO is absent in crucial situations	Respondents found it was difficult to quantify the degree of absence. Therefore, due to the poor responses, this question was eliminated.
52	My organisation is a very dynamic and entrepreneurial place. People are willing to take high risks	Certain respondents interpreted this question as his/her appetite to risk, whilst other respondents generalized the question as the entire organisations risk appetite and not specific to his or her own experience. Therefore, due to the inconsistency of responses, the question was eliminated.

#### 4.2 Reliability of Data

Cronbach's alpha is a measure of internal consistency, which measures how closely related a set of response are to the particular item within the variable. Furthermore, it is considered as a measure of scale reliability. The table 5 illustrates Cronbach's alpha calculated with respect to the dependent, independent and moderating variables pertaining to this research.

Table 4: Chronbach's Alpha

Variable Description	Chronbach's Alpha
<b>Independent Variable</b>	
Transformational Leadership 1 (II(A), II(B), IM, IS)	0.961
Transformational Leadership 2 (IC)	0.889
Transactional Leadership 1 (MBE(A) and MBE(P))	0.778
Transactional Leadership 2 (CR)	0.763
<b>Dependent Variable</b>	
Organisational Performance	0.883
<b>Moderating Variable</b>	
Clan Culture	0.865
Adhocracy Culture	0.775
Competitive Culture	0.886
Hierarchical Culture	0.892

4.3 Validity of data

4.3.1 Convergent Validity

Convergent validity was tested based on Kaise-Mayer-Olkin Measure of Sampling Adequacy (KMO), Bartlett's Test of Sphericity, Average Variance Extracted (AVE) and Composite Reliability (CR). The results are presented in table 5.

Table 5: Results of convergent validity

Variable Description	Kaise-Mayer-Olkin Measure of Sampling Adequacy (KMO)	P-value of Bartlett's Test of Sphericity	Average Variance Extracted (AVE)	Composite Reliability (CR)
<b>Independent Variable</b>				
Transformational Leadership 1 (II(A), II(B), IM, IS)	0.957	0.000	0.612	0.926
Transformational Leadership 2 (IC)	0.784	0.000	0.755	0.925
Transactional Leadership 1 (MBE(A) and MBE(P))	0.918	0.000	0.754	0.960
Transactional Leadership 2 (CR)	0.610	0.000	0.733	0.892
Lessiez-Faire Leadership	0.769	0.000	0.927	0.974
<b>Dependent Variable</b>				
Organisational Performance	0.858	0.000	0.657	0.919
<b>Moderating Variable</b>				
Clan Culture	0.720	0.000	0.607	0.819
Adhocracy Culture	0.500	0.000	0.816	0.899
Competitive Culture	0.745	0.000	0.815	0.929
Hierarchical Culture	0.742	0.000	0.826	0.935

All variables satisfied the minimum criteria required under each test as discussed in section 3.7. Therefore, the convergent validity of data can be accepted satisfactory.

4.3.2 Discriminant Validity

Discriminant Validity tests the validity of a variable and indicates its ability to be discriminated from the others. It is based on the premise of measuring the variable as an independent entity if it is to stand by on its own. Discriminant validity is established when constructs that are expected not to relate do not, as such a distinct discrimination can be established between these constructs.

Table 6: Discriminant Validity Test Results for Independent Variables

		Correlations				
		Transform II(B), II(A), IM, IS	Transform IC	Transac CR	Transac MBE (A,P)	LF
Transformational Leadership 1 II (B), II(A), IM, IS		<b>AVE= 0.6124</b>				
Transformational Leadership 2 IC	Pearson Correlation	.641**	<b>AVE= 0.7546</b>			
	Squared Correlation	0.41				
Transactional Leadership 2 CR	Pearson Correlation	-.202**	-0.085	<b>AVE= 0.7337</b>		
	Squared Correlation	0.222	0.17			
Transactional Leadership 1 MBE(A), MBE(P)	Pearson Correlation	-.494**	-.199**	.266**	<b>AVE= 0.7545</b>	
	Squared Correlation	0.244	0.039	0.07		
Lassiez – Faire Leadership	Pearson Correlation	-.757**	-.474**	.138*	.669**	<b>AVE= 0.7926</b>
	Squared Correlation	0.573	0.224	0.019	0.448	

Table 7: Discriminant Validity Test Results for Moderating Variables

		Correlations			
		Clan Culture	Adhocracy Culture	Competitive Culture	Hierarchical Culture
Clan Culture		<b>AVE= 0.6066</b>			
Adhocracy Culture	Pearson Correlation	.121*	<b>AVE= 0.8165</b>		
	Squared Correlation	0.014			
Competitive Culture	Pearson Correlation	.335**	.261**	<b>AVE= 0.8150</b>	
	Squared Correlation	0.112	0.068		
Hierarchical Culture	Pearson Correlation	-.377**	-.454**	-.596**	<b>AVE= 0.8263</b>
	Squared Correlation	0.142	0.206	0.355	

According to the above computation the AVE (Average variance Extracted) for each dimension is greater than the squared value of correlation coefficient the variable has with the other dimensions. This satisfies the required condition in order to establish the discriminant validity of the data with respect to the dimensions of independent and moderating variables.

4.4 Identification of Dominant Leadership Styles Vs Organizational Performance and the Underpinning Organizational Cultures  
The composite mean value for each leadership style, organizational performance and each type of organizational culture were categorized in to four groups. The decision criteria used for this categorization are given in table 8.

Table 8: Decision Criteria for categorization of Mean Values

Range of Mean Values	Level Assigned
≤ 2.5	Very Low
2.51-3.2	Low
3.21-4.00	High
≥ 4.1	Very High

To facilitate a more rational comparison for the purpose of this chapter, companies are grouped into two main categories based on the performance.

1. Companies with High & Very High organizational performance
2. Companies with Low & Very Low organizational performance

Table 9: Analysis of Companies with “High” and “Very High” Organizational Performance

Company	Performance	Leadership Style				Organisational Culture			
		Transformational	Transactional 1	Transactional 2	Laissez-Fair	Clan Culture	Adhocracy Culture	Competitive Culture	Hierarchical Culture
		II(B), II(A), IM, IS, IC	CR, MBE(A)	CR MBE(P)					
8	High	High	High	Low	Very Low	Low	Low	Very High	Very Low
11	High	High	Very High	Low	Very Low	Very Low	Low	Very High	Very Low
12	High	High	Low	Very Low	Very Low	Low	Low	Very High	Very Low
14	High	Very High	Very High	Very Low	Very Low	Very High	Low	Very High	Very Low
15	High	Very High	Very High	Very Low	Very Low	High	Low	Very High	Very Low
21	High	Low	Low	Low	Very Low	Low	High	Very High	Low
27	High	Very High	High	Very Low	Very Low	High	Low	Very High	Very Low
28	High	Low	Very High	Very Low	Very Low	Low	Very Low	Very High	Very Low
29	High	Very High	Low	Very Low	Very Low	Very Low	Very High	Low	Very Low
1	Very High	Very High	High	Very Low	Very Low	Very High	Very Low	Low	Very Low
2	Very High	Very High	Very High	Very Low	Very Low	Low	Low	Very High	Very Low
5	Very High	Very High	Very High	Very Low	Very Low	Very High	Low	Low	Very Low
10	Very High	Very High	High	Very Low	Very Low	Low	Very High	Very High	Very Low
16	Very High	Very High	High	Very Low	Very Low	High	Low	Very High	Very Low
18	Very High	Very High	High	Very Low	Very Low	Very High	Low	Very High	Very Low
26	Very High	Very High	High	Very Low	Very Low	Very High	Low	Very High	Very Low

Table 10: Analysis of Companies with “Low” and “Very Low” organizational performance

Company	Performance	Leadership Style				Organizational Culture			
		Transformational	Transactional 1	Transactional 2	Laissez-Faire	Clan Culture	Adhocracy Culture	Competitive Culture	Hierarchical Culture
		II(B), II(A), IM, IS, IC	CR, MBE (A)	CR, MBE (P)					
3	Very Low	Low	Low	Low	Very High	Low	Low	Low	High
4	Very Low	Low	Very High	Low	Low	Low	Low	High	High
13	Very Low	Low	Low	Very High	Very High	Very Low	Low	Low	High
17	Very Low	Low	Low	High	Very High	Low	Low	Low	High
19	Very Low	Low	High	Low	Low	Low	Low	Very Low	High
22	Very Low	Low	Low	High	Low	Low	Low	Low	Low
25	Very Low	Low	High	Very High	Low	Low	Low	Low	Very High
30	Very Low	Low	Low	High	Low	Very Low	Low	Low	High
6	Low	Very High	Very High	Low	Very Low	Low	Low	Very High	Very Low
7	Low	Low	Low	Low	Very Low	Low	Low	Low	Low
9	Low	Low	Very High	Low	Very Low	Low	Low	Low	Very High
20	Low	Low	Very High	Low	Low	High	Low	Low	Low
23	Low	Low	Very High	Low	Very Low	Low	Very Low	High	Very Low
24	Low	Low	High	Very Low	Very Low	High	High	High	Very Low

The color code used in figures 9 and 10 are developed where positive relationships are indicated in green and the negative relationships in pink. Fourteen of the thirty companies identified under the study were ranked either ‘Very Low’ or ‘Low’ based on the performance criteria set under Appendix 1 of the paper. These companies were predominantly marked by transactional and Lassies-faire leadership styles. There is a clear lack of transformational leadership attributes among the fourteen companies with the exception of a single outlier. The dominant cultural facet seen as common among the above companies is a hierarchical culture and some companies lacked dynamics of a clear culture. These organizations also clearly lacked sub cultural elements. The clear dearth of transformational leadership attributes and the dominance of transactional and Lassiez-faire leadership attributes combined with the dominance of a Hierarchical Culture is seen to strongly moderate the association between the said leadership styles and organizational performance. Further, a clear majority of these companies signified the lack of clan and adhocracy cultures which were seen to positively influence organizational performance.

As per the table 9, sixteen of the thirty companies under the study are rated as “Very High or High” based on their overall organizational performance.

It is notable that in fourteen out of the sixteen companies, the CEOs demonstrate ‘High’ and ‘Very High’ transformational leadership attributes, correspondingly the same companies were ranked ‘High’ and ‘Very High’ in terms of demonstrating transactional leadership attributes of Contingent Reward and Active Management By Exception. Further, all sixteen companies ranked ‘Very Low’ and ‘Low’ on the prevalence of Passive Management By Exception and Lassiez-faire leadership attributes. Therefore, it is evident that CEOs integrate attributes of both transformational and transactional leadership styles in leading organizations and appropriately switch between these attributes based on the principles of situational leadership.

With respect to culture, it is evident that most of the companies above ranked either “High” or “Very High” with respect to competitive or market cultures and this culture seems to dominate most of the high performing apparel manufacturing companies in Sri Lanka. Further, these companies were typified by a clear presence of sub cultures which largely constituted clan and adhocracy cultures which were seen to complement the dominant culture. Thus, congruence between the dominant and subculture combined with the compatibility of the leadership attributes resulted in higher than average organizational performance in these organizations.

The two dimensions of cultures identified based on the statistical analysis as follows;

Cultural Dimension 1: Dominant Culture: Competitive Culture  
 Sub Cultures: Clan Culture, Adhocracy Culture

Cultural Dimension 2: Dominant Culture: Hierarchical Culture  
 Sub Culture: No distinctly identifiable sub culture

The tests of moderation were conducted based on these two dimensions of culture identified.

#### 4.5 Test of Hypothesis

##### 4.5.1 Hypothesis 1

Association between Leadership style and organizational performance was tested using correlation and regression analysis.

Table 11: Results of Correlation and Regression analysis testing H1

Leadership style	Pearson Correlation with Organisational performance		Regression analysis			Significance of regression analysis
	Pearson Coefficient	Significance	R Square	Adjusted R Square	F Value	
Transformation 1	0.888	.000	0.789	0.788	1118.14	.000
Transformation 2	0.637	.000	0.406	0.404	204.305	.000
Transactional 1	-0.116	.000	0.013	0.010	4.054	.045
Transactional 2	0.767	.000	0.588	-0.587	429.998	.000
Laizes Fair	-0.833	.000	0.693	0.692	676.18	.000

The statistics provided in table 11 indicate that all leadership styles have statistically significant relationships with organizational performance at .05 level of significance. Hence H1 is supported.

##### 4.5.2 Hypothesis 2

Moderation effect of organizational culture.

The results of hierarchical regression analysis conducted to test moderation is presented in table 12.

Table 12: Results of Hierarchical Regression Analysis testing H2

Interaction considered	R square Change	Significance of R square Change	Significance of the interaction term
Transformational 1and Culture	.092	.000	.000
Transformational 2and Culture	.384	.000	.000
Transactional 1and Culture	.684	.000	.000
Transactional 2 and Culture	.248	.000	.000
Laizers Fair and Culture	.191	.000	.000

The statistics provided in table 12 clearly indicate that the organizational culture moderates the relationship between leadership style and the organizational performance.

#### 4.6 Interview findings

The respondents of semi-structured interviews were senior officers who directly reported to the CEO who represented senior general manager and general manager levels and had more than 5 years of service at senior positions of the company. Further, the 10 companies were chosen representing different levels of performance including Very high, High, Low and Vey Low levels. All the respondents of the semi-structured interview process believed that apparel manufacturing CEOs maintain an interactive relationship between the leadership attributes under the distinct leadership styles identified through the FRLM. This interaction was essentially based on the dynamics in the apparel industry and the resultant situational demands that requires the CEOs to flex between appropriate leadership styles and the attributes therein. This suppleness of the CEOs in adapting to situational demands was seen as pivotal in maintaining the organization’s sustainable competitive advantage. The situations that demand apparel CEOs to demonstrate transformational leadership attributes to positively influence organizational outcomes were identified as instances where the CEO needs to see the bigger picture whilst understanding the worldview they serve. Organizational change and transformation were also identified as organizational circumstances that require the CEOs to demonstrate transformational leadership attributes. Furthermore, when an organization is in a state of flux, transformational leadership style was found to be more appropriate. These leaders lead by way of appealing to the higher order psychological desires of their subordinates through the establishment of an ethical climate by way of personal integrity. In word, deed and appearance, transformational leaders develop confidence, and an stimulate the intellect of their subordinates. They inspire and motivate their subordinates by provoking a sense of purpose within them. The leader’s charisma plays an important role in effectively demonstrating transformational leadership attributes.

The respondents further distinctively identified the situations that demand transactional type leadership attributes to optimize organizational outcomes. Contrary to situations that demand transformational leadership attributes, transactional leadership attributes yield optimal outcomes in highly structured situations that are less volatile. Transactional leadership is essential in maintaining the status quo and abiding by the current standards and enforcing the current rules and expectations by trailing deviations and implementing proactive course correction. These leadership traits were essential in leading subordinates who are motivated by extrinsic rewards and strive for short-term wins.

It was the common consensus among respondents that the CEOs of leading apparel manufacturing firms in Sri Lanka should not adopt Laissez-faire leadership attributes. It was further reiterated that the CEOs cannot adopt a delegative approach to leadership in apparel manufacturing given the interactions of multiple, complex and fluid business dynamics. Whilst it was understood that this leadership approach was untenable to be adopted organization wide, the leaders could adopt this leadership approach in leading specialized teams such a product design and development within the boundaries of these specific functions. Therefore, it was derived that the active avoidance of leadership will hinder or deter the achievement of organizational outcomes.

It was established that organizational culture impacted the relationship between leadership styles demonstrated by the apparel manufacturing CEOs and organizational performance. The nature of the relationship was corroborated to have a moderating effect on this relationship. It was identified that whilst many organizations were characterized by a strong, dominant culture, there was a clear visibility of interplay with the dynamics of subcultures. In most instances the underpinning attributes of organizational culture were clearly seen to augment the leadership attributes of the CEOs in delivering above average organizational performance. The association between the dominant and subcultures were also essential in moderating the leadership attributes to deliver superior performance. When these cultures are seen to complement each other, the resultant impact on the leadership attributes and organizational performance was seen to be enhanced. Further, the co-existence of a dominant and subculture/s was advantageous in terms of providing the organization more flexibility to operate within the complexities and dynamism of the external environment.

4.7 Evaluation of Industry Specific Business Cases

The business cases based on leadership styles that were presented to the CEOs are shown in table 13.

Table 13: Business Cases

Business Case	Description
<b>Business Case 1</b> (Focused on financial perspective of BS measured through Net profit margin)	It has become evident in quarter1 of the financial year that the forecasted net profit for quarter2 significantly falls short of the budgeted net profit for the quarter. In an effort to claw back to the budgeted net profit or to minimize the deviation, a recovery plan and a profit bridge needs to be revised and driven within the SBU. The Solutions are two fold and have been identified as follows; <ul style="list-style-type: none"> <li>- Increased contribution through profit maximization such as scouting for additional orders identifying filler strategies and over shipping options</li> <li>- Management of the overhead of SBU through cost reduction strategies</li> </ul>
<b>Business Case 2</b> (Focused on internal business measured through production line efficiency)	The work study department of the company is in the process of introducing automated line balancing in order to effectively balance the line through scientific approach as opposed to current practice of manual line balancing in an effort to increase efficiency.
<b>Business Case 3</b> (Focused on customer perspective measured through First Pass Yield)	The company on boarded a new customer, who is the second largest apparel manufacturer of the world and is earmarked to be a strategic customer of the company in the long term. The customer quality parameters are much more stringent than the existing customer base. The quality department has to adopt this new requirement which requires maintaining a higher level of quality standards in meeting customer expectations. This entails re-defining quality parameters, aligning the process to the new standard and up-skilling the personnel.
<b>Business Case 4</b> (Focused on innovation learning and growth measured through Reduction in Standard Minute Value)	It has been brought to the company’s attention by the customers that the standard minute value (SMV) of the company is far greater than their competitors and this threatens the company’s competitive position. Therefore, industrial engineering, engineering and production teams are required to come up with an innovative solution in automating elements of the garment manufacturing process that requires least human intervention. The project team has been assigned a timeline to reduce the garment SMV through innovation and automation.

According to the insights derived from simulated business cases, it was evident that the CEO’s of the private sector apparel manufacturing firms in Sri Lanka prefer the adoption of the principles of situational leadership in addressing the business cases presented. Furthermore, the driving forces behind their judgment of the appropriate leadership style to be adopted was based on the maturity and the performance readiness of their subordinates as well as the demands of the situation itself. In relation to the business cases presented, in most cases the CEOs opted to adopt leadership attributes pertaining to different leadership styles, where these attributes fairly complemented the leadership needs of higher level appeal to the psychological needs of the subordinates through transformational leadership attributes, strict governance and control achieved through Active Management By Exception and delegative leadership style achieved through Laissez-faire leadership attributes.

It was further observed that in addressing business cases that were associated with financial, internal business perspective and customer perspective, of the Balance Score Card the leaders opted to adopt an integrative approach of transformational leadership attributes and to a greater degree Active Management By Exception and Contingent Reward at a lower degree of involvement. It was deliberated that these business decisions required the CEOs to appeal to the value-based leadership requirements of their subordinates through motivation, inspiration, ideation and intellectual stimulation. Equally important were the leadership attributes to strengthen governance and proactive management of exceptions. It was observed that where the leadership attributes of different dimensions of leadership interacted, the results manifested in terms of exceptional organizational performance, whereas in the instances that CEOs adopted a solitary approach to leadership the corresponding results were observed to be weak.

In the business case pertaining to Innovation, learning and development, the CEOs of the high performing organizations were also biased towards aspects of Laissez-faire leadership attributes, where at the brainstorming phase of the project the leaders opted to follow a delegative leadership style by setting the board parameters of outcome, timelines and budgetary controls, giving the highly specialized teams the freedom to innovate and create the model. During the rest of the phases of the project the appropriate transformational and transactional leadership attributes were brought in to play. This integrative leadership approach yielded optimal organizational outcomes, whereas the outcomes were suboptimal when the CEOs adopted a single leadership approach.

In all these instances organizational culture was observed to play an important intermediary role in steering the leadership attributes towards achieving enhanced organizational performance. Organizational performance was seen to excel in organizations where a dominant culture and a complementing sub-culture prevailed as this offered the CEOs the opportunity to flex between multiple leadership attributes. The organizational outcomes were observed to be suboptimal in the organizations that lacked or had a weak presence of a subculture or the subculture was not compatible with the dominant culture.

### 5. RELATING FINDINGS WITH LITERATURE

The literature review undertaken for the purpose of this research is mainly centered around the Full Range Leadership Model (FRLM), Situational Leadership Model, Culture Model and Balanced Score Card.

The ensuing section attempts to link the findings of the study with the models and theories through the following illustrations.

#### 5.1. Full Range Leadership Model

Principally, the FRLM as presented by Avolio and Bass (2001) [1] is spread across a spectrum or continuum of leadership styles, which manifests through the augmentation of transformational leadership style and behaviors with the positive aspects of transactional leadership, such as Contingent Reward or Active Management-By Exception.

The structured questionnaire and the semi-structured interviews evaluated the above principle and distinguished multiple aspects to the categorization of leadership attributes.

Figure 3: Full Range Leadership Model (Adopted from Avolio and Bass, 2001) [1]

Transformational Leadership					Transactional Leadership			Laissez-Faire Leadership
Idealized Influence (B)	Idealized Influence (A)	Inspirational Motivation	Intellectual Stimulation	Individualized Consideration	Management By Exception (A)	Management By Exception (P)	Contingent Reward	

#### 5.2 Linking the FRLM to the Findings

Figure 4: Full Range Leadership Model Revised based on Findings

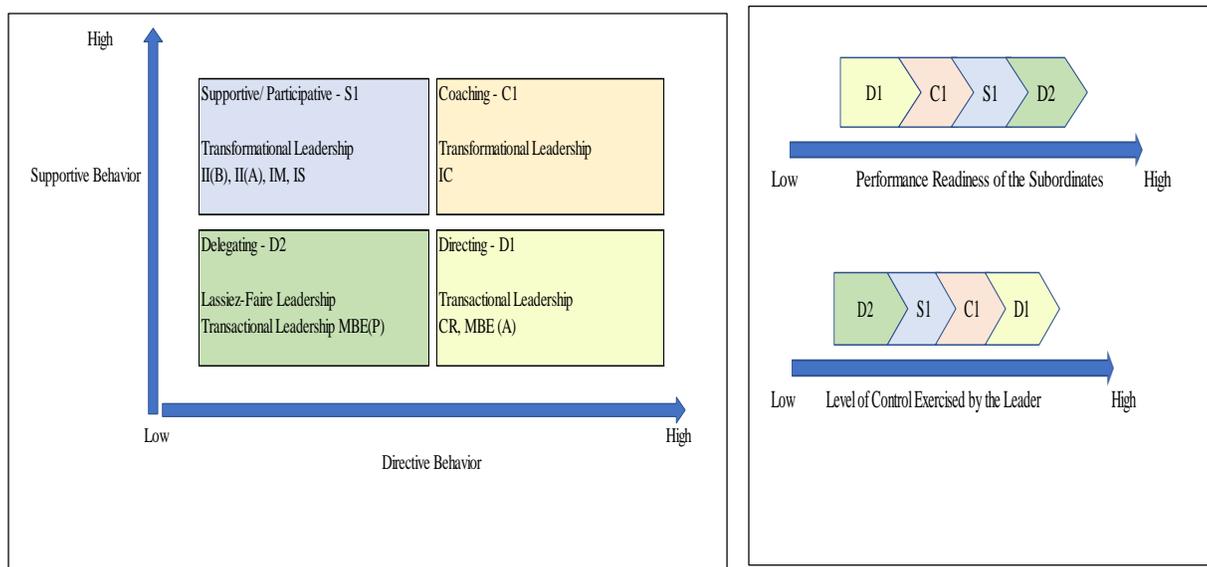
Transformational Leadership		Transactional Leadership		Laissez-Faire Leadership
Idealized Influence (B)	Individualized Consideration	Contingent Reward	Contingent Reward	Delegative Leadership
Idealized Influence (A)		Management By Exception (A)	Management By Exception (P)	
Inspirational Motivation				
Intellectual Stimulation				

Whilst the original theory is depicted in figure 3, the statistical analysis revealed the categorization as indicated in figure 4. This segregation was further supported through the qualitative findings.

#### 5.3. Situational Leadership Model

The overriding principle of situational leadership model is that there is no single "ideal" style of leadership. Effective leaders are those who adapt their leadership styles based on important dynamics. These dynamics were established to be the performance readiness of their subordinates or groups (ability and willingness) and the circumstances at play, which in the main constitute the nature of the job or task at hand, and the demands of the situation [16]. Based on the above dynamics the most apt leadership attributes as per the findings are illustrated in figure 5.

Figure 5: Diagram Linking Situational Leadership Model to the Findings

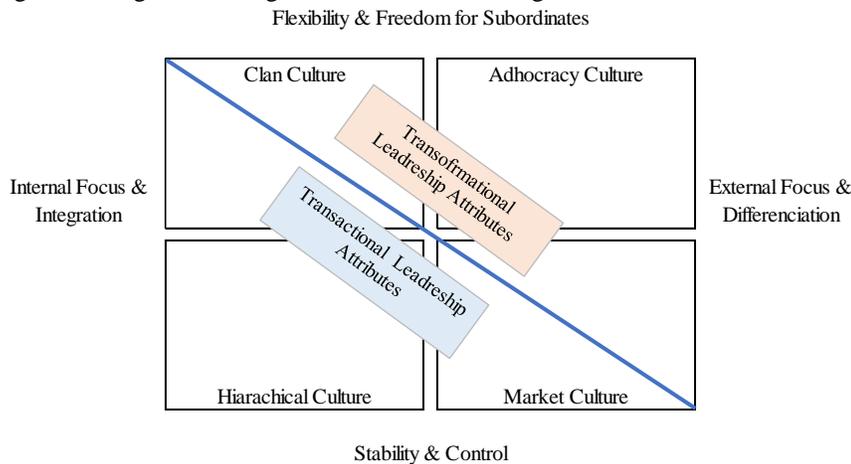


5.4. OCAI

The OCAI as per Quinn and Cameron (2011) [26] is a two-dimensional segregation of the organizational cultures into 4 categories; flexible versus stable and internal versus external orientations.

Based on the findings of the research, the typical cultural dynamics that support the different leadership attributes demonstrated by the CEOs in augmenting organizational performance is illustrated in figure 6.

Figure :6 Diagram Linking the OCAI to the Findings



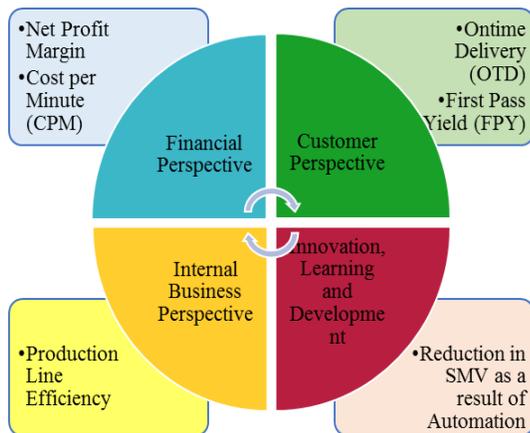
5.5. Balanced Score Card

The Balanced Score Card model is used to assess the organizational performance of the private sector apparel manufacturing companies in Sri Lanka based on the leadership attributes of the CEOs. Performance variables in terms of the KPIs that are most pertinent in the apparel industry in assessing the different perspectives namely financial perspective, customer perspective, internal business perspective and innovation, learning and development perspective have been identified and corroborated through the study.

Based on the results obtained from the respondents with respect to the dependent variable, the applicability of the Balance Score Card to evaluate the performance criteria in line with the pertinent KPIs has been reasserted through the findings of the research.

Figure 6: Diagram Linking the Balanced Score Card to the Findings

(Adopted from the BSC developed by Kaplan and Norton)



## 6. RECOMMENDATIONS

### 6.1. Recommendations for Very low and Low Performing Companies

It is recommended that these companies reassess their leadership process in influencing organizational outcomes. It is also recommended that these entities consider investing in strategic leadership development programs such as those conducted by the Center for Creative Leadership targeted at CEOs of large-scale organizations to ensure that these leaders are abreast of the modern leadership phenomena that influence positive organizational outcomes. Moreover, it is recommended that a further study be carried out to understand the underlying organizational, and situational dynamics and constraints in terms of time and resources that compel these leaders to demonstrate a particular leadership style/s. Further, these leaders are encouraged to learn and adopt appropriate leadership, management and power tools to effectively flex between leadership styles in managing their organizations.

It is also recommended that the prevailing cultural dynamics, predominantly hierarchical in nature which hinders flexibility, be reassessed as these bureaucratic structures and high red tape prevent organizations from nimbly adopting to the demands of the highly fluid environments in which the apparel manufacturing organizations operate. Measures need to be implemented to encourage teamwork through clan cultures and innovation through adhocracy cultures.

### 6.2. Recommendations for High Performers

Based on the statistical insights and the qualitative analysis it is recommended that the CEOs of these companies invest and dedicate more time and effort in coaching and mentoring their direct subordinates and on a personal and professional capacity attend to their individual needs within the boundaries of corporate ethics as most of the transformational CEOs were rated low in terms of the leadership attribute of Individualized Consideration. If these CEOs advance in this respect it will further enhance organizational outcomes through the mediating effects of subordinates' satisfaction with their CEOs.

Furthermore, it is recommended that the CEOs of these organizations bridge the cultural gaps identified in terms of creating a culture for innovation as extensive research reveals that the future of the apparel industry lies in innovation, automation and robotics. Therefore, facilitation of such innovations within these organizations will require a conducive culture and cultural dynamics to be in place. Therefore, these CEOs should make timely decisions to incorporate and promote these cultural elements within their organizations in order to sustain the high levels of performance that the organizations are currently enjoying.

Moreover, it is recommended that all CEOs and particularly those pertaining to the above companies make timely leadership strides towards investments in new technologies, automation and robotics to ensure processes are streamlined through the development of more efficient systems, modernizing operations and incubating the human resources of the organization towards incorporating technological advancements as business norms.

## 7. CONCLUSION

CEOs of apparel manufacturing companies are pursuing ways to successfully address the challenges of the current global economy. In this endeavor they are also employing strong and effectual leadership as a weapon to combat environmental fluidity, competition and organizational change to win in today's business arena. Businesses facing challenging circumstances need to be aptly managed through effective leadership strategies to ensure the survival of organizations. However, leadership is not entirely a behavioral approach, rather entails a scientific element as well. Therefore, whilst the style of leadership would differ from one individual to another, it would also vary based on the demands of the situation, the circumstance under which the CEO needs to operate as well as the established norms, practices intricacies in the industry.

This research paper intended to establish the association between the leadership styles demonstrated by the CEOs of the private sector apparel manufacturing companies in Sri Lanka and their consequential impact on organizational performance. Further, the study also established organizational culture as the key moderator between such leadership styles and organizational performance. As such various leadership styles were identified as the study progressed, and the circumstances under which such styles were likely to be adopted were evaluated within an industrial context.

The insights gathered through the research was then applied to the leadership process and the transformation of the model through the application of various leadership styles at different stages was also addressed. In conclusion, various leadership styles and approaches adopted by the CEOs were identified and incorporated into the rational leadership model to provide an integrated view of leadership in the private sector apparel manufacturing companies in Sri Lanka. Thereby, best suited leadership styles that could be adopted by the CEOs in enhancing organizational performance within the principles of situational leadership are recommended, taking into consideration the best suited cultural dynamics in augmenting the outcomes of leadership in the private sector apparel manufacturing companies in Sri Lanka.

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#### APPENDIX

##### Appendix 1- Indicators considered under Balance Score Card

<b>Cost Per Minute</b> [0.05-0.07] =Very Low, [0.08-.10] =Low, [0.11-0.13] =Moderate, [0.14-0.16] = High, [0.16<] =Very High
<b>Net Profit Margin</b> [0%-2%] = Very Low, [3%-5%]=Low, [6%-7%] =Moderate, [8%-12%]=High,[12%<] = Very High
<b>Production Line Efficiency</b> [0%-15%] =Very Low, [16%-25%]=Low, [26%-50%] =Moderate, [51%-75%]=High, [75<]= Very High
<b>On Time Delivery (OTD)</b> [0%-50%]=Very Low, [51%-70%]=Low,71%-80%=Moderate, [81%- 95%]=High,[>96%] =Very High
<b>Reduction in the Standard Minute Value</b> [0%-10%]=Very Low, [11%-15%]=Low, [16%-25%]=Moderate, [26%-40%]=High, [41%<]=Very High

##### Appendix 2: Mean values of leadership styles and the company ranking

##### Appendix 2.1: Transformational Leadership Mean Values

Company	Transformational Leadership			
	II (B), II(A), IS, IM	IC	Composite Mean	Rank
1	4.77	3.64	4.21	11
2	4.71	3.61	4.16	12
3	2.62	2.63	2.62	
4	3.04	3.44	3.24	
5	4.88	5	4.94	1
6	4.68	4.25	4.46	5
7	3.41	3.09	3.24	
8	4.37	3.57	3.95	
9	3.61	3.45	3.53	
10	4.67	4.57	4.62	2
11	3.84	3.49	3.66	
12	4.59	3.57	4.05	13
13	2.75	2.49	2.62	
14	4.16	4.55	4.35	9
15	4.16	4.62	4.39	8
16	4.17	4.32	4.25	10
17	2.76	2.7	2.73	
18	4.64	4.57	4.6	3
19	3.51	3.08	3.29	
20	3.11	3.99	3.52	
21	4.3	2.76	3.44	
22	3.32	3.66	3.48	
23	2.94	2.41	2.66	
24	3.45	3.37	3.41	
25	3.26	3.23	3.24	
26	4.44	4.57	4.51	4
27	4.24	4.6	4.42	6
28	4	2.79	3.34	
29	4.61	4.2	4.4	7
30	2.64	2.53	2.58	

Appendix 2.2 Transactional Leadership mean values

Company	CR	MBE(A)	(MBE(P)	Composite Mean CR & MBE(A)	Rating	Composite Mean CR & MBP (P)	Rating
1	3.34	4.68	1.00	4.01	13	2.17	
2	3.65	4.67	1.04	4.16	8	2.35	
3	2.62	2.74	3.89	2.68		3.26	
4	3.80	4.70	2.95	4.25	5	3.38	
5	3.41	5.00	1.15	4.21	7	2.28	
6	3.78	4.85	1.00	4.32	4	2.39	
7	3.37	3.70	1.56	3.54		2.47	
8	3.21	4.62	1.00	3.92		2.11	
9	4.47	4.57	1.30	4.52	3	2.89	
10	3.42	4.09	1.00	3.76		2.21	
11	4.67	4.82	1.49	4.75	2	3.08	
12	3.06	3.77	1.39	3.42		2.23	
13	4.06	2.60	4.03	3.33		4.05	2
14	3.67	4.52	1.00	4.10	11	2.34	
15	3.63	4.60	1.00	4.12	10	2.32	
16	3.87	4.20	1.00	4.04	12	2.44	
17	3.63	2.71	3.94	3.17		3.79	
18	3.16	4.62	1.00	3.89		2.08	
19	3.21	4.08	1.94	3.65		2.58	
20	4.65	4.86	2.14	4.76	1	3.40	
21	2.97	3.02	2.07	3.00		2.52	
22	3.96	2.53	3.96	3.25		3.96	
23	4.06	4.37	1.00	4.22	6	2.53	
24	2.96	4.37	1.00	3.67		1.98	
25	4.82	2.68	4.50	3.75		4.66	1
26	3.02	4.68	1.00	3.85		2.01	
27	3.09	4.57	1.00	3.83		2.05	
28	4.00	4.28	1.00	4.14	9	2.50	
29	3.06	3.67	1.00	3.37		2.03	
30	4.13	2.63	3.77	3.38		3.95	

Appendix 2.3 Laissez-Faire Leadership mean values

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Company	Mean LF	Rating
1	1.00	
2	1.00	
3	4.19	1
4	2.58	
5	1.02	
6	1.00	
7	1.00	
8	1.00	
9	1.58	
10	1.00	
11	1.00	
12	1.00	
13	4.04	
14	1.00	2
15	1.00	
16	1.00	
17	4.04	
18	1.00	
19	3.12	3
20	2.81	
21	1.00	
22	3.26	
23	1.00	
24	1.00	
25	3.63	
26	1.00	
27	1.00	
28	1.00	
29	1.00	
30	3.46	

# Determinants of Moonlighting Decisions Among Government Employees In Sri Lanka: Evidence from government employees who dwelt in Kegalle district

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**Abstract-** Objective of this study is to investigate the determinants which motivate the government employees in Sri Lanka for moonlighting. For this purpose, 925 government employees who dwelt in Kegalle district were randomly selected during the period of 2019. Moonlighting is the dependent variable which takes a value of 1 when an individual holds more than one job and 0 if an individual is engaged in only one job. Since, the dependent variable has two categories of dichotomous such as moonlighter or non-moonlighter, binary regression models namely, probit and logistic models were applied with education levels, number of Dependents, primary income from main job, and civil status which were considered as four explanatory variables in the study. Results of chi - square test, Probit and logistic model testing reveal that all the independent variables have significant association with the moonlighting. Further the results are showing that two variables namely Education level & Income from primary job are negatively impacted in case of being a moonlighter while other two variables namely number of dependents & civil status are positively affected to be a moonlighter. And the results are showing a consistent with the results previous studies too. The overall results of the study may support to the policy planners and relevant stakeholders to develop strategies that affect workers choice and attitude to work in the labour market, specially in related to the government employees.

**Index Terms-** Moonlighting, Education Level, Number of Dependents, Civil status

## I. INTRODUCTION

Moonlighting is defined by various person in different ways such as The American Heritage Dictionary of the English Language (2009), defined Moonlighting as working at a secondary job, to work at another job, often at night, in addition to one's full-time job. According to Shishko and Rostker (1976) moonlighting is a situation where an individual maintains primary employment and engages in additional work to pay. Generally, Moonlighting occurs when a full-time worker has a second (or even a third or fourth) job in addition to primary one. As an example, musician sing in the hotels rather than their primary job that they are doing and also school teachers are conducting tuition classes rather than their primary job. Moonlighting has become a prominent feature in most of labour market because it provides huge contribution for the economic development of a country. In the present situation, economic and business environment of a country change rapidly as a result of micro and macroeconomic factors. These rapid changes badly affected to the people's job and job preferences. Thus, moonlighting or multiple jobs holding arise when individuals work in more than one job at the same time and it has been increased considerably in transition & industrialized countries in recent decades. Statistical information on multiple jobs holding is limited in developing countries also in Sri Lanka when comparing with some other developing or developed countries. However, at present, developing countries also collects information on multiple jobs due its importance at the statistical estimations on entire labour market. Also, multiple jobs holding directly affect the country's job market and thus, it is vital to the economic development of Sri Lanka. (Labour force survey annual report,2016). According to the survey results show that 11.0% of total employed, persons hold secondary jobs during the survey year 2016 and out of these secondary employed persons, 655,488 were males and 222,140 were females during the same year. Above statistics are proved that there is a high level of moonlighting activities in Sri Lankan context. But, even though some related studies on moonlighting have been carried out in local and foreign context (see e.g. Gaag et al., 1989; Owusu, 2005., Samaraweera and Ranasinghe, 2012., Boateng, 1996., Heineck, 2009), a quantitative analysis that links moonlighting with relevant triggers has not been well established particularly in Sri Lanka. So, it is researchable to identify determinants of moonlighting activities in case of Sri Lankan context using a quantitative approach. Further, it is better to test those relative to the different segments of the workforce as in government sector.

## II. REVIEW OF LITERATURE & HYPOTHESES DEVELOPMENT

Moonlighting is defined by various persons in different ways. According to the American Heritage Dictionary of the English Language (2009), Moonlighting refers to working at a secondary job, work at another job, often at night, in addition to one's full-time job. According to Shishko and Rostker (1976), an individual is considered a multiple job-holder or said to be moonlighting if he or she maintains primary employment and engages in additional work for pay. Normally in the discussion of secondary job-holdings, two types of additional work are considered: working at a second formal job or engaging in an individual (self-employed) economic activity, i.e. formal and informal secondary work. When consider about who is the moonlighter simply can define individual who moonlight is moonlighter. But there are two broad definitions of moonlighter and they are point definition and duration definition (Boateng, 1996). The point definition considered the worker at a particular point in time, and classified the worker as a moonlighter if more than one job was held during the reference period. This definition did not consider the period over which the two jobs had been simultaneously. According to the duration definition the worker was observed over a time interval, and if more than one job was held during the entire period then the individual was considered as moonlighter. The problem with the point definition is that it included in its definition of moonlighter individuals who might be held transitional jobs and who have no intention of keeping both or all jobs simultaneously.

Most researchers put their effort to identify the determinants of moonlighting. Heineck (2009) examined the determinants of secondary jobholding in Germany and the UK. Through his research he revealed that secondary jobholding is a persistent phenomenon in both Germany and the UK. He has examined both male and female workers separately by using panel data whereas the results are varying across gender and countries. There is a support for both main theoretical stands, either for the hours constraint motive and, through less clear, for the heterogeneous jobs motive. Hall and Pertrosky (2016) have also examined the determinants of moonlighting among lecturers of State Universities in Cameroon. According to his research paper he identified that in addition to the classical determinants of moonlighting (hours of work in the main job, pay in the primary job, pay in the secondary job) gender and localization of the university also play major roles. Shishko and Rostker (1976) have found that the labour supply becomes more elastic to changes in the wage rate after accounting for the decision to moonlight as a response to an hour's constraint on the primary job. According to them, the hours spent in the secondary job increases with the secondary job wage rate and decrease with the primary job earnings, suggesting a financial motivation for multiple job-holding. Furthermore, increases in the earnings and hours worked in the primary job have a negative effect on secondary job hours. Paxson and Sicherman (1996) have found evidence to support the hours constraint motivation and confirmed that dual job holding is a dynamic process. Their study has been revealed that dual jobs and job changes are used to adjust hours of work simply due to the evening and weekend hours are not available in their main job. In a further study by Casari (2010) for urban and rural workers in Brazil, evidence was found to support the hours constraint motivation but adds that heterogeneity in occupation and stability contribute to increased labour in the secondary labour market. William et al., (2013) have identified that a number of factors have been influence to moonlighting decisions in Ghana. Key amongst these are the number of working hours, earnings, type of employment in the main job, rural location and worker's age. Specifically, individuals in poor households are less likely to moonlight with household size having increasing influence on the individual desire to hold more than one job while education and age are estimated to have positive effect on individual decision to the moonlight. According to Samaraweera and Ranasinghe (2012), moonlighting among married men is high for two groups with children less than 6 years of age and 6-14 years of age. Furthermore, the total hours of work of this two life cycle stages are higher for married males and they have concluded that low per hour income and the educational level encourage more moonlighting. While most of the researchers have tried to find the reasons for the moonlighting some researchers put their effort to find the impact of moonlighting. It may be positive or a negative one. Adeyeye (2009) has conducted a study to measure out the impact of moonlighting practices on job satisfaction of the university teachers. That study meant to put its effort to explore the impact of moonlighting practices on job satisfaction of teachers of public sector universities of the province of Punjab and Federal Capital. In order to consider this research paper, the researcher has identified factors responsible for moonlighting university teachers as additional income, blocked promotion, skill diversity and the job autonomy. Further, Recently Pathirana and Thayabaran (2019) has conducted a same type of study in Sri Lankan context and have concluded that household characteristics such as secondary and higher education levels and number of children and as well as among labour market characteristics, two income ranges from primary job such as income between Rs 10000/= and Rs39999/= and the income Rs 40000/= and above were found statistically significant influence on an individual's motivation to engage in more than one job in labour market in the country.

According to the prior studies, researcher has identified five major determinants of moonlighting decisions as below.

- Level of education.-Kimmel (2001), has considered the level of education as a determinant of moonlighting decisions in his study. Furthermore, Samaraweera and Ranasinghe (2012) have also considered years of education as a determinant of moonlighting decisions in their study.
- Income earns through the primary job.-Perlman (1966), Shishko and Rostker(1976), Samaraweera and Ranasinghe (2012), Heineck (2009) have tested that whether income earn through the primary job would be a determinant of moonlighting decisions.

- Number of dependents:-Samaraweera and Ranasinghe (2012) have considered number of children as a determinant of moonlighting decisions.
- Civil status:-Pathirana & Thayabaran (2019) have tested working hours of primary jobs a variable of their studies.

In this study, researcher has tested the validity of these determinants in Sri Lankan context. In that case researcher has tested following hypothesis which have been developed by the researcher based on prior studies.

- H1- There is a significant relationship between educational level of a person and be a moonlighter.
- H2- There is a significant relationship between the income from the primary job of a person and be a moonlighter.
- H3- There is a significant relationship between a numbers of dependents of the household and be a moonlighter.
- H4- There is a significant relationship between the marital status of a person and be a moonlighter.

### III. ADOPTED METHODOLOGY

In this academic study, the positivism research approach is chosen and used in general by natural scientists. Positivism is a natural theoretical approach that assumes that the findings are based on positive facts rather than on impressions. Everything, which is not observable and cannot be proved through scientific experiment or ethical and theological questioning is against the positivism approach. From the observed part of society, which will be surveyed during the research process, a generalization of the whole society can be made. The research strategy of collecting data should be built on existing theory. This was discussed in the previous literature review to develop the research hypothesis, which will be proved or refuted. If the hypotheses are refuted, further theory has to be tested. Moreover, the positivism approach assumes an on-going scientific progress and a value-free attitude of the researcher.

Following conceptual model gives a brief outline about the related variables and how the particular variables of the study connected together.

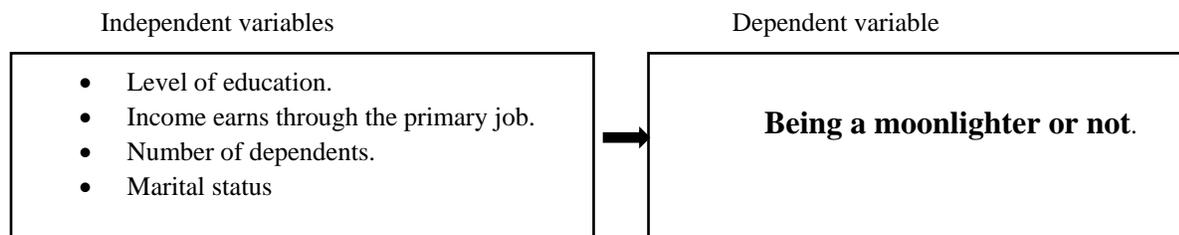


Figure 1 Conceptual Framework

Following operationalization table has been developed by the researcher based on the prior studies

Table 1 : Operationalization

Variable	Measurements
Being a moonlighter	1- If the worker is doing more job rather than their primary job, he is moonlighter. 0- If the worker is not doing more jobs rather than their primary job he is not moonlight.
Income from the Primary Job	1- Less than Rs.10000 2- Rs.10000 to Rs.39999 3- Rs.40000 and above
Number of dependents	1- No any 2- 1-2 Dependents 3- More than 2 Dependents
Level of Education	1-Primary education 2-Secondary education 3-Higher education
Civil status	1-Maried 2-Unmaried

In this research, researcher has concerned only about government employees who dwelt in Kegalle district. Here, identifying the total population is difficult. Anyhow, the number of government employees in Sri Lanka is 1,104,219 (Census of Public and Semi Government Sector Employment Preliminary Report,2016) Therefore, researcher will concern comparatively a big sample to minimize the impact of this matter to this study. Sample is chosen by using random sampling method. Government employees of all categories (Permanent and Pensionable, Permanent and non-pensionable, Contract basis) who live in Kegalle would be cover up by the researcher when selecting the sample. To collect reliable primary data, researcher has collected data from 925 government

employees who dwelt in Kegalle district through a structured online questionnaire (in year 2019). Questionnaire will be developed by the researcher based on the developed operationalization.

To investigate the major determinants of the government employees towards the secondary job or moonlighting and identify the characteristics of government employees in moonlighting, descriptive analysis and econometrics analytical techniques were applied in the study. Those have been explained in below table.

Table 2 Data Analysis Methods

Statistical test	Objective
Frequency analysis	Describing the characteristics of the set of data
chi-squared test	Testing relationships between categorical variables
probit model	calculate the marginal effects of explanatory variables & Hypothesis Testing

The dependent variable of this research is to identify whether the individual worker is engaged in more than one job. It has measured in a dichotomous form and takes a value of 1 if the individual holds more than one job and 0 if he is engaged in one job. Because of the binary nature of the dependent variable, has used the probit regression estimation technique to explore how each of the explanatory variables influences the probability of a worker engaging in moonlighting. Probit regression model can be mentioned as follows.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots \dots \dots (1)$$

Where;

- Y – Be a moonlighter
- O - Other factors
- X1 – Educational level
- X2 – Primary job income
- X3 – Number of dependents
- X4 – Marital status

After estimate the probit regression estimation to identify the impact of independent variable on dependent variable in terms of probability, estimation of marginal effect is also has been tested. William et al., (2013) also have used probit regression in a same type of study.

IV. RESULTS & DISCUSSION

According to the accepted responses 51.35% of respondents are moonlighters and remaining 48.65% of respondents are only doing their primary job. Above results disclosed that the target group (sample) have higher moonlighting rate. 41.1% moonlighters who have responded for this study are having secondary education and 30.3% and 28.6% moonlighters are having primary education and higher education respectively. In fact, 45.9% of the respondents have income of Rs.10000 - Rs.39999 from their primary job, 29.2% of the respondents have income of less than Rs.10000 and remaining 24.9% of the respondents have income of higher than Rs.10000. Further, researcher has noted that nearly 46% of the sample of surveyed government employees have one/ two dependents and nearly 32% of the sample are not having any dependents. Rest of the other 22% had more than two dependents. And, most of respondents are married, giving approximately 78% of the sample size and rest of other 22% of sample size are unmarried.

Table 3 Results of Chi-square test (Source: Survey data)

Variable	Moonlight (%)	Non-Moonlighter (%)	$\chi^2$	Sig.
<b>Education</b>				
Primary	91.1	8.9	63.738	0.000
Secondary	47.4	52.6		
Higher	15.1	84.9		
<b>Primary job income</b>				
<10000	96.3	3.7	78.186	0.000
10000-39999	45.9	54.1		
<40000	8.7	91.3		
<b>Number of Dependents</b>				
0	25.0	75.0	35.067	0.000
1 -2	54.1	45.9		
<2	85.0	15.0		
<b>Civil status</b>				
Married	46.2	53.8	7.105	0.008
Single	70.0	30.0		

According to the table 3 (Results of Chi-square Tests), All the variables are affected to behavior of government employees in Kegalle district as Through the chi-squire test researcher can identify whether there is an association between the dependent variable and independent variables.

Further, researcher has used Probit regression estimation technique to explore how each of the explanatory variables influences the probability of a worker engaging in moonlighting. The result of particular model is given in Table 4.

*Table 4 Results of Estimated Probit Model*

Variable	Coefficient	Standard error	z	P>  z
Education	-1.191	0.219	-5.42	0.000*
Primary income	-1.678	0.278	-6.04	0.000*
No. of dependents	0.451	0.200	2.26	0.024**
Civil status	-0.585	0.355	-1.65	0.099***

*NOTE: \*, \*\*, \*\*\*, represent significant level of 1%, 5% and 10% respectively.*

According to the estimated Probit model all independent variables are statistically significant at 1%, 5%, and 10% levels, indicate that all the above variables are the main factors to determine the decision of moonlighting among government employees of Kegalle district.

Through Marginal effect results researcher has identified the probability of independent variables affected to dependent variable.

*Table 4 Results of Marginal Effect*

Variable	dy/dx	Standard error	z	P>  z
Education	-0.185	0.025	-7.61	0.000*
Primary income	-0.260	0.026	-9.45	0.000*
No. of dependents	0.070	0.029	2.36	0.018**
Civil status	0.091	0.053	1.69	0.091***

*Note: \*, \*\*, \*\*\*, represent at 1%, 5% and 10% significant level respectively.*

This estimation also provide evidence to suggest a statistically significant effect of government employees who are in Kegalle on the probability of engaging in multiple job holding. Specifically, the probability of engaging in moonlighting decreases with education based on negative marginal effect. Negative marginal effect of education suggests concavity of the relationship between worker’s probability of engaging in moonlighting and education. This implies that the probability of engaging in moonlighting assumes an increasing pattern initially and beyond a certain level of education, the probability decline. Additionally, workers with secondary and higher education are observed to have less probability relative to the primary educators of engaging in moonlighting. Based on the 4 table when education increases from primary to higher, they have 18% of less probability to moonlight. Income earn from primary job also have negative marginal effect and represent 26% of less probability to moonlight. This may confirm the view that lower income of primary job among government employees is a major trigger to engage in moonlighting. Table 4 provides evidence to suggest a statistically significant effect of household characteristics of the workers on the probability of engaging in multiple job-holding. Probability of engaging in moonlighting increases with number of dependents based on the positive marginal effect of it. Larger households could reflect higher dependency and more financial strain. However, workers who have a smaller number of dependents are less likely to work in more than one job. Same time marital status also has positive marginal effect and according to the table 4, it means there is a high probability of being a moonlighter when government employee’s marital status becomes married.

Based on the findings of above statistical analysis, following table 5 shows a conclusion of these findings.

*Table 5 Hypotheses testing results*

Hypotheses	Accepted/ Reject	Relationship status (If accept)
H <sub>1</sub> - There is a significant relationship between educational level of a person and be a moonlighter.	Accepted	Negative
H <sub>2</sub> - There is a significant relationship between the income from the primary job of a person and be a moonlighter.	Accepted	Negative
H <sub>3</sub> . There is a significant relationship between a number of dependents of the household and be a moonlighter.	Accepted	Positive
H <sub>4</sub> . There is a significant relationship between the marital status of a person and be a moonlighter.	Accepted	Positive

Findings of the data analysis have been disclosed that researcher is having enough statistical evidences to accept all the hypotheses which have been tested through this study.

## V. CONCLUSION

The main objective of this study is to identify the factors that affected to moonlighting preferences of government employees in Kegalle District. To achieve this objective chosen 925 sample and delivered an online structures questionnaire. Different econometric methods enable to use to capture the real picture of moonlighting behavior based on their responses. According to finding these is a statistically significant association between all the independent variables with the dependent variable. Furthermore, it has been revealed that two variables namely Education level & Income from primary job are negatively impacted in case of being a moonlighter while other two variables namely number of dependents & civil status are positively affected to be a moonlighter. On the other hand, in simple words, in case of Kegalle District Government employees there is a high probability of being a moonlighter when people are having less education level, less income from primary job, higher number of dependents in the family and being a married person.

In a very recent study Pathirana & Thayabaran (2019), has identified that level of education, earning income from main job and number of children has significant association with the moonlighting in case of Sri Lankan Labour Market. So, finding of this study also are showing a consistent with the findings of that study. The results from the empirical analyses provide the evidence mainly focusing on the motivation factors which are influencing the moonlighting and characteristics of moonlighters in government employees, Kegalle District, Sri Lanka. The empirical analyses from frequency test indicate that secondary jobholding is a persistent phenomenon and over the time period considered, more than 50% of the responded government employees doing more than one job in the study area. In the study of Pathirana & Thayabaran (2019) which has obtained same type of results has suggested that Education of the respondents mainly secondary and high levels, and workers' earnings capacity and the income from their primary job which may encourage them to do only one job while the respondents who have dependents motivate them to become as a moonlighter in order to adjust their financial strain and burden of their family in Sri Lanka. Here, these study providing more empirical evidences to make strong the opinion which have socialized by Pathirana & Thayabaran (2019).

Moonlighting generate opportunities to the labour market to get the best from worker's strength and abilities. Specially the person who have special knowledge with regarding some specific areas can optimally utilize by using moonlighting. So, moonlighting opportunity must be extended in relevant situations. With moonlighting behaviors of government employees arising some socio and health problems (Less caring about children, Less happy/ satisfaction/ Mental diseases). By developing flexible work schedule helps to achieve work-family balance and it led to higher family welfare. So must give the attention to develop flexible work environment within the organization.

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# Flexible work arrangements and organization productivity: Study of KCB Bank, Rwanda.

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## Abstract

Flexible Work Arrangement has recently seen the attention of both academicians as well as practitioners as a tool to improve organizational performance. However there is a lack of research as how FWA can be helpful to the increase productivity of organization specifically in the banking sector where customer satisfaction and customer service being the pertinent work. The study examined the effect of FWA on organization productivity in Rwanda using a case of Kenya Commercial Bank (KCB). Specifically, this study identified the flexible work arrangement used at KCB, determined the level of productivity at KCB and found out the relationship between flexible work arrangements and Organization productivity at KCB. This study adapted a descriptive research design and it was performed onsite at Kenya Commercial Bank Rwanda. The target population consisted of 248 employees from Kenya Commercial Bank (KCB) and Yamane formula was used to get a sample size of 154 respondents. A stratified random sampling method were used to choose respondents from different strata. Primary data was gathered using questionnaire and interview guide and multiple regression analysis was used to find out the relationship between flexible work arrangements and organization productivity. It was found that the most commonly FWAs used at KCB are telework and job sharing. A variation of bank's profit was found, where a high percentage of profit KCB earns in relation to its overall resources. A significant correlation was found between telework and organizational productivity indicators ( $r=0.010$ ,  $t=2.691$   $p=0.010$ ), while the correlation was significant between job sharing and productivity with a  $t=4.180$ ,  $r=0.000$ . The researcher recommend KCB to implement and strengthen flexible work arrangements as they are more advantageous and suitable for KCB employees. Going forward, public or private, financial or non-financial institution should take into consideration having more proponent rate of workforce teleworking of course with policy and regulations. The Researchers interested in conducting similar research, this study is to work as reference in filling the gap left by this study.

**Keywords:** *flexible work arrangement, flexi time, Telework, compressed work week, job sharing, organization productivity*

## 1. Introduction

The interest in the outcome of the flexible work arrangements dates into early 1970s when the researchers attempted to access the impact of flexible work arrangement on employee's productivity (Amah and Ahiauzu, 2013). It is argued that the flexible work arrangement can affect either directly or indirectly to the improvement of the individual as well as organization and society wellbeing. It intensified the researchers to investigate on the subject and the government to take step to implement the Flexible work arrangement by way of bring legislations to implement the scheme (Bipp, 2010). Flexible work arrangement allow employees the freedom to work outside the standard work schedules (Barney and Elias, 2010).

There has been changes over the last 300 years regarding the standard work week. Previously employees would work for 96 hours, that is, 16 hours per day (Bird, 2010). Since 1900s Labor Unions have continued to hire employees' grievances until the 40 hours week was established by Labor Standards Act (Munjuri, 2013).

According Njeru (2013) a survey carried out found that 87% of workforce preferred flexible work arrangement and this would take priority when looking for new employment. Organizations are look for ways and means of attracting employees. According to World of Work Report (2011), the flexible work schedules are important element of Organization strategies which should be geared towards retaining a motivated workforce. Flexible work arrangement have been practiced in both developing and developed countries and both employers and employees have benefitted from them.

According to Bipp (2010) one manufacturing company changed its work schedule from working six hours per day to eight hours. This alteration brought increase in production because accidents reduced as well as increasing employee's morale. The program was accepted nationally by stakeholders from government and business organizations.

According to Kattenbach et al., (2010) the US President passed a Telework Act that enabled for more flexibility by employees. Other countries for instance Australia followed suit in order to bridge the production gap (Galinsky, et al., 2010). According Christopher and Angelique (2014), Germany aerospace introduced flexible practices in order to reduce absenteeism. In UK several organizations introduced flexible work arrangements (International Labor Organization, 2010). Organizations in Africa have introduced flexible work arrangement but to a lesser extent (Ioan, et al., 2010).

In Rwanda flex-time has been in use by various firms, for instance Safaricom in 2012 and ECO Bank in 2013 and some commercial banks (Kamau, et al., 2013). According to Kamau et al., (2013) a study on flexible work arrangement in Rwanda concluded that flexible work arrangement improves employee job performance.

According to Kamau, et al (2015) work flexibility enables the workers to seek a new job. Therefore labor turnover was linked to the degree of flexibility the organization practices. Employee's absenteeism reduces as a result of work scheduling (Kossek, et al., 2010). As a result of practicing these schedule flexibilities the organizations productivity improves. Research has shown that organization using schedule flexibility tend to perform better (Anafarta, 2011).

This study was interested in only four types of flexible work arrangement namely: compressed work week, job sharing, Telework and flexi-time.

This research was conducted on the basis of the following objectives:

- (i) To identify the flexible work arrangements used at KCB
- (ii) To determine the level of organization productivity at KCB.
- (iii) To find out the relationship between flexible work arrangements and Organization productivity at KCB.

## 2. Literature review

According to Lewis and Den (2010), flexible work arrangement are different forms of working schedule that enables employees to work outside the normal workday. Some of various forms of flexible work arrangement include Telework, compressed hours, shift, and flexi-time and annualized hours (McLean and Collins, 2011).

Nowadays, flexible work arrangements have become an essential part of today's work culture because of socio-demographic changes, but the organization's benefits are still one of its major driving forces (Masuda et al., 2011). Organizations adopt more flexible work arrangements in order to respond to the needs and expectations of employees which have increased because of these socio-demographic changes.

Coenen and Kok (2014) claims that in many cases, Employers have introduced flexible working arrangement in order to attract, recruit, and retain highly qualified staff to the organizations. This gives an employer the possibility to create a good work place where people want to work, it also help to reduce employee turnover and absentee-ism and increase organization productivity.

Wheatley, (2016) stated that flexible work arrangement also increase employee performance- By creating an environment where employees have higher levels of satisfaction and motivation, productivity also increases, which has a positive impact on the bottom line. Flexible working arrangement is one of the human resource strategy to attract and retain a talented workforce – In order to continue to attract, retain and develop talent, businesses need to understand what drives the workforce.

Smith (2010) observed that a key factor in employee engagement was the ability to 'switch off' or psychologically detach from work during non-work time. Typically psychological detachment involves people's social relationships and activities such as catching up with friends or pursuing hobbies or other interests. In addition, most employees have other responsibilities that must be attended to and for which employees must be psychologically present, such as dependent children and/or other family matters, household tasks, and sport.

Travis (2010) found that employees who were unable to achieve detachment from work experienced a corresponding lowering of work engagement. It is therefore observed that a long-hours' work culture described by a number of researchers (Van de Wiele, 2010) could potentially erode employees' engagement with work. Research shows there is a direct correlation between engaged employees and the satisfaction of the customer and ultimately achieving business outcomes.

Baruah, (2013) identified work life balance initiatives such as flexible work arrangements to be significant for employees retention and engagement particularly in a business environment that shows support for the family.

Adekola (2010) attempted to identify and relate work demand to work life conflict and it was discovered that career salience, hours of work and work involvement were associated with work interference and family conflict. Better performing employees at work become more committed to the organizational and ultimately contribute to increase organizational performance as well as growth of the economy. To achieve this, flexible work arrangement is important. Availability of FWA have also been related to increased affective commitment and decrease turnover intentions among all employees' not just users of the FWA (Wu, et al., 2012).

Amah and Ahiauzu (2013) further observes that employee satisfaction is likely to increase one's performance as one will always exert himself or herself to a task that employee feel capable of and in an environment that is conducive but factors such as work pressure, fatigue and high stress levels may limit employee performance (McNall and Nicklin, 2010).

Barney and Elias (2010) assert that many commercial banks are cropping up or older ones opening up new branches in order to meet the high demand of clients that is a result of a more financially enlightened population in an economy that is seeing gradual progress to remain competitive in an industry where there is strong competition among the commercial banks and from other financial institutions the burden is on the employees to improve the performance.

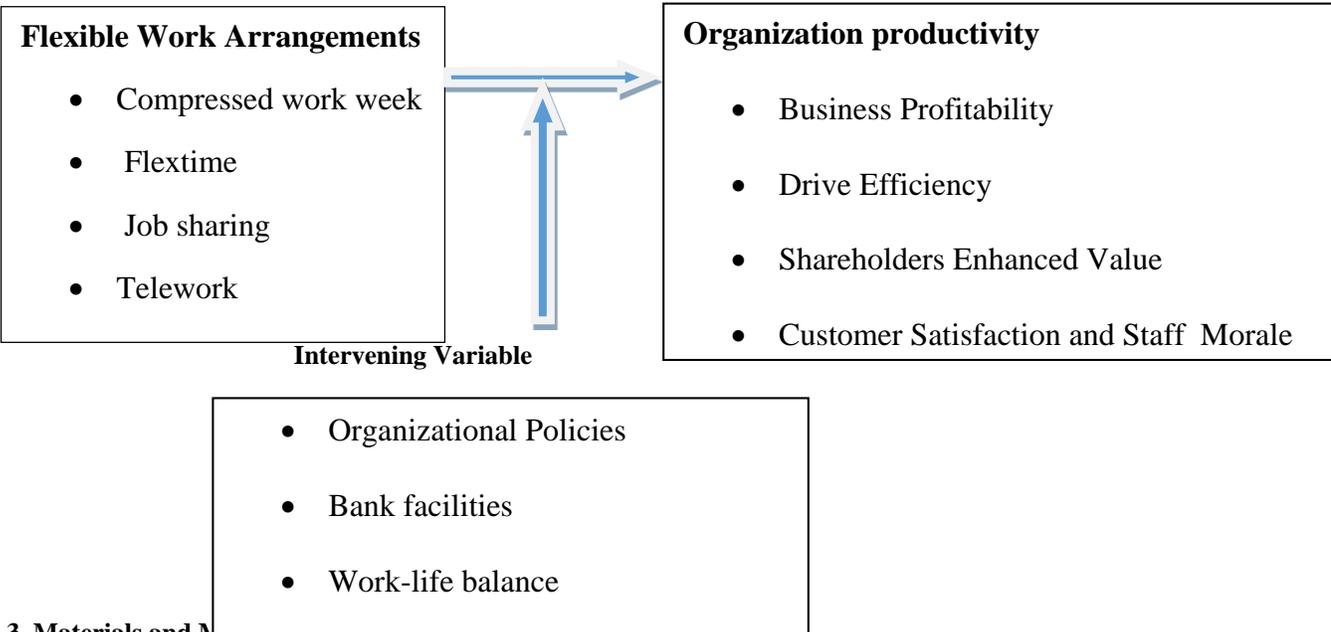
Lewis and Den (2010) established that both employers and employees equally benefits from schedule flexibility. These studies are not specific on various forms of flexible work arrangement adopted.

Lewis and Den (2010) used the work adjustment model to explain how flextime schedules influence employees' attitudes and behaviors. The work adjustment model leads to the prediction that high correspondence between an employee's abilities and the ability requirements of the job should lead to high role performance. Work adjustment is high when individuals fulfill the work/ role requirements and the organization simultaneously fulfills the needs of the individual. More recent research has modified the model so that moderating relationships also exist between job attitudes and job performance (Madsen, 2011).

The conceptual framework focuses on the interaction among independent, dependent and intervening variables. This conceptual framework explained how compressed hours, flexi time, job sharing, and Telework affects organization productivity.

**Independent Variable**

**Dependent Variable**



**3. Materials and Methods**

This study, qualitative and quantitative methods for analyzing information were employed. The research design used was mixt Method (quantitative and qualitative).Therefore, a descriptive research was chosen as the same meaning, it is expected to define the current status while discussing the existing and be taken for visual assistance like figures and tables. Target population is composed of KCB Rwanda's employees. In total, there are 248 KCB employees all over the country. To define the Sample size Yamane's simplified formula was used as follow:

$$n = \frac{N}{1+Ne^2}$$

Source : Yamane (1967:886).

When n is the Sample Size, N is the population size and e is the degree of precision. The confidence level was considered to be 95%. With N=248 employees; e=5%; considering the confidence levels of 95%; n is equal to 154 employees. The 154 staff members were purposively chosen as a sample size for the study. The stratified random sampling and the simple random method were used in selecting respondents to be involved in research and grouping the respondents. For analyzing quantitative information, statistical package for social sciences (SPSS) version 22.0 and Ms Excel were used. Qualitative information was expressed in different format such as tables, figures and the analysis of percentages were done through Microsoft excel spreadsheet application which organizes data in columns and rows to be manipulated through formulas to allow the researcher to easier interpreted the collected data from interviews and questionnaires.

#### 4. Results and discussion

The researcher collected both qualitative and quantitative information from 154 respondents. The first part consists of identifying the flexible work arrangements used at KCB, the second determined the level of productivity at KCB, and the third party of finding out the relationship between flexible work arrangements and Organization productivity at KCB.

The investigation on flexible work arrangements used at Kenya Commercial Bank, to determine whether Flexible Work Arrangements existed in the bank. These include compressed workweek, flexi-time, job sharing, and telework.

**Table 4. 1 Flexible Work Arrangement used at Kenya Commercial Bank**

Flexible Work arrangements available at KCB	Strongly Disagree		Disagree		Not Sure		Agree		Strongly Agree		Total N	Mean	Sd
	N	%	N	%	N	%	N	%	N	%			
Compressed work week	0	0	88	57.6	61	39.8	5	2.6	0	0.0	154	2.5	1.9
Flexi Time	106	69.3	34	22.2	11	7.2	3	1.3	0	0.0	154	1.4	1.0
Job sharing	0	0	20	13.0	0	0.0	62	39.9	72	47.1	154	4.2	3.8
Telework	0	0	4	2.6	0	0.0	73	47.7	76	49.7	154	4.4	3.9

Source: Field survey (2020)

The study revealed that 57.6% of respondents indicates that respondents disagree with the adoption of compressed work hours at KCB, though 39.8% of respondents were neutral. The findings suggests that compressed work week is not known by employees in the Institution. The study similarly established that 69.3% of respondents strongly disagreed with the adoption of flexi time. In other term, flexi time was not used at KCB or not commonly known by majority of employees in the Institution. The study also established that job sharing is frequently adopted at KCB, majority of respondents strongly agreed that job sharing exist at KCB. The study established that a big number of the respondents indicated that at KCB telework has been adopted especially during this period of Cov-19. In this regards, 49.7% of respondents respectively agreed and strongly agree with the existence of telework at KCB.

The researcher sought to determine the level of organizational productivity at Kenya Commercial Bank-Rwanda, using organization productivity indicators such as: Business profitability, drive efficiency, shareholders enhanced value, and staff morale and customer satisfaction.

**Table 4.2 Business Profitability**

Business Profitability	Very low		Low		Average		High		Very High		Total N	Mean	Sd
	N	%	N	%	N	%	N	%	N	%			

Product innovation	21	13.7	39	25.5	28	18.3	23	15.0	42	27.5	154	2.8	2.7
Return on Assets	5	3.3	19	12.4	18	11.8	19	12.4	92	60.1	154	1.9	1.8
Customer deposit	11	7.2	32	20.9	6	3.9	58	37.9	46	30.1	154	2.9	2.2
loans and advances	34	22.1	17	11.0	51	33.8	39	25.3	12	7.8	154	3.1	2.9

**Source: Field survey (2020)**

Table 4.2 reflect to what extent there was business profitability at Kenya Commercial bank. In this regard, 15% respondents and 27.5% respondents strongly agreed with the statement. The majority of respondents confirm that there is a high profitable product innovation which was launch on the market such as Diaspora banking, internet banking, and online purchase (electricity, water, TV). In addition, 60% of respondents stated an increase of ROA, while 68% of respondents mentioned a high increase of customer deposit at KCB in the last five years. Findings show that both increase in the customer deposit and loans and advances was provided in other report and was shown in the table 4.3.

**Table 4. 3 Trends in Business Profitability**

Business Profitability	2017	2018	2019	2020 By June	2020 Dec 2020
Return on Assets (ROA)	1.7%	1.9%	2.7%	1.7%	3%
Profit of year	3.8Bn	3.7Bn	8.4Bn	2.4Bn	
Customer deposit	38.6Bn	40.323Bn	41.131Bn	41.387Bn	42.3Bn
Loans and Advances to customers	25.5Bn	26.8Bn	28.752Bn	30.2Bn	32.599Bn

**Source: KCB Annual report 2017-2020**

The researcher found out a variation of growth of the bank from 2017 to 2020. From increase of 1.7% to a target of 3% from 2017-2020, ROA ration shows the percentage of profit KCB earns in relation to its overall resources. Indicators show there is a significant increase of customer deposit of 38Bn to 42Bn from 2017-2020 and increase of loans from 25Bn to 32Bn from 2017-2020.

This show a good loan to deposit ratio, it means that KCB bank loaned to the customer almost every dollar received in its deposits. Banks also earn money from interest earned by lending out money to other clients. Bank lend funds from customer deposits. However, the interest rate paid by the bank on the money borrowed is less than the rate charged on the money lent. Profits can be measured as a return on assets (ROA). ROA is shown as a percentage, and the higher the number, the more efficient KCB's management is at managing its balance sheet to generate profits. With a higher ROA in 2019, that means KCB was more profitable in 2019 than 2017, 2018 and 2020.

**Table 4. 4 Trends in Drive Efficiency**

Drive Efficiency	2017	2018	2019	2020 June
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Cost to income ratio	60.4%	61.1%	61.2%	62.7%
Staff cost to income ratio	24.4%	24.8%	26.1%	28.6%

**Source: KCB Annual report 2017-2020**

The researcher found out a variation on the cost to income ratio from 60 % to 62% from 2017 to 2020. The research found a lower and stable staff cost to income ratio which means also that the cost of running a business is lower compared to its operating income. The lower the cost-to-income ratio is, the more profitable the company should be.

**Table 4. 5 Trends in Shareholders enhanced valued**

Shareholders Enhanced Valued	2017	2018	2019	2020 June
Maintain Operational Losses/Total Revenue ( $\leq 1\%$ )	1%	1%	1%	0.88%
NPL as a % of Gross Loans ( $\leq$ )	3.6%	5.9%	2.4%	5.96 %
Capital Adequacy ratio ( $\geq$ )	15.0%	15.0%	15.4%	15.5 %

**Source: KCB Annual report 2017-2020**

According to secondary data from KCB, the researcher found out a variation of maintaining operational losses/total revenue ( $\leq 1\%$ ) from 2017 to 2020. Indicators show that the percent was 1% in consecutive three years (2017, 2018, and 2019) but went down to 0.88% in 2020, that is mean the bank manage to maintain operations losses under 1%. For the case of Non-performing loan NPL as a % of Gross Loans ( $\leq$ ), the percentage varied between 3.6% to 5.9% for year 2017 and 2018 and NPL went down to 2.4% for year 2019. Finally, the Capital Adequacy ratio ( $\geq$ ) was 15.0% in 2017, 2018 and 2019 against regulatory limit of 15%, hence it reached 15.5% in June 2020 against 15.5% regulatory limit, therefore, in 2020 KCB was qualified as domestic systemic important bank and the Capital adequacy ratio regulatory limit was increase to 15.5%, these led KCB to increase its target as well to 16.5% end of year 2020 to ensure it covers it Risks. Therefore, KCB Rwanda show an increase of capital adequacy ratio and is considered to be resilient to shock. As a result, KCB is less likely to become insolvent if unexpected losses was to occur. The results are directly in line with previous findings with Pedersen and Jeppesen (2012) who stated that increasing shareholder value has become a strategically important part of the decision-making process.

**Table 4. 6 Customer Satisfaction and Staff Morale**

Customer Satisfaction and Staff Morale	Very Low		Low		Average 3		High		Very High		Total		
	5		4		2		2		1		N	Mean	Sd
	N	%	N	%	N	%	N	%	N	%	N		
Commitment to organization or effort to serve the customer	43	28.1	21	13.7	2	1.3	20	13.1	67	43.8	154	2.7	2.7
Long term training opportunity for career	13	8.5	12	7.8	10	6.5	45	29.4	73	47.7	154	2.0	1.9
Market competitive salary	47	30.7	22	14.4	4	2.6	28	18.3	52	34	154	2.9	2.9
Customer satisfaction score	9	5.9	21	13.7	27	17.6	37	24.2	59	38.6	154	2.2	2.1

**Source: Field survey (2020)**

The Table 4.6 shows that 56.9% of respondents who confirmed the existence of a high employee commitment to organization. In addition, respondents show a high involvement of KCB in providing the necessary training to meet the organization targets and also for the long term career development of its employees. Furthermore, 45.1% of respondents disagree that salaries in KCB are competitive on market and 52.3% of respondents agree that the salaries are competitive on the market. Researcher found that KCB employees are most important asset to the bank. As such the bank continue to improve its employee value proposition to address remuneration through improved flexibility of remuneration options available. KCB keep revise the employee retention strategy to retain the best staff and also encourage staff to utilize the e-learning channels as well as classroom-based learning for skills and knowledge development. Research shows there is a direct correlation between engaged employees and the satisfaction of the customer and ultimately achieving business outcomes. In other words, employee engagement drives customer satisfaction. Happy Employees Make Customers Feel Valued. This emotional attachment means that employees will go above and beyond the call of duty.

**Table 4. 7 Trends on Customer Satisfaction**

Customer Satisfaction	2017	2018	2019	2020
Increase Net Promoter Score (after a market survey)	30%	30%	≥30%	≥42%
Customer satisfaction score	≥85%	≥85%	≥88%	≥89%

**Source: KCB Annual report 2017-2020**

According to secondary data from KCB, the researcher found out a variation of Increase Net Promoter Score (after a market survey) from 2017 to 2020. Indicators show that the NPS was 30% in consecutive three years (2017, 2018, and 2019) but went at 42 and above % in 2020. This increase is a positive reputation for the bank, because it shows how likely customers are to recommend the bank. For the case of customer satisfaction score, it help the bank to know if its customers are happy with the services provided. The percentage was ≥85% for 2017, and 2018, but for 2019 it was 88% for year 2019 and target of 89% for 2020. This increase means customers are satisfied with the service received and also the bank satisfied with the employee’s effort given to satisfy the customer.

**Table 4. 8 Correlation between Flexible Work Arrangement and Organizational Productivity at Kenya Commercial Bank Rwanda**

Flexible work arrangements		Organization productivity			
		Business profitability	Drive efficiency	Shareholders enhanced value	Customer satisfaction and Staff Morale
Compressed work week	Pearson Correlation	.592**	.189	.931**	.655**
	Sig. (2-tailed)	.000	.086	.000	.000
	N	154	154	154	154
Flexi Time	Pearson Correlation	.681**	.145	.802**	.311**
	Sig. (2-tailed)	.000	.191	.000	.000
	N	154	154	154	154
Job sharing	Pearson Correlation	.370**	.304**	.669**	.850**
	Sig. (2-tailed)	.001	.005	.000	.004
	N	154	154	154	154
Telework	Pearson Correlation	.665**	.324**	.861**	.519**
	Sig. (2-tailed)	.000	.003	.000	.000
	N	154	154	154	154

**Source: Primary data (2020)**

Findings showed that variables are correlated. In these results, the Pearson correlation between compressed work week and business profitability is about ( $r=.592^{**}$ ,  $p=0.001$ ), which indicates that there is a moderate positive relationship between the variables. And between compressed work week and Drive efficiency is about ( $r=.189^{**}$ ,  $p=0.086$ ), which indicates that there is a small positive relationship between the variables. The Pearson correlation between compressed work week and Shareholders enhanced value is about ( $r=.931^{**}$ ,  $p=0.000$ ), which indicates that there is a high positive relationship between the variables. And between compressed work week and customer satisfaction and staff morale is ( $r=.655^{**}$ ,  $p=0.001$ ), which indicates that there is a moderate positive relationship between the variables. Given that the majority of p-value for variables are less than the significance level of 0.05, it is an indicator that most of correlation coefficients are significant. The p-value between compressed work week and Drive efficiency is ( $r=.189^{**}$ ,  $p=0.086$ ), The p-value between flexitime and Drive efficiency is ( $r=.145^{**}$ ,  $p=0.191$ ); Because both p-value are greater than the significance level of 0.05, there is inconclusive evidence about the significance of the association between the variables explaining the absence of relationship between compressed work week and flexi time at KCB.

**5. Conclusion**

Findings from the first objective lead the researcher to conclude that flexible work arrangement like compressed work week is not used therefore there is insignificant effect on employee and institution productivity. The study noted that job sharing had influenced performance positively. Employees should be encouraged to use this form of flexible work arrangement and managers to ensure there is always a suitable partner for job sharers. Flexi time had significant influence on performance. The Institutional management should implement and allow employees to be on flexi time to reduce absenteeism and also for employees to take care of personal duties. However due to the business continuity, some employees may be excluded from this flexible work arrangement. Telework was being used by a small percentage of employees and facilities were not adequate. Telework influenced employee performance, staff morale and increased productivity in the institution in a very small percentage. Therefore this study concluded that Telework is now a new way of working which will require new behavior and new norms. Even though teleworking is mostly thought of in a positive manner,

there are some downsides with regard to career development, future prospects and the social aspects of not working in a regular office.

Conclusion to the second specific objective indicates a variation of growth of the bank from 2017 to 2020. Profits could be measured as the higher ROA happened in 2019 that means KCB was more profitable in 2019 than 2017, 2018 and 2020. KCB was more profitable because of a lower and stable staff cost to income ratio which means also that the cost of running a business is lower compared to its operating income. Considering the high percentage of customer satisfaction score, this means customers are satisfied with the service received and also the bank satisfied with the employee's effort given to satisfy the customer.

In light with the third specific objective, the researcher concludes that All other intendant variables were statistically correlated with organizational productivity since the p value were less than 0.05, Except a negative correlation between compressed work week and Drive efficiency, flexitime and Drive efficiency; Because both p-value are greater than the significance level of 0.05, there is inconclusive evidence about the significance of the association between the variables explaining the absence of relationship between compressed work week and flexi time at KCB.

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# The impact of trade on employment and wages in the manufacturing industry in Sri Lanka

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**Abstract:** This paper examines the impact of trade on employment and wages in the manufacturing industry in Sri Lanka. The study models the effects of trade on employment and wages in the manufacturing industry in a labour demand and a wages framework on an integrated panel dataset of trade, labour and manufacturing industries. The impact of trade on manufacturing employment and wages is empirically examined following the predictions of the Heckscher-Ohlin trade theorem. Empirical findings on the labour demand model suggest a positive and statistically significant impact of exports on manufacturing employment, confirming the Heckscher-Ohlin predictions. On the wages model, empirical results suggest a positive and a statistically significant impact of exports on manufacturing wages confirming the Stolper-Samuelson theorem. The empirical examination also controls for structural and policy effects in analysing the impact of trade on employment and wages in the manufacturing industry.

**Key words:** Trade, factor endowments, Heckscher-Ohlin trade theory, Stolper-Samuelson theorem

## 1. Introduction

At independence, Sri Lanka pursued an open economic model and the State remained confined to its functions before independence. With influence from the socialist bloc, in the late 1950's, it tilted towards a closed economic model. With this shift, the country embarked on a rigorous programme of import substitution and the State directly intervened in economic affairs by nationalising private ventures and opening up new public-sector enterprises. After a few years of experimenting with closed economic policies, the Government realised the futility of inward-oriented economic policies and their potency in delivering economic independence. Against this backdrop, Sri Lanka, together with many other developing economies embarked on a rigorous path of economic liberalisation, setting liberal policies aimed at reducing State intervention in the economy. This policy broke with the traditional restricted economies of South Asia and the economy was liberalised in 1977. Under the liberalised regime, the manufacturing industry was expected to play a leading role in contributing towards economic growth and labour market outcomes. Despite optimistic expectations, the impact of trade on employment and wages in the manufacturing industry has been quite depressing. At the time of independence, plantation agriculture dominated and fuelled economic growth. However, the share of agriculture continued to decline from 35.6 percent (1950) to 7.7 percent by 2017. This was in response to the liberal economic policies and the shift of emphasis to industrialisation. On the other hand, the share of manufacturing declined from 16.8 percent (1950) to 15.5 percent by 1977 reflective of the import-substitution policies. Policy reforms in 1977 were aimed at driving the manufacturing industry to play a leading role in the country's economic growth. As a result of these open economic policies, the share of manufacturing increased to 21 percent by 1996, led by the growth in readymade garments, while its share continued to decline to 17.7 percent by 2017. Along with this, the share of manufacturing employment that was 9.1 percent in 1963, settled at 21.3 percent by 2017. On wages, regardless of the nominal wage increases, real wages have continued to deteriorate or to be stagnant during 1994-2011.

While economic theory offers several explanations for the pattern of trade between developed and developing economies, the orthodox Heckscher-Ohlin trade theory is the most commonly invoked theory to explain the link between trade, employment and wages. Hence the main objective of this paper is to examine the impact of trade on employment and wages in the manufacturing industry as postulated by the Heckscher-Ohlin trade theory also known as the factor-endowment theory.

## 2. Theory and evidence

Heckscher (1919) and Ohlin (1933) extends the basic Ricardo (1817) model to include both labour and capital to isolate the differences in relative factor abundance among nations as the basic determinant of comparative advantage. The Heckscher-Ohlin model predicts that a country will export based on its abundant factor and will import based on its scarce factor of production. In other words, a capital-rich country will have a comparative advantage in the export of capital-intensive commodities, while a country abundant in labour, will be a net exporter of labour in terms of the amount of labour incorporated in its exports, compared to the amount of labour embodied in a representative bundle of import-competing commodities. Based on the Heckscher-Ohlin framework, Stolper and Samuelson (1941) argued that an increase in the relative price of one of the commodities will raise the real return of the factor used relatively intensively in the production of that commodity and decrease the real reward of the other factor.

Using a longitudinal dataset, Edin, Fredriksson, and Lundborg (2004) studied the effect of trade on wages in the Swedish labour market. Exports were found to be positive on wages. In another study, Gaston and Trefler (1994); Kravis (1956) find exports to be positive on manufacturing wages of workers in the United States. For the United Kingdom, Konings and Vandebussche (1995) empirically verified the impact of foreign competition on employment and wages by means of a panel dataset covering the period 1982-1989. Findings indicated a negative effect of foreign competition on both employment and wages in the manufacturing sector, that was later confirmed by Greenaway, Hine, and Wright (1999); Greenaway, Wright, and Hine (2000); Hine and Wright (1998).

For Latin America, Revenga (1997) analysed the impact of trade liberalisation on employment and wages in the Mexican manufacturing industry. The study was based on plant-level data for the period 1984-90. Findings revealed a negative impact on employment and wages subsequent to the trade liberalisation episode; later to be confirmed by Cardero, Mantey, and Mendoza (2006). Extending this work, Cervantes and Fujii (2012) analysed the impact of trade liberalisation in Mexico on employment of skilled and unskilled workers in labour-intensive industries for the period 1998-2004 using an input-output approach. Findings revealed a positive impact of trade on unskilled workers and a negative effect on skilled workers. Further, Cragg and Epelbaum (1995) analysed wage dispersion between skilled and unskilled workers for Mexico subsequent to trade reforms in the mid 1980's. Their findings revealed; despite the magnitude of pace of liberalisation, industry specific effects had a negligible effect on wage dispersion, while the occupational effects explain wage dispersion to a great extent. Using growth accounting and factor content approaches, Moreira and Najberg (2000) investigated on the impact of liberalised trade on Brazilian manufacturing over the period 1990-97 and found a negative effect of liberalisation on employment in the short-term while a positive effect on employment in the longer-run. Arbache, Dickerson, and Green (2004) examined the impact of trade liberalisation on manufacturing wages for Brazil using cross-sectional household data since 1976 that revealed a negative effect of trade liberalisation on wages. Despite these findings, Pavcnik, Blom, Goldberg, and Schady (2004) confirmed that trade reforms in Brazil had not adversely affected industry wage differentials between skilled and unskilled workers. For Columbia, Kugler and Verhoogen (2009) found exports to have a positive impact on manufacturing wages.

In the Asian and African contexts, the impact of trade liberalisation on employment is clear, although its impact on wages is ambiguous. Using a panel of manufacturing industries over the period 1991-2010, Das, Raychudhuri, and Roy (2014) assessed the effect of trade liberalisation on Indian manufacturing employment. Their findings indicated a positive impact of exports on manufacturing employment as earlier confirmed by Banga (2005a, 2005b); Goldar (2009). Further, Hashim and Banga (2009); Krishna, Poole, and Senses (2012) find exports to be positive on manufacturing wages in the case of India. Although trade has had a positive effect on Indian manufacturing employment, its effect was minimal and not significant (Raj & Sen, 2012; Sen, 2008). Chamarbagwala (2006), investigated on the widening skills wage-gap in India using household level data for the period 1983-2000. Findings indicated that relative demand shifts resulted in relative wage shifts and the increase in the demand for skilled labour was due to skills upgrading within industries that occurred subsequent to trade liberalisation. In a contradicting argument, Mishra and Kumar (2005) found a decrease in wage inequality in India as a result of increased wages for unskilled workers following trade liberalisation in the 1990's, due to tariff reductions in industries where the unskilled were mostly employed. For Pakistan, Yasmin, Khan, and Ghani (2005) examined the impact of trade liberalisation on employment in the manufacturing industry using a panel dataset of manufacturing industries for the period 1971-96. She demonstrated a positive impact of trade reforms on employment levels. In a similar study from Vietnam, Ha and Tran (2017) found a positive effect of international trade on manufacturing employment due to abundantly available cheap labour. In the case of Morocco, Currie and Harrison (1997) analysed the impact of trade reforms on employment and wages using plant-level data from 1983. Findings showed that although employment in the private sector was unaffected, employment in export-oriented firms was drastically affected. For Mauritius, Milner and Wright (1998) discovers a positive impact of exports on their manufacturing employment. In line with empirical findings from other developing economies, Devadason (2006, 2007) also finds exports to be positive on manufacturing employment in the case of Malaysia. In the case of Indonesia, Amiti and Davis (2012) find both exports and imports to be positive on manufacturing wages.

### 3. Methodology

#### *Data*

Data for this research is captured from diverse sources. Manufacturing data is drawn from the Annual Survey of Industries conducted by the Department of Census and Statistics. The scope of the Annual Survey of Industries includes all industrial activity encompassing mining & quarry, manufacturing, electricity, gas and water supply. As the study is concerned with the manufacturing industry, data pertaining to manufacturing activity was carefully delineated using the manual on industrial classifications. A distinctive feature of this rich manufacturing dataset is the availability of data at the firm-level. This is a sample survey which supplements the industry census conducted once in every 10 years, providing a nationally representative sample of manufacturing industries. The survey takes the previous year as the reference period and includes all industrial establishments with 5 persons or more. The Industry Census frame is used to determine the sample of establishments to be surveyed each year. The Annual Survey of Industry sample includes 3500 to 4500 manufacturing firms each year. The geographical strata contain all 25 administrative districts of Sri Lanka.

Trade data is drawn from the United Nations Commodity Trade database. This database includes import and export data for over 170 countries and is maintained by the United Nations Statistical Division. The database records imports and exports data using several commodity classification methods. For this study, the Standard Industry Trade Classification method at a 5-digit level was used to extract import and export data for Sri Lanka with the rest of the world. Exports are valued on free-on-board basis and imports are valued on cost-insurance-freight basis. Exports do not include re-exports.

The data on custom duties is captured using the Tariff Analysis Online database. The Tariff Analysis Online database is maintained by the World Trade Organisation. This database maintains customs duties for each commodity based on the Harmonised System of Coding at a 6-digit level. In addition to custom duties, the government of Sri Lanka also charges a variety of tariffs on imports. Since these charges are outside the scope of customs duties specified by the World Trade Organisation, these extra charges are commonly known as para-tariffs or other levies. They include charges such as National Security Levy, Road infrastructure Development Levy, Value Added Tax on imports, Excise duties, Ports Authority Levy etc. The tariff rates of these additional levies are captured from the Tariff Guides prepared by Sri Lanka Customs. Tariff guides by Sri Lanka Customs are maintained using HS Coding at a 6-digit and 8-digit level.

*Conceptual framework*

The conceptual framework for the analysis is based on the Neo-classical Heckscher-Ohlin trade theory aiming to examine the impact of trade on manufacturing employment and wages. Along Heckscher-Ohlin trade theorem predictions, an increase in the demand for labour and wages is predicted for a labour abundant developing economy following an increase in the demand for ‘labour-intensive’ commodities. Therefore, the hypotheses for empirical examination are as follows;

1. Exports have a positive impact on manufacturing employment.
2. Exports have a positive impact on manufacturing wages.

This study is an attempt to model manufacturing labour and wages in response to trade stimulus. Therefore, in the labour demand model, the dependent variable is manufacturing labour (*L*). Based on the hypothesis developed, exports based on factor endowments are captured by the key independent variable; export-intensity (*EI*). The analysis also controls for other factors that have a considerable impact on manufacturing employment. The study conceptualises the relationship between the independent variable and the control variables with the dependent variable in the following manner. In the labour demand model, the key independent variable (*EI*) and the dependent variable (*L*) is expected to be positively related. On the control variables, manufacturing output (*Q*), capital intensity (*KI*), skills intensity (*SKI*), four firm concentration ratio (*FFR*) and marginal efficiencies of production (*MEP*) is expected to be positively related to the dependent variable (*L*), while manufacturing wages (*W*), import penetration ratio (*IP*), custom duties (*CD*) and para tariffs (*PT*) are negatively related to the dependent variable (*L*). Similarly, on the wages model, the dependent variable is manufacturing wages (*W*). Based on the hypothesis developed, exports based on factor endowments are captured by the key independent variable; export-intensity (*EI*). The analysis also controls for other factors that have a considerable impact on manufacturing wages. The study conceptualises the relationship between the independent variable and the control variables and the dependent variable in the following manner. In the wages model, the key independent variable (*EI*) and the dependent variable (*W*) is expected to be positively related. On the control variables, manufacturing output (*Q*), skills intensity (*SKI*), four firm concentration ratio (*FFR*) and marginal efficiencies of production (*MEP*) is expected to be positively related to the dependent variable (*W*), while manufacturing labour (*L*), capital intensity (*KI*), import penetration ratio (*IP*), custom duties (*CD*) and para tariffs (*PT*) are negatively related to the dependent variable (*W*).

*Modelling*

Following Hine and Wright (1998) and Greenaway et al. (1999) Milner and Wright (1998), this paper uses the Cobb-Douglas production function of the following form, which serves as the core model in this analysis;

$$Q_{it} = A^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} \dots \dots \dots (1)$$

where for the representative firm in industry *i* in period *t*; *Q* = real output; *K* = capital stock; *L*= units of labour utilised; *A* = technology and  $\alpha, \beta$  represent the factor share coefficients while  $\gamma$  allows for factors changing the efficiency of the production process. Based on this, the following standard labour demand model equation (2) is derived, where *L<sub>it</sub>* is total employment, *W<sub>it</sub>* is average real wages, *Q<sub>it</sub>* is the real output and *K<sub>it</sub>* is real capital intensity in industry ‘*i*’ at time ‘*t*’ and *X<sub>it</sub>* is a vector of variables which affect the efficiency of production, so it is related to *A<sup>γ</sup>*. The vector of variables includes the key independent variable and other control variables that impacts manufacturing employment. The  $\theta_0$  is the overall intercept and  $\theta_1, \theta_2, \theta_3$  and  $\theta_4$  are unknown slope parameters to be estimated and the error term *u<sub>it</sub>*. A profit maximising firm employs labour where the marginal revenue product of labour equals the wage (*W*).

$$\ln L_{it} = \theta_0 + \theta_1 \ln W_{it} + \theta_2 \ln Q_{it} + \theta_3 \ln K_{it} + \theta_4 \ln X_{it} + u_{it} \dots \dots \dots (2)$$

Similarly, wages are determined by numerous factors, and following Greenaway et al. (1999); Hine and Wright (1998); Milner and Wright (1998), and the following wages equation is derived (3), where  $W_{it}$  is average real wages,  $L_{it}$  is total employment,  $Q_{it}$  is the real output and  $K_{it}$  is real capital intensity in industry 'i' at time 't'.  $X_{it}$  represents a vector of variables that are engaged in the wage setting process and includes the key independent variable and other control variables that impacts wages. The  $\beta_0$  is the overall intercept and  $\beta_1, \beta_2, \beta_3$  and  $\beta_4$  are unknown slope parameters to be estimated and the error term  $\epsilon_{it}$ .

$$\ln W_{it} = \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln Q_{it} + \beta_3 \ln K_{it} + \beta_4 \ln X_{it} + \epsilon_{it} \dots \dots \dots (3)$$

*Variables*

In the labour demand model, manufacturing labour is the main outcome variable, while the key independent variable is export intensity. In the wages model, the main outcome variable is manufacturing wages and export intensity is the key independent variable. The operational definitions of the variable are presented accordingly in table 1.

Table 1: Variable definition

Variable	Definition
<i>L</i>	Labour is expressed in its natural logarithmic form. This includes all type of manufacturing labour.
<i>Q</i>	Real output is expressed in its natural logarithmic form.
<i>W</i>	Average real wages are expressed in its natural logarithmic form.
<i>K</i>	Capital intensity is the real output divided by real value of machinery, expressed in its natural logarithmic form.
<i>EI</i>	Export-intensity is the value of real exports expressed as a percentage of real output
<i>IP</i>	Import penetration is measured as the value of real imports expressed as a percentage of real consumption
<i>SKI</i>	Skills-intensity is estimated by expressing the share of skilled factory operatives as a percentage of total manufacturing workers
<i>FFR</i>	Four-firm concentration ratio is the total output of top four firms expressed as a percentage of the total industry output
<i>MEP</i>	Marginal efficiency of production is measured as the average plant size of the top fifty percent of firms expressed as a percentage of total output
<i>CD</i>	Industry structure variables Custom duties is estimated using the simple average tariff of all tariff lines for each four-digit manufacturing industry.
<i>PT</i>	Para-tariffs is estimated using the simple average of all para-tariff lines at each four-digit manufacturing industry level.

*Analytical technique*

Given that the research question is theory testing and the data is quantitative in nature, a quantitative method of analysis is adopted. Therefore, a multiple regression analysis technique is engaged to empirically analyse the impact of trade on employment and wages in the manufacturing industry. This study is based on a trade and industry panel data set covering the period 1994 to 2011. Given that the dataset is a panel, a panel data technique should be employed in the analysis of data. Initially, a pooled ordinary least squares regression was conducted. However, pooled regression biases the estimated results upwards when significant cross-section or time-fixed effects are present. Accordingly, a Breusch-Pagan Lagrangian multiplier test was conducted to determine whether the pooled regression was consistent or not. The estimated test results were significant, implying that pooled regression is not an appropriate method in this case. Given this, researchers often use a fixed effects model or a random effects model in analysing panel data. Following the Hausman (1978), the fixed effect estimation model is engaged.

### *Regression diagnostics*

A preference for economic theory over method was followed as recommended strongly by Studenmund (2001) for selecting variables to the model. To complement, several alternative formal model specification tests such as the Akaike's Information Criteria (Akaike, 1973), Schwarz's Information criteria (Schwarz, 1978), and the Ramsey Regression Specification test (Ramsey, 1969) were performed. This study is based on a trade and industry panel data set covering the period 1994 to 2011 and is an unbalanced panel dataset with gaps. To avoid inflation leading to spurious correlation, all nominal values have been adjusted for inflation to be comparable across different time points. Spurious correlation is caused by nonstationary time series. Accordingly, both the Augmented Dickey Fuller test and the Phillips-Perron unit-root tests were conducted. The null hypothesis was rejected at less than 1 percent level of statistical significance. Several tests for multicollinearity such as the correlation matrix and the sensitivity of the model when adding and deleting independent variables were checked. When tested for multicollinearity, the variance of inflation factor was less than 1.5 except in the case of two variables yet, well below the standard. Models were also tested for heteroscedasticity. Since the dataset we have is a panel that is unbalanced and with gaps, there is no robust mechanism that tests for heteroscedasticity, when using a fixed effects model. Given the limited options, heteroscedasticity is tested using a graphical method of detection (Gujarati, 1998). The models were also tested for serial correlation. The DW statistics for both the labour demand and the wages model converges to 2, thereby indicating no serial correlation. Having conducted different tests and precautions in modelling for labour demand and wages, their robustness is also investigated. The estimated labour demand model is robust in conventional statistical terms. Drawing attention to the final labour demand model, the model is statistically significant at less than one percent as indicated by the F-statistics. It possesses a high level of explanatory power as indicated by the adjusted R-squared (0.8431). On the wages model, according to the conventional statistical measures, the estimated model is robust. The wages model is statistically significant at less than one percent as indicated by the F-statistics. It possesses a satisfactory level of explanatory power as indicated by the adjusted R-squared (0.4846).

## **4. Empirical results**

The results of the labour demand model are presented in table 2, while those of the wages model is presented in table 3.

### *Labour demand model*

The coefficient on export-intensity is positive and statistically significant on manufacturing employment as expected. Export-intensity is the key independent variable in this analysis and analyses the effect of trade on manufacturing employment. Heckscher-Ohlin predicts an increase in the demand for labour for a small developing economy abundant in labour and engaged in international trade. In other words, the comparative advantage for Sri Lanka lies with labour-intensive manufacturing exports. In a factor content analysis conducted for manufacturing exports covering the period 1962-1995, Athukorala and Rajapathirana (2000) corroborate these findings. They conclude that the labour-intensive factor content of manufacturing exports to have increased from 3 percent during (1962-77) to 58.6 percent (1990-1995). Therefore, our econometric findings of this study further extend the above findings for the period post 1994 that Sri Lankan manufacturing exports yet confirms the neo-classical Heckscher-Ohlin trade model.

The coefficient on manufacturing output is positive and statistically significant on manufacturing employment as expected. As the demand for labour is a derived demand, output increases are followed by corresponding increases in the demand for labour. The coefficient on manufacturing wages is negative and statistically significant on manufacturing employment as expected. It explains that firms and industries are sensitive to wage increases. The coefficient on capital-intensity is negative and statistically significant on manufacturing employment. These findings are consistent with the Heckscher-Ohlin model and its predictions in the context of a labour abundant developing economy. Hence mechanisation in a labour surplus economy leads to employment losses. The coefficient on import penetration ratio is positive and statistically significant on manufacturing employment. The effect of imports on employment depends on whether imports represent substitutes to domestically produced commodities or are complementary to production. Therefore, the positive coefficient explains that import inputs are complementary to the export manufacturing. Skills-intensity is positive and statistically significant on manufacturing employment as expected. It confirms that the use of skilled labour triggers a positive demand on the overall manufacturing employment. Four-firm concentration ratio is negative and statistically significant on manufacturing employment. Although against theoretical expectations, this is possible where changes in domestic competition generally have an impact on labour usage. The coefficient on marginal efficiency of production is negative and statistically significant on manufacturing employment. Theoretically, firms characterised by increasing returns to scale are expected to positively influence employment. However, the empirical findings indicate otherwise, and scale economies can be statistically significant and negative on the exports of developing economies. The coefficient on customs duties is negative on manufacturing employment as expected, although not statistically significant. Therefore, the effect of custom duties on manufacturing employment is inconclusive. The impact of para-tariffs on manufacturing employment is negative and statistically significant as expected. It explains that high tariffs have kept manufacturing employment inefficiently low.

Table: 2: Labour demand model

	1	2	3	4
<i>Q</i>	0.7082*** (64.11)	0.7188*** (60.69)	0.7058*** (61.34)	0.7086*** (61.55)
<i>W</i>	-0.5527*** (-16.49)	-0.555*** (-16.59)	-0.5199*** (-15.96)	-0.5406*** (-16.69)
<i>K</i>	-0.0741*** (-6.60)	-0.0743*** (-6.63)	-0.0780*** (-7.17)	-0.0759*** (-6.95)
<i>EI</i>		0.00001** (2.41)	0.00001** (2.07)	0.00001*** (2.55)
<i>IP</i>		0.00004c (1.71)	0.00004** (2.04)	0.00005*** (2.08)
<i>SKI</i>			0.0035*** (3.93)	0.0037*** (4.17)
<i>FFR</i>			-0.0090*** (-7.82)	
<i>MEP</i>				-0.0039*** (-7.14)
<i>CD</i>			-0.0014 (-0.89)	
<i>PT</i>			-0.0054*** (-5.43)	-0.0053*** (-5.38)
<i>Constant</i>	-0.9657*** (-3.01)	-1.1612*** (-3.52)	-0.5128 (-1.54)	-0.9628*** (-2.98)
<i>N</i>	1327	1327	1327	1327
<i>R2</i>	0.8227	0.8229	0.8496	0.8450
<i>F</i>	21.29***	21.39***	15.31***	16.41***

*t*-values in parentheses. \*\*\* Significance at 1 percent, \*\* at 5 percent, \* at 10 percent

Source; Authors calculations

### Wages model

Export-intensity is positive and statistically significant on manufacturing wages as expected. This confirms the Stolper-Samuelson theorem in the Heckscher-Ohlin framework. However, export-intensity is statistically significant on manufacturing wages at 10 percent in equation 1, while its statistical significance has disappeared in equations 2 to 4 possibly due to market imperfections. Although, Stolper-Samuelson predicts an increase in wages following trade liberalisation, the theorem might not work fully due to market imperfections in developing economies. In other words, non-market factors are powerful enough to dilute the predictive ability of the Stolper-Samuelson theorem in developing economies (Konings & Vandebussche, 1995).

Output is positive and statistically significant on manufacturing wages as expected. Output increases are followed by an increase in the demand for labour and hence an increase in wages. Labour is negative and statistically significant on contemporaneous manufacturing wages as expected. Capital-intensity on manufacturing wages is negative and statistically significant as expected in the case of a developing economy. Import penetration ratio is positive on manufacturing wages, though not statistically significant. Therefore, the effect of imports on manufacturing wages is inconclusive. Skills-intensity is positive and statistically significant on manufacturing wages as expected. Four-firm concentration ratio is positive on manufacturing wages, although not statistically significant. The coefficient for marginal efficiency of production is negative and statistically not significant on manufacturing wages. Therefore, the effect of marginal efficiencies in production on manufacturing wages is inconclusive. Customs duties are positive and statistically significant on manufacturing wages. The coefficient on para-tariffs is negative on manufacturing wages as expected, although statistically not significant.

Table 3: Wages Model

	1	2	3	4
<i>Q</i>	0.3550*** (23.97)	0.3621*** (23.62)	0.3632*** (23.31)	0.3677*** (23.69)
<i>L</i>	-0.3327*** (-16.49)	-0.3353*** (-16.59)	-0.3368*** (-15.96)	-0.3460*** (-16.59)
<i>K</i>	-0.0144 (-1.62)	-0.0147* (-1.66)	-0.0161* (-1.80)	-0.0167* (-1.88)
<i>EI</i>		0.00001* (1.68)	0.00001 (1.55)	0.00001 (1.64)
<i>IP</i>		0.00002 (1.21)	0.00002 (1.37)	0.00002 (1.42)
<i>SKI</i>			0.0016** (2.21)	0.0017** (2.35)
<i>FFR</i>			0.0006 (0.64)	
<i>MEP</i>				-0.0006 (-1.38)
<i>CD</i>			0.0025** (2.00)	0.0025** (1.95)
<i>PT</i>			-0.0010 (-1.20)	-0.0012 (-1.46)
<i>Constant</i>	5.6877*** (28.58)	5.6877*** (28.58)	5.5298*** (25.77)	5.5937*** (27.43)
<i>N</i>	1327	1327	1327	1327
<i>R2</i>	0.4900	0.4900	0.4774	0.4746
<i>F</i>	8.10***	8.10***	7.75***	7.83***

*t*-values in parentheses. \*\*\* Significance at 1 percent, \*\* at 5 percent, \* at 10 percent

Source: Authors calculations

## 5. Conclusions

The research objective of this paper focused on examining the impact of trade on manufacturing employment and wages. Accordingly, the empirical examination was conducted in the context of the Heckscher-Ohlin trade theory. Along these predictions, Sri Lanka being a labour abundant country should export using its abundant factor which is labour. Therefore, exports are expected to positively influence the manufacturing demand for labour. The empirical results on the labour demand model confirms these predictions. In other words, manufacturing exports are positive and statistically significant on manufacturing employment. Hence, the policy of export promotion has allowed the economy to exploit the comparative advantage of labour-intensive goods. Thereby the expansion of exports becomes an important factor in the growth of manufacturing employment in Sri Lanka. Therefore, the study confirms the predictions of the theory of factor endowments in the context of the manufacturing employment in Sri Lanka. Based on the Heckscher-Ohlin framework, the Stolper-Samuelson theorem established that an increase in the relative price of one of the goods increases the real reward of the factor used relatively intensively in the production of that good and decreases the real reward of the other factor. In other words, an increase in the price of the labour-intensive commodity

which the labour-rich country (Sri Lanka) exports will experience an increase in the price of labour. Given that exports are positive and statistically significant on manufacturing wages, the wages model confirms the Stolper-Samuelson theorem in the case of manufacturing wages in Sri Lanka. However, exports were positive and statistically significant on manufacturing wages at a level of 10 percent; a weaker link, while in some equations, the statistical significance is not consistent. This result is not surprising for Sri Lanka being a small developing economy. In developing economies, wages are unlikely to be a pure result of the interaction of the forces of demand and supply of labour. Many intervening factors work to influence the determination of wages in a developing country context.

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# “A STUDY OF SERUM MAGNESIUM LEVELS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS, HYPERTENSION, DYSLIPIDEMIA, CORONARY ARTERY DISEASE AND CORRELATION WITH ASCVD RISK SCORE.

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**ABSTRACT-** There has been an association between serum Magnesium levels and presence of Diabetes Mellitus, Hypertension, Dyslipidemia, BMI and severity of coronary artery disease. In this study we measured the serum Magnesium levels in patients having Diabetes Mellitus, Hypertension, Dyslipidemia and angiographically proven coronary heart disease and studied the trend of Magnesium levels in these individuals. We observed that mean Magnesium levels were lower among the Diabetic group compared to non-diabetic; lower mean Magnesium levels in Hypertensive group compared to non-hypertensive group; lower mean Magnesium levels among the Coronary artery disease group compared to patients without coronary artery disease; higher mean Magnesium levels in the overweight people compared to normal BMI individuals. However, the severity of coronary artery disease i.e Single vessel/Double vessel/Triple vessel disease had no relationship with Magnesium levels.

**INDEX TERMS-** ASCVD risk, Coronary artery disease, Diabetes, Hypertension, Magnesium

## INTRODUCTION

As we all know that Magnesium is an abundant mineral in the human body. An average sized adult has around 25g of Magnesium.<sup>[1]</sup> Magnesium acts as a co-factor in numerous enzymes in the human body responsible for glycolysis, ATP production, Oxidative phosphorylation, synthesis of nuclear material, anti-oxidant action.<sup>[2]</sup> Mg is also responsible for Ca<sup>2+</sup> and K<sup>+</sup> ion transport across the cell membranes which is crucial for impulse conduction in nerves, muscle and cardiac contraction.<sup>[2]</sup> Rich sources of Magnesium are nuts, green leafy vegetables, whole wheat, brown rice, carrots, apple, banana, beef and chicken breast. <sup>[3]</sup> Magnesium deficiency has long been associated with Diabetes Mellitus and metabolic syndrome as Magnesium plays a role in glucose homeostasis. Certain clinical trials show role of magnesium supplementation in reducing the blood glucose values and hence reduce the risk of developing metabolic syndrome and its consequences. <sup>[4,5]</sup> Magnesium similarly has a role in hypertension. Magnesium relaxes the vascular Smooth muscle cells and hence reduces the blood pressure. The role of Magnesium in Coronary Artery Disease is still debatable as there are no enough studies establishing a causal relationship. As per a large systematic review and meta-analysis done by Grober U, people with low serum magnesium levels and low dietary intake of Magnesium containing foods had more risk of developing an Ischemic heart disease.<sup>[6]</sup> In this cross sectional study done in Kasturba Medical College & Hospital, Manipal; we have measured the serum Magnesium levels among the risk factors for Coronary artery disease like Diabetes, Hypertension, Dyslipidemia, Obesity and also studied the Magnesium levels in coronary artery disease and also compared with the severity of Coronary artery disease.

## Study Methodology

This is a cross sectional study done in Kasturba Medical College & Hospital, Manipal, Karnataka, India. The study was conducted only after obtaining an approval by the Institutional ethics committee and also the study was registered under the Clinical Trials Registry of India. The calculated sample size was 162. In our study we could obtain a total of 156 samples.

- Patient selection:** - Patients visiting our out-patient department and also in-patients admitted under the Department of Internal Medicine were selected for the study. Patients having Type 2 Diabetes Mellitus, Hypertension, Dyslipidemia and angiographically proven Coronary Heart Disease were included in the study. Patients who were having chronic kidney disease, chronic liver disease, endocrinopathy, rheumatologic diseases, magnesium supplements, antacids, diuretics and chronic alcoholic were excluded as these conditions can affect the serum magnesium levels and act as confounders. The patients were interviewed with a proforma and informed consent was taken after counseling. Questions related to Demographic details were taken; and history pertaining to whether Diabetic, Hypertensive or Dyslipidemia or suffering from Coronary artery disease were asked. Questions related to ASCVD risk score calculation like race, smoking history, whether on antihypertensive or statins were asked. Blood pressure was taken for all individuals included in the study. Height, weight, Waist circumference and Hip Circumference was measured. Blood samples were collected for measuring serum Magnesium levels by venepuncture. ASCVD risk score was calculated as per American college of cardiology ASCVD risk estimator.

### Statistical Analysis

We calculated that a sample size of 162 patients would be required for a 5% level of significance and 80% power considering moderate effect size. However, we obtained a total sample of 156 in the study. Data was entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.

The results obtained are tabulated as follows.

**Table 1: Study Demographics**

Characteristics	Value in % or Mean ± Standard deviation
Age- yrs	57.73 ± 9.925
Sex- Males(N)	102 (65.38%)
Females(N)	54 (34.62%)
Type 2 Diabetes Mellitus – Yes	98 (62.82%)
No	58 (37.18%)
Hypertension – Yes	78 (50%)
No	78 (50%)
Dyslipidemia – Yes	75 (48%)
No	81 (52%)
Coronary Artery Disease- Yes	95 (60.89%)
No	61 (39.11%)
Severity of Coronary Artery Disease	(N=95)
Single Vessel Disease	40 (42.1%)
Double Vessel Disease	38 (40%)
Triple Vessel Disease	17 (17.9%)
Body Mass Index(BMI) kg/m <sup>2</sup>	(N=156)
Normal(<22.9)	49 (31.41%)
Overweight(23-24.99)	36 (23%)
Pre-Obese(25-29.99)	62 (39.7%)
Obese(>30)	9 (5.89%)
Waist Hip Ratio(Mean)- Males	0.9845±0.054
Females	0.9279±0.065
Total Cholesterol- Males	155±46.123
(mg/dl) Females	178±56.108

Triglyceride – Males (mg/dl)	153±98.5
Females	163±76.4
LDL-Cholesterol- Males (mg/dl)	94± 38.4
Females	112±49.25
HDL-Cholesterol- Males (mg/dl)	36±12.737
Females	39±13.823
Magnesium Level- Males (mg/dl)	1.910±0.237
Females	1.894±0.212
10 yrs ASCVD Risk score (N=49)	12.130±10.614
Optimal ASCVD risk score(N=53)	3.547±3.902

Plus-Minus Indicates Mean ± Standard Deviation

**Table2: Correlation between Serum Magnesium and Cardio-Vascular Risk Factors**

Parameter	Serum Mg level (Mean +/- S.D)	p-value
Sex Male=102 Female= 54	1.9107±0.237 1.8944±0.212	0.673
Diabetes Yes=98 No=58	1.879±0.247 1.948±0.186	0.070
Hypertension Yes=78 No=78	1.896±0.258 1.914±0.196	0.626
Dyslipidemia Yes=75 No=81	1.906±0.231 1.903±0.025	0.448
Coronary artery disease Yes=95 No=61	1.898±0.235 1.914±0.219	0.675
SVD=40 DVD=38 TVD=17	1.9125±0.217 1.865±0.218 1.941±0.308	0.796
BMI Normal=49 Overweight=36 Pre-obese=62 Obese=9	1.869±0.221 2.019±0.237 1.8677±0.215 1.900±0.20	<b>0.007</b>

**Table3:**

Parameters	p-value
Age	0.183
Sex	0.673
Diabetes Mellitus	0.070
Hypertension	0.626
Dyslipidemia	0.448
Body Mass Index	0.007
Systolic Blood pressure	0.602
Diastolic Blood pressure	0.313
WHR	0.692
Total cholesterol	0.379
Triglycerides	0.289
HDL-C	0.256
LDL-C	0.140
10 yrs ASCVD	0.655
Optimal ASCVD	0.119

**Correlation between Magnesium Levels and Cardiovascular risk factors**

An Independent samples T test was applied to compare the serum Magnesium levels with parameters viz. Age, Sex, Diabetes Mellitus, Hypertension, Dyslipidemia, Coronary Artery Disease. A one way Anova was used for comparing multiple groups viz. Severity of Coronary Artery Disease (Single vessel disease/Double Vessel Disease/ Triple Vessel Disease), Compare BMI groups (Normal/Overweight/Pre-Obese/Obesity). A Pearson correlation test was done to compare Serum Magnesium levels with Scalar variables like Systolic Blood pressure, Diastolic Blood Pressure, Waist-Hip Ratio, Total Cholesterol, Triglycerides, HDL-C, LDL-C and for ASCVD risk score.

## Results

### Demographics and patient data

The study population had a total of 102(65.3%) males and 54(34.7%) females among the 156 patients collected. Hence, males dominated the study population. This was similar to an Indian study done by Mahalle et al<sup>[7]</sup> which was male predominant. The age groups included were all above the age of 40 yrs for ASCVD risk estimation, except for 1 patient who was 36 yrs of age.

The study population comprised of 98(62.8%) diabetics and the rest 58(37.2%) were non-diabetics. The study had equal number of hypertensive and non-hypertensive patients. There were 75 people with dyslipidemia which constituted 48% of the study population and the rest 52% did not have dyslipidemia.

Out of the 156 patients, 95(60.8%) had angiographically proven coronary artery disease and the rest 39% did not have coronary artery disease. The frequency of severity of coronary artery disease were Single Vessel Disease > Double Vessel Disease > Triple Vessel Disease.

In this study only 31.4% of the individuals were in the normal BMI range, 23% of patients were overweight, 39.7% were in the pre-obese category and 5.7% were obese highlighting the high prevalence of overweight and obesity in the Asian population.

We also observed that total cholesterol, triglycerides, LDL cholesterol, HDL cholesterol were higher among the females than the males. This may be attributed to the age group recruited being more than 40 yrs, since postmenopausal women are at a higher risk of having dyslipidemia.

### **Magnesium and Cardiovascular risk factors**

In this study the mean Mg levels were slightly higher among the males than females however this was not statistically significant. This study showed that mean Mg levels were lower among the diabetics than non-diabetics which was consistent with the study done by Mahalle et al<sup>[7]</sup>, however our study did not show any statistical significance between the 2 groups. This study also showed that mean Mg levels were lower among the hypertensives than the non-hypertensives which was consistent with the study done by Mahalle et al<sup>[7]</sup>. However, our study did not show any statistical significance between the 2 groups. This may be explained by the fact that dietary patterns were not taken into consideration which can have a significant impact on the serum Mg levels. There may also be an element of selection bias as this was not an epidemiological study in the general population and the samples collected were hospitalized sick patients having co-morbidities.

This study did not show any difference between the Mg levels among the Dyslipidemia and non-dyslipidemia group. This was not consistent with the studies done by Mahalle et al<sup>[7]</sup> which showed a significant difference between the dyslipidemia and non-dyslipidemia group. The cause for this is multifactorial as most of the diabetics with ASCVD risk were already on a statin which would have reduced their cholesterol levels and also dietary habits were not taken into consideration. Hence, a matched comparison could not be made between the 2 groups due to confounders.

This study showed that patients having coronary artery disease had lower magnesium levels than those without a coronary artery disease. This was consistent with the studies done by Joachim M et al<sup>[8]</sup> which showed that serum magnesium levels were lower in patients with coronary artery disease than patients without CAD and the results were not statistically significant in both these studies. This may be attributed to the small range of serum Mg levels and also serum Mg level does not reflect the total body Magnesium. This study also showed that severity of Coronary artery disease had no statistical significance with serum Mg levels. However patients with DVD had a slightly lower Mg levels than patients with SVD, however this was not statistically significant.

In this study magnesium levels were found to be higher among the overweight and obese individuals compared to the normal BMI individuals and this correlation was statistically significant. This data was however not consistent with the studies done by Mahalle et al<sup>[7]</sup> and Gengiz et al<sup>[9]</sup> These conflicting results may again be explained as dietary history in this study has been omitted which is a major drawback. Other reason could possibly be that obese patients tend to eat more and may have a higher serum magnesium levels but at present this question may be debatable as currently there is not enough literature to support this.

In our study there was no correlation between waist-hip ratio and the serum Mg levels and this data was consistent with the studies done by Mahalle et al.<sup>[7]</sup>

In our study we could not establish any significant correlation with magnesium deficiency and lipid levels i.e Total cholesterol, triglycerides, LDL and HDL. This data was consistent with the study done by Joachim et al.<sup>[8]</sup>

All patients without having an ASCVD underwent an ASCVD risk assessment for 10yrs ASCVD risk and optimal ASCVD risk using an ASCVD risk estimator app by the American college of cardiology foundation. There was no statistically significant correlation between the serum magnesium levels and the 10 yrs ASCVD risk score and also the optimal ASCVD risk score. This is the 1<sup>st</sup> ever study in India comparing the ASCVD risk score with the magnesium levels. At present magnesium levels affecting the

future ASCVD risk need to be further assessed by larger epidemiological studies as this study data is insufficient to conclude the same.

## Conclusion

In this study we have observed that the mean Magnesium levels were lower among the Diabetics, Hypertensive, Coronary Artery Disease groups compared their counterparts. Dyslipidemia had no correlation with Magnesium levels; and also the Total Cholesterol, LDL, HDL and Triglycerides had no correlation with Magnesium levels. We also observed that higher BMI individuals had a higher serum Magnesium levels than the normal BMI individuals and the data was statistically significant, hence the possibility of obesity paradox can be bought in. However this is a very naïve concept and needs further understanding and research. The role of magnesium in metabolic syndrome and coronary artery disease needs further understanding and more studies in future to establish an association. The method of Magnesium estimation in the body also needs to be refined as current methods like serum assay and urinary magnesium excretion does not reflect the total magnesium level in the body which may hamper the magnesium estimation and hence the results.

## Appendix

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# A study on Internet Gaming Addiction and its Relation to Aggression and ADHD

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## Abstract

This research is conducted to investigate the association between online game to aggression and ADHD, known as the psychological characteristics associated with the risk of online game addiction among the population. The findings of this research have revealed an intriguing profile that shows that some psychological features such as aggression and ADHD (Attention-Deficit Hyperactivity Disorder) can predispose certain people to becoming addiction to online gaming. This research would improve our understanding of online risk factors in terms of aggression and ADHD.

**Keywords: Internet addiction, Aggression, ADHD (Attention-Deficit Hyperactivity Disorder)**

## Introduction

Throughout the 2000s, video gaming became common, although research on the addiction to Internet gambling indicate the negative effects, prevalence and related risk factors of excessive gambling. Study on online gaming addiction has grown both in quantity and in consistency in recent years. Gaming dependency study dates back to 1983, when the first article found that video gaming addiction is an issue for students. Shortly afterward, Shotton (1989) conducted the first observational study on gaming addiction, focused on self-reports from young male players who said they were "hooked" in their games. The early research had a lack of standardized psychometric methods for gaming addiction. Analysis reveals, nevertheless, that self-reports align with structured steps. Then additional experiments were performed in the 1990s, which initially measured gaming dependency on the pathology standards stipulated in Diagnostic and Statistical Manual on Mental Disorders (DSM).

## Internet Gaming Addiction

Video game players could achieve educational benefits (Freitas & Griffiths, 2007) as well as social and therapeutic benefits (Gentile et al., 2009). But evidence suggests that playing video games excessively could become addictive (Griffith, 2002), particularly playing online video games where the game never ends and there is a 24-7 possibility. The rising prevalence of social networking and video games allows many more addicts. Gaming dependency has become a global societal problem that impacts families around the world as well as countries like China, U.S.A. and Canada. Online addiction may have a detrimental effect on students' desire to leave school, damage friendships and family relationships (Griffiths, 2002), youth delinquency, and suicide. The players who suffer from single, stress and violence are more likely than stable players to be addicted to the game (Jeong, Kim & Lee, 2016).

Considering the increasing public health epidemic of addictive sports, the potential to enact or improve government legislation, analogous to alcohol consumption, gambling and substance addiction, is raised (Park & Ahn 2010). But in the western world rules are mostly restricted to ranking schemes assessing content and age suitability rather than improper usage, which make rating-based attempts very unacceptable. South Korea, China and few Asian countries have created government policies on issue gaming. The Entertainment Software Rating Board (ESRB) rating systems are used, for example, in Europe, the Pan European Game Information (PEGI) and North America (Laczniak et al. 2017).

### **Internet Gaming Addiction and Aggression**

Aggression is an active or concealed social contact, often negative, with the intention of causing injury to another person. It can happen reactively or without aggression. Aggression in humans can be triggered by many causes, including agitation because of blocked targets to contempt. More people have access to video gaming with the rise of the Internet. Online gaming is a common entertainment type which affects players' quality of life (Shen & Williams, 2011). A particular type of game involving violent online gaming (VOGE) worries academics, regulators and the general public considerably. Teens grow into adulthood and start displaying problem habits or negative feelings. The prefrontal development remains incomplete in which regulates anxiety and frustration, plays a significant role in the actions of adolescents. Adolescents also emit testosterone, the male hormone, larger than in the juvenile phase, and this hormone promotes aggression and indignation. Aggressive behavior is meant to injure or damage others and involves angry feelings, contributing to offensive behavior (Duke et al., 2014).

Aggression increases during puberty and gradually declines slowly as adulthood begins. Adolescent hostility has been documented to be related to antisocial activity, such as delinquency, alcohol and abuse as well as criminality and school maladjustment. Families influence socialization of teenagers, and may also play an important role in the anti-social and criminal behavior of adolescents. Parents play the most important role in the socialization process of teenagers. It is understood that contact between teenagers and parents is positively related to success, self-esteem, and psychological wellbeing and negatively linked to isolation, depression, substance addiction and violence. Open and unrestricted contact between parents and children tends to discourage criminal conduct, while closed and repressive communication has a detrimental impact on the child and contributes to crime (Cheung CS, Pomerantz, 2012).

Due to the quick growth of information and communication technologies in recent years, high-speed Internet has made Internet gaming popular. The internet is now part of children and adults' entertainment habits, but Internet gaming dependency can lead to a number of social, physical and psychological problems. One research has demonstrated that the IGD induces the same modifications in the brain as those caused by alcohol and drug addiction. In self-recognition, action planning, information integration and the store of feelings, instincts and wishes, the front lobe plays the most important role. It evolves progressively between the ages of 12 and 20 at most; such brain changes thus impact teenagers rather than adults. Middle school students are the most popular Internet gaming users. An Internet survey found that teens are the largest (30.6 percent) of all age groups in the high-risk overdependence group. To date, IGD risk factors include fatigue, depression, anxiety, impulsiveness, aggressiveness and financial status. Aggression is recognized as one of IGD's origins (Brooks et al., 2015). A common concern is that playing aggressive online games can affect violence on both the short and the long term (Anderson & Bushman 2002) through cognitive and emotional effects (Anderson and others 2010).

Similar to the general model of violence, individuals addicted to intensely violent video games appear to show offensive cognitions and convictions. Aggression is characterised as any actions directed at another person with an imminent intention of harm (Anderson & Bushman, 2002). Aggression is conditioned by factors in personality (e.g. self-control) and circumstance (e.g. media attention to violence). Persons with personality characteristics such as neuroticism, depression, and poor self-control are more likely to develop aggression (Teng & Liu, 2013). In light of Young's (1998) study, which postulated that Internet Addiction is an impulse control condition (as described by DSM-IV criteria), the interrelationship of internet use and self control and violence can be explained. Specifically, the long-term use of the Internet and the unnecessary spending of time playing video games may lead to a reduction in self-control, such as impulse-control issues. Immature people have trouble limiting their efforts to fulfill their needs, which makes them more aggressive. In brief, the literature indicates that online violent games can increase the likelihood of violence through the use of scenarios and personality variables to intensify rage and animosity (Anderson & Bushman 2002).

### **Internet Gaming Addiction and ADHD**

Attention-deficit/hyperactivity disorder (ADHD) is a lifelong disease that affects thousands of children and continues to develop into adulthood. ADHD is a mixture of persistent issues such as attention support, hyperactivity and emotional instability. Few populations seem to be at greater risk of developing video game addiction than others, such as men, younger individuals or people with ADHD (Ho et al., 2014). ADHD is a common adult neurodevelopmental condition in children. The inherited predisposition to neurobiological imbalance such as behavioral inhibition, self-regulation and self-control contributes to everyday activity difficulties. Symptoms usually include hyperactivity, impulsiveness which carelessness and can make it impossible for people with ADHD to handle and respond successfully to the complex demands of life. The actual reported prevalence rate of adult ADHD for individuals aged 18–44 is approximately 4% in the USA (25,26). Luman, Tripp, and Scheres (Metin et al., 2015) suggested that changed reward sensitivity could contribute to addictive, impulsive and compulsive behavior for individuals with ADHD. Research indicates that individuals with ADHD have less movement, specifically in the vision, sound, and touch regions, in cortical regions correlated with concentration, impulse regulation and stimulus integration, and greater perception of incoming stimuli, which could sensitivize them particularly to enhancing stimuli in video games. This along with attention deficiencies, will make it difficult for people with THD to control their time and actions, which may result in difficulties handling video game play behavior. People with ADHD may prefer limited immediate reinforcement over large delays (Jelenchick et al., 2015), which implies that they may be more affected than other persons by reinforcement contingencies in video games, and that they may be at a greater danger of addiction to videogames, particularly if they play games more strongly. Consistent with neurobiological studies, a correlation between exposure to video games and ADHD is apparent. Higher Internet addiction rates have been observed in both unattended and hyperactive communities, particularly in internet video game activity, relative to non-ADHD (Ko et al, 2009). Furthermore, self-reported internet gaming addiction in children diagnosed with ADHD studies have demonstrated that there is a correlation between ADHD and video game addiction, no one has tested whether the link between ADHD symptoms and video game addiction is based upon the degree of strengthening of game type chosen or most frequencies.

### **Scope of the Study**

The constructions considered for research work are particularly influential constructs for earlier research, but other interventions can have a stronger effect on the reduction of dependency by integrating different systems. The severity of the ADHD symptoms positively forecast the severity of the video game addiction symptoms. This research indicates that persons with a greater severity of the ADHD symptoms could be more likely to develop problematic play behaviors. The kinds of difficulties people with ADHD

frequently face time management issues, priority setting, etc in addition to the fact that ADHD itself is a risk factor for addiction, can raise the risk of trouble play. However, it can be said that those who play a lot of internet games will have attention deficit problems and are more aggressive.

The supportive relationship between violence and addiction to online gaming indicates that violent behavior can make it easier to establish online addiction. A variety of studies have shown that young men tend to play violent games online and offline rather than peaceful ones. As the feeling of searching, if game aggression is rewarding to those who participate, it implies that the action is replicated and contributes to too much or too much addiction in certain individuals. Thus, higher levels of aggression are correlated to the behavioral objectives.

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## Comparison of a Proposed Algorithm and Hill cipher Algorithm in Cryptography

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**Abstract** - The Hill cipher algorithm only encrypts messages in the form of document and can only decrypts the same message provided the matrix used as key is non-singular. In this paper, we propose an algorithm for decryption of documents to be possible for both singular and non -singular matrices as involutory key alongside giving practical examples by using two by two and three by three involutory keys for singular and non singular matrices to illustrate our result when encrypting and decrypting documents.

**keywords:** Singular Matrix, Non- Singular Matrix, Involutory Key

### 1 Introduction

Modular arithmetic is an aspect of algebra and has diverse applications in mathematics and one crucial application is in the field of cryptography which is the study of mathematical techniques to change important messages and informations to unreadable one. Cryptography deals with information which comprises of confidentiality, security, data integrity and authentication[1] etc. There are two types of cryptography namely symmetric and asymmetric cryptography. In symmetric cryptography, the same key is used for both encryption and decryption whiles in asymmetric, different keys are used. In all the aspects of cryptography, they employ techniques which results in ciphers or ciphertext. Some of the great mathematicians that introduced algorithms for encryption and decryption generating ciphers include Hill cipher, Vigenere cipher, Affine-Hill Ciphers. The Hill cipher algorithm  $C = VR$ , is a very powerful technique used by cryptographers to encrypts documents using  $n \times n$  invertible matrix as key but the only draw-back was when generating the plaintext message for a singular matrix used as key since decryption is dependent on the matrix being invertible which is the decryption aspect for the algorithm[3]-[5]. In 2018, Yangyang and Chengzhe made valuable contribution by improving on the Hill cipher algorithm and published in their journal "The improved Hill Encryption algorithm". This algorithm was solely on video encryption . In 2017, there was another improvement on the Hill cipher algorithm which was published by J.Zou and T.weng entitled "A new image encryption instant communication method" and was based on matrix transformation which was focused solely on image encryption. This paper therefore focuses and makes an improvement on the Hill cipher algorithm by proposing an algorithm which uses either singular or non-singular matrices as keys in the area of encryption and decryption of documents in the form of messages.

## 2 Preliminaries

This section discusses the concept of equivalence in modular arithmetic where we look at congruence relation looking at some definitions, proposition, theorems and some examples that will enable us to understand modular arithmetic in cryptography

**Definition 2.1** For equivalence in modular arithmetic, the idea of congruence relation where  $r \in N_o$  is positive with  $r > 0$  and  $e$  and  $f$  are integers. Then we say that  $e$  is congruent to  $f$  modulo  $r$  if  $r|(e-f)$  and it is written as  $e \equiv f(modr)$

**Example 2.1** 7 and 79 can be said to be congruent in mod 4 because  $4|(79-7)$ . This can be seen by noting that  $79 \equiv 7$

**Theorem 2.1** For positive integers  $e, f, g, h$  and  $r$ , if  $e \equiv f(modr)$  and also  $g \equiv h(modr)$ , then (i) $e + g \equiv f + h(modr)$  and (ii) $eg \equiv fh(modr)$

**Proof**(i) when  $e \equiv f(modr)$ , then it can be written as  $r|(e-f)$  which also means  $(e-f) = pr$ .this gives  $e = f + pr$ . then it also means  $g \equiv h(modr)$  can be written as  $g = h + tr$  where  $p, t \in Z$  are positive integers.we than write  $e + g \equiv f + h(modr)$  as  $(e + g) - (f + h)modr$ , then from the results we produce  $f + pr + h + tr - f - h = r(p + t)$  and since  $p, t \in Z$ , then it implies  $e + g \equiv f + h(modr)$ (ii) also from the above,  $eg \equiv fh(modr)$ can also be written as  $eg - fhmodr$ . then we have  $(f + pr)(h + tr) - fh = fh + ftr + prh + ptr^2 - fh$  we get  $r(ft+ph+ptr)$  but  $ft + ph + ptr \in Z$  meaning  $eg \equiv fh(modr)$

**Example 2.1** if  $7 \equiv 37 \pmod{5}$  and  $9 \equiv 29 \pmod{5}$ , then(i)  $7+9 \equiv 37+29 \pmod{5}$  and (ii) $7(9) \equiv 37(29) \pmod{5}$

**Definition 2.2** For all  $[e] \in Z_r$  and  $[f] \in Z_r$  or if  $([e][f]) \in Z_r$ , then we can define addition mod  $r$  as  $[e]_r + [f]_r = [e + f]_r$

**Theorem 2.2** Addition and multiplication mod  $r$  satisfy the commutative and associative laws and multiplication distributes over addition

**Proof** For integers  $[e], [f], [g] \in Z_r$ , then for commutativity,  $[e] +_r [f] = [f +_r e]$ . Since  $\forall e, f \in Z_r$ , we have  $e + f = f + e$ , then  $[e] +_r [f] = [e + f] = [f + e] = [f +_r e]$ .

Also for associativity,  $[e] +_r ([f] +_r [g]) = ([e +_r f]) +_r [g]$ . Since  $\forall e, f, g \in Z_r$ , then we have,  $e + f + g = (e + f) + g$ , then  $[e] +_r ([f] +_r [g]) = ([e +_r f]) +_r [g] = ([e] + ([f + g]))_r = [e] + ([f + g])_r = (([e + f]) + [g])_r$ . This produces the associative law for ordinary sums giving us  $(([e +_r f]) +_r [g])_r = ([e] +_r [f]) +_r [g]$

**Example 2.2** (i)  $[(4+15 \bmod 5)] \bmod 5 = [(15+4 \bmod 5)] \bmod 5$  (ii)  $[3+(6+17 \bmod 6)] \bmod 6 = [(3 + 6 \bmod 6) + 17] \bmod 6$

### 3 Main Result

In this section, we propose an algorithm for encrypting and decrypting documents or messages using the Hill cipher algorithm as foundation.

#### 3.1 Overview of Hill cipher Algorithm

The encryption and decryption process of the Hill cipher algorithm are given as  $C = VR \bmod m$  and  $R = CV^{-1} \bmod m$  respectively.

where  $V$  is a symmetric key which is chosen randomly in any invertible  $n \times n$  matrix

$R$  are numerical values of the letters of the English alphabet,  $C$  is the ciphertext produced which are also numerical values and  $m$  is the number of the letters of the English alphabet which is 26

#### 3.2 Propose algorithm

Since the above Hill cipher algorithm only encrypt and decrypts documents for any  $n \times n$  non-singular matrices chosen as key only, then there should be an improvement on this algorithm for either singular or non-singular matrices chosen as keys where the algorithm can be encrypted as

$$C = V + Imodm$$

and also decrypted as

$$I = C - V \bmod m$$

where,

- $V$  is an  $n \times n$  singular or non-singular matrix chosen as key
- $I$  is identity matrix for the  $n \times n$  matrix chosen as key which is always replaced by numerical values of the letters of the alphabet
- $C$  is ciphertext which are also numerical values of the letters of the alphabet
- $m$  is numerical values of the letters of the English Alphabet which would be encrypted in modulo 27 to bring about clear distinction between the numerical value 0 and the spaces in between letters

**Table 3.3 Letters of the English Alphabet and their numerical values in mod 27**

Plaintext letters	sc	A	B	C	D	E	F	G	H	I	J
Numerical values	0	1	2	3	4	5	6	7	8	9	10
Plaintext letters	K	L	M	N	O	P	Q	R	S	T	
Numerical values	11	12	13	14	15	16	17	18	19	20	
plaintext letters	U	V	W	X	Y	Z					
Numerical values	21	22	23	24	25	26					

where "sc" represents space in between letters

**3.3.1 Encryption process of the propose algorithm**

For this process, we will be converting documents in the form of plaintext messages into their ciphertext using the procedure below

- step 1. Get any key of  $n \times n$  matrix  $V$  being singular or non-singular. The size of the matrix is dependent on the grouping of the plaintext letters. This means any  $2 \times 2$  matrix would be grouped into two letters each and  $3 \times 3$  matrix chosen as key would also be grouped into three letters each.
- step 2. Convert the letters in the plaintext message into their corresponding numerical values using table 3.3
- step 3. Replace The first column of the identity matrix as plaintext letters of the message which will form  $I$ .  
 In order to make the algorithm more secured,we replace the columns of the identity matrix by the letters of the plaintext message to be encrypted
- step 4. Add  $V$  to  $I$  to get the ciphertext matrix  $C$
- step 5. Convert each element in the matrix into their corresponding letters to form the ciphertext

We then produce the algorithm

$$V + I = C$$

based on the technique where  $2 \times 2$  and  $3 \times 3$  singular or non- singular matrix keys we choose; produces the following respectively

$$\begin{bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{bmatrix} + \begin{bmatrix} I_{11} & 0 \\ I_{21} & 1 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix}$$

and

$$\begin{bmatrix} V_{11} & V_{12} & V_{13} \\ V_{21} & V_{22} & V_{23} \\ V_{31} & V_{32} & V_{33} \end{bmatrix} + \begin{bmatrix} I_{11} & 0 & 0 \\ I_{21} & 1 & 0 \\ I_{31} & 0 & 1 \end{bmatrix} = \begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix}$$

where  $I_{11}, I_{21}$  and  $I_{31}$  are replacement of the letters in the message by their numerical values

**3.3.2 Decryption Process of the Propose algorithm**

- step 1. Get the key for the matrix which is a singular or non-singular matrix
- step 2. Convert the letters from the ciphertext  $C$  to each of their corresponding numerical values
- step 3. Subtract  $V$  from  $C$  to get the matrix  $I$ . It would be vividly seen that, in getting  $I$ , the plaintext letters would be seen including the elements of the identity matrix.

step 4. Convert the elements seen in the plaintext letters of the matrix  $I$  to get the plaintext message.

We also produce the decryption algorithm from the techniques above as

$$C - V = I$$

where  $2 \times 2$  and  $3 \times 3$  singular or non-singular matrix as key can be given as

$$\begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} - \begin{bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{bmatrix} = \begin{bmatrix} I_{11} & 0 & 0 \\ I_{21} & 1 & 0 \\ I_{31} & 0 & 1 \end{bmatrix}$$

and

$$\begin{bmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} - \begin{bmatrix} V_{11} & V_{12} & V_{13} \\ V_{21} & V_{22} & V_{23} \\ V_{31} & V_{32} & V_{33} \end{bmatrix} = \begin{bmatrix} I_{11} & 0 & 0 \\ I_{21} & 1 & 0 \\ I_{31} & 0 & 1 \end{bmatrix}$$

where  $I_{11}, I_{21}$  and  $I_{31}$  are replacement of the letters in the message by their numerical values.

### 3.3.3 Practical example for $2 \times 2$ singular matrix on the propose algorithm

We are going to encrypt and decrypt informations in the form of messages on the proposed algorithm but with a  $2 \times 2$  singular matrix as a key. Lets suppose Abenaa want to send a very confidential message entitled "I AM BLESSED" to kofi in London using the key  $V = \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix}$

Abenaa will first of all convert every letter in the plaintext message into their numerical values using table 3.3 giving,

$I \rightarrow 9, sc \rightarrow 0, A \rightarrow 0, M \rightarrow 14, sc \rightarrow 0, B \rightarrow 2, L \rightarrow 12, E \rightarrow 5, S \rightarrow 19, S \rightarrow 19, E \rightarrow 5, D \rightarrow 4$

Abenaa will now group the message into two letters each since the size of the matrix is dependent on the grouping and  $I$  is the identity matrix with replacement of the first column of the identity matrix as numerical values of the plaintext message or letters. She now encrypts to get the ciphertext using  $V + I = C$  as follows

$$\begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 9 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 16 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 16 \\ 25 & 5 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 0 & 13 \end{bmatrix} = \begin{bmatrix} -7 & 17 \\ -2 & 17 \end{bmatrix} = \begin{bmatrix} 20 & 17 \\ 25 & 17 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 19 & 16 \\ 0 & 5 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 12 \\ 0 & 5 \end{bmatrix} = \begin{bmatrix} 20 & 1 \\ 25 & 9 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 19 & 0 \\ 19 & 1 \end{bmatrix} = \begin{bmatrix} 11 & 16 \\ 17 & 5 \end{bmatrix} \text{ mod } 27$$

Abenaa will then convert every elements in the matrix operation gotten into their letters to get the ciphertext which is the hidden message as "AYFETYQQSPETYAIKQPETYUH". Abenaa then sends the ciphertext and the key  $V$  to kofi. Kofi receives the message and decrypt it using the algorithm  $C - V = I$  where he converts the ciphertext letters into their numerical values using table 3.3 which produces

$$\begin{bmatrix} 1 & 16 \\ 25 & 5 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 9 & 0 \\ 0 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 20 & 17 \\ 25 & 17 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 13 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 19 & 16 \\ 0 & 5 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 20 & 1 \\ 25 & 9 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 12 \\ 0 & 5 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 11 & 16 \\ 17 & 5 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 19 & 0 \\ 19 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 20 & 21 \\ 25 & 8 \end{bmatrix} - \begin{bmatrix} -8 & 16 \\ -2 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 5 \\ 0 & 4 \end{bmatrix} \text{ mod } 27$$

It can be seen that, the letters of the plaintext message are gotten including the identity elements. The numerical values representing the letters of the message are then converted to their plaintext letters using table 3.3 leaving the identity elements which we get,  
 $9 \rightarrow I, 0 \rightarrow sc, 1 \rightarrow A, 13 \rightarrow M, 0 \rightarrow sc, 2 \rightarrow B, 12 \rightarrow L, 5 \rightarrow E, 19 \rightarrow S, 19 \rightarrow S, 5 \rightarrow E, 4 \rightarrow D$   
 This gives "I AM BLESSED" which is the plaintext message encrypted by Abenaa

**3.3.4 Practical example for  $2 \times 2$  non- singular matrix on the propose algorithm**

In this example, we will be using a  $2 \times 2$  non-singular matrix  $V = \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix}$

as a key for the algorithm to encrypt the same confidential message "I AM BLESSED". Abenaa who is the sender will still change all the letters in the plaintext message into their numerical values producing, I→9, sc→0 A→0, M→14,sc→0 B→2, L→12, E→5, S→19, S→19, E→5, D→4

She then groups the message into two letters and replaces the first column of the identity elements by the numerical values of the plaintext letters for  $I$ . She then encrypts the message using the algorithm  $V + I = C$  as,

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 9 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 15 & 3 \\ 4 & 6 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 0 & 13 \end{bmatrix} = \begin{bmatrix} 7 & 4 \\ 4 & 8 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix} = \begin{bmatrix} 6 & 3 \\ 6 & 6 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 1 & 12 \\ 0 & 15 \end{bmatrix} = \begin{bmatrix} 7 & 15 \\ 4 & 10 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 19 & 0 \\ 19 & 1 \end{bmatrix} = \begin{bmatrix} 25 & 3 \\ 23 & 6 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 1 & 5 \\ 0 & 4 \end{bmatrix} = \begin{bmatrix} 7 & 8 \\ 4 & 9 \end{bmatrix} \text{mod}27$$

Abenaa still converts the elements of each matrix above into their letters using table 3.3 to form the hidden message which is the ciphertext as "ODCFGDDRF-FCFGDOJYWCFGDHI" and then sends to kofi. Kofi receives the message and then decrypts by converting every letter in the ciphertext into their corresponding numerical values producing  $C - V = I$  which gives,

$$\begin{bmatrix} 15 & 3 \\ 4 & 6 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 9 & 0 \\ 0 & 1 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 7 & 4 \\ 4 & 18 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 13 \end{bmatrix} \text{mod}27$$

$$\begin{bmatrix} 6 & 3 \\ 6 & 6 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 7 & 15 \\ 4 & 10 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 12 & 5 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 25 & 3 \\ 23 & 6 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 19 & 0 \\ 19 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 7 & 8 \\ 4 & 9 \end{bmatrix} - \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \begin{bmatrix} 1 & 5 \\ 0 & 4 \end{bmatrix} \text{ mod } 27$$

It can be seen above that, the elements of the plaintext letters are gotten in addition to the elements of the identity. The numerical values which represents the plaintext letters in the message are then converted leaving the identity elements which produces

9→I, 0→sc, 1→A 13→M, 0→sc 2→B, 12→L, 5→E, 19→S, 19→S, 5→E, 4→D which represents "I AM BLESSED" which is the message that was sent by Abenaa

**3.3.5 Practical Example for 3 × 3 non- singular matrix on the propose algorithm**

In this example, we will be encrypting and decrypting documents using the algorithm in the form of messages sent by Linda entitled "DO NOT OPEN" to

Thomas as receiver with the non- singular matrix key  $V = \begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix}$

Linda will encrypts the message by converting the letters in the plaintext message into their numerical values using table 3.3 and also replaces the columns of the elements of the identity matrix by the numerical values of the plaintext letters to form  $I$ . Now we have,

D→4, O→14, sc→0 N→13, O→14, T→19, sc→0 O→14, P→15, E→4, N→13

Now lets get the ciphertext using the encryption algorithm  $V + I = C$  as

$$\begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} + \begin{bmatrix} 4 & 0 & 0 \\ 15 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & 1 & 1 \\ 19 & 4 & 2 \\ 2 & 8 & 5 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 15 & 0 \\ 0 & 18 & 0 \\ 0 & 19 & 1 \end{bmatrix} = \begin{bmatrix} 4 & 15 & 1 \\ 4 & 18 & 2 \\ 2 & 0 & 5 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 15 \\ 0 & 0 & 16 \end{bmatrix} = \begin{bmatrix} 4 & 1 & 1 \\ 4 & 4 & 17 \\ 2 & 8 & 20 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} + \begin{bmatrix} 5 & 0 & 0 \\ 14 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 8 & 1 & 1 \\ 18 & 4 & 2 \\ 2 & 8 & 5 \end{bmatrix} \text{ mod } 27$$

Linda gets the ciphertext "GSBADHABEDDBORABEDDBADHAQTHRBADHABE" by converting the result of every elements in the operation into their letters using table 3.3. She then sends the ciphertext in addition with the key  $V$  to Thomas. Thomas decrypts the hidden message using the decryption algorithm  $C - V = I$  which produces,

$$\begin{bmatrix} 7 & 1 & 1 \\ 19 & 4 & 2 \\ 2 & 8 & 5 \end{bmatrix} - \begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} = \begin{bmatrix} 4 & 0 & 0 \\ 15 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 4 & 15 & 1 \\ 4 & 18 & 2 \\ 2 & 0 & 5 \end{bmatrix} - \begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 14 & 0 \\ 0 & 15 & 0 \\ 0 & 19 & 1 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 4 & 1 & 1 \\ 4 & 4 & 2 \\ 2 & 8 & 5 \end{bmatrix} - \begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 15 \\ 0 & 0 & 16 \end{bmatrix} \text{ mod } 27$$

$$\begin{bmatrix} 8 & 1 & 1 \\ 18 & 4 & 2 \\ 2 & 8 & 5 \end{bmatrix} - \begin{bmatrix} 3 & 1 & 1 \\ 4 & 3 & 2 \\ 2 & 8 & 4 \end{bmatrix} = \begin{bmatrix} 5 & 0 & 0 \\ 14 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ mod } 27$$

Thomas then convert each element in the operation into their plaintext letters using table 3.3 leaving the elements of the identity which produces,  $4 \rightarrow D, 15 \rightarrow O, 0 \rightarrow sc$   $14 \rightarrow N, 15 \rightarrow O, 19 \rightarrow T, 0 \rightarrow sc$   $15 \rightarrow O, 16 \rightarrow P, 5 \rightarrow E, 14 \rightarrow N, 0 \rightarrow sc$  and reveals the plaintext message "DO NOT OPEN" which was sent by Linda.

**3.3.6 Practical Example for  $3 \times 3$  singular matrix on the propose algorithm**

In this example, we will consider a  $3 \times 3$  singular matrix key  $V = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix}$  where Linda still sends the confidential message "DO NOT OPEN" to Thomas

in London. She groups the letters of the message into three letters and converts them into their numerical values using table 3.3 as

D→4, O→14, sc→0 N→13, O→14, T→19, sc→0 O→14, P→15, E→4, N→13  
 she gets the ciphertext using the encryption algorithm  $V + I = C$  as

$$\begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} + \begin{bmatrix} 4 & 0 & 0 \\ 15 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 6 & 1 & 1 \\ 17 & 5 & 6 \\ 1 & 2 & 4 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} + \begin{bmatrix} 1 & 14 & 0 \\ 0 & 15 & 0 \\ 0 & 19 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 15 & 1 \\ 2 & 19 & 6 \\ 1 & 21 & 4 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 15 \\ 0 & 0 & 16 \end{bmatrix} = \begin{bmatrix} 3 & 1 & 1 \\ 2 & 5 & 21 \\ 1 & 2 & 19 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} + \begin{bmatrix} 5 & 0 & 0 \\ 14 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 7 & 1 & 1 \\ 16 & 5 & 6 \\ 1 & 2 & 4 \end{bmatrix} \text{ mod}27$$

Linda gets the hidden message as "FQAAEBAFDCBAOSUAFDCBAAEBAUS-GPAAEBAFD" which she sends to Thomas in addition with the key  $V$ . Thomas also decrypts and converts the letters in the hidden message into numerical values and then uses the decryption algorithm  $C - V = I$  which he gets

$$\begin{bmatrix} 6 & 1 & 1 \\ 17 & 5 & 6 \\ 1 & 2 & 3 \end{bmatrix} - \begin{bmatrix} 2 & 1 & 1 \\ 25 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 4 & 0 & 0 \\ 15 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 3 & 15 & 1 \\ 2 & 19 & 6 \\ 1 & 21 & 4 \end{bmatrix} - \begin{bmatrix} 2 & 1 & 1 \\ 25 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 14 & 0 \\ 0 & 15 & 0 \\ 0 & 19 & 1 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 3 & 1 & 1 \\ 2 & 5 & 21 \\ 1 & 2 & 19 \end{bmatrix} - \begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 15 \\ 0 & 0 & 16 \end{bmatrix} \text{ mod}27$$

$$\begin{bmatrix} 7 & 1 & 1 \\ 16 & 5 & 6 \\ 1 & 2 & 4 \end{bmatrix} - \begin{bmatrix} 2 & 1 & 1 \\ 2 & 4 & 6 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 5 & 0 & 0 \\ 14 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ mod}27$$

Thomas converts every elements in this operation into their plaintext letters

leaving the elements of the identity where we gets  
 $4 \rightarrow D, 15 \rightarrow O, 0 \rightarrow sc$   $14 \rightarrow N, 15 \rightarrow O, 19 \rightarrow T, 0 \rightarrow sc$   $15 \rightarrow O, 16 \rightarrow P, 5 \rightarrow E, 14 \rightarrow N,$   
 $0 \rightarrow sc$   
and produces "DO NOT OPEN" which is the message encrypted by Linda.

#### 4 Conclusion

In a nutshell , an algorithm has been proposed with either singular or non-singular key matrix to be used to encrypt and also decrypt document with practical examples on the proposed algorithm. Comparing the two algorithms, the proposed algorithm can be encrypted and decrypted whether the key is either singular or non-singular matrix which is an improvement or an advantage over the Hill cipher algorithm

#### 5 Recommendation

Studies have shown that, matrices with complex entries used as key becomes a challenged when carried out using the algorithm. So we therefore recommend that further studies should be carried out to involve complex matrices with either singular or non-singular key

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# Book Review Of The Communist Manifesto By Karl Marx & Friedrich Engels

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## I. INTRODUCTION

The Communist Manifesto is one of the influential political documents in history. It was written in 1848 by Karl Marx and Friedrich Engels. Furthermore, it was commissioned by the Communist League and was first published in London as Manifesto of the Communist Party. The manifesto is divided into four chapters or parts namely: Bourgeois and Proletarians, Proletarians and Communists, Socialist and Communist Literature and Position of the Communist in relation to the various existing opposition parties.

Communist manifesto is Marx and Engels theories about the structure or nature of society and politics. It reveals how the society is characterised by class antagonisms in all historical epoch of human existence. Hence the chapters will be evaluated separately and its application to contemporary situation in Nigeria.

## II. BOURGEOIS AND PROLETARIANS

The authors began this section by proclaiming that a spectre was haunting Europe and that was the spectre of communism, hence the necessity to publicly (openly) publish their party views and aims. They postulated that “the history of all hitherto existing society is the history of class struggles”. Marx and Engels admonished that they were living in the modern bourgeois society which sprouted from the ruins of feudal society. Here, bourgeoisie refers to the class of modern capitalists who own the means of production and are also employers of wage labour. The epoch of the bourgeoisie possesses a distinct feature, simplified class antagonisms between two great hostile classes directly facing each other – Bourgeoisie and Proletariat.

The discovery of America and other colonies and steam and machinery revolutionised industry opened up fresh grounds for rising up of the bourgeoisie. Modern industry has established a

world market for capitalism to thrive on and every step in the development of the bourgeoisie was accompanied by a corresponding political advance of that class. For instance, there was an oppressed class during the sway of feudal nobility, and in modern time the representative state exclusive political sway. Thus, Marx saw the executive modern state as a committee for managing the affairs of the bourgeoisie.

This section depicts the characteristics of the bourgeoisie in respect to their relationship with the proletarians. The bourgeoisie are cash or capital driven, and when it is possible, they alter situation to their advantage. They advocate free trade for exploitation through the use of politics and religion.

The bourgeoisie have stripped honourable occupations of their own such as the lawyers, priests, the poets and scientists thereby turning them into mere wage labourers. It has also torn away family ties and reduced family relation to mere money relationships. The existence of the bourgeoisie is made possible due to the constant revolution of instruments of production and relations of production and with them the whole relations of society.

The need for expansion makes the bourgeoisie explore all surfaces of the globe and has given the world market a cosmopolitan character to production and consumption. Through rapid improvement of all instruments of production facilitated by means of communication draws all nations into civilisation. Psychological manipulation is done by production of cheap commodities even to barbaric nations. The proletarians are only but wage labourers whose interaction with the bourgeoisie leads to further pauperisation.

However, the weapons the bourgeoisie felled- feudalism, are now turned against the bourgeoisie itself, and has also called into existence the men who will wield the weapons – the modern working class – the proletarians. Just as the development of capital, is the development of the proletariat, a class of labourers who live only so long as they find work and only if their work can increase the bourgeoisie capital. The dignity of the workers has been reduced to that of a commodity, an element of commerce and is also subjected to fluctuations of the market.

Therefore, the authors postulated that other middle class - the artisan, small manufacturers, shopkeepers and peasants cannot stand up against the bourgeoisie and are always struggling to keep their positions in society. The proletarians on the other hand are subjected to the same oppression whether in Germany, England, America or France and the law, morality and religion are usually ideas of the ruling class in the interest of the bourgeoisie.

Every human society is based on antagonism of oppressing and oppressed classes and certain conditions must exist for such relationship. Pathetically, the modern labourers instead of rising with the process of industry sinks deeper below the conditions of existence of his own class and is pauperised.

### III. PROLETARIANS AND COMMUNISTS

Here emphasis was made on the aim of the Community Party. The communists do not form a party opposed to other working-class parties. Their aim is the formation of proletariat into a class, overthrow of bourgeois supremacy and conquest of political power by proletariats.

Communists advocated the following principles in order to achieve their aim:

1. Abolition of private property
2. Abolition of the family and rescuing education from the influence of the ruling class.
3. The acknowledgement of the community of women.
4. Raising the proletariat to the ruling class position to win the battle of democracy.

An achievement of the aforementioned principles will lead to the following in most advanced countries.

- i. Abolition of property in land and application of all rents of land to public purposes,
- ii. A heavy progressive or graduated income tax,
- iii. Abolition of all rights of inheritance, and
- iv. Confiscation of the property of all emigrants and rebels
- v. Centralisation of credit in the hands of the state, by means of a national bank with state capital and an exclusive monopoly.
- vi. Centralisation of the means of communication and transport in the hands of the state.
- vii. Extension of factories and instruments of production owned by the state; the bringing into cultivation of wastelands and the improvement of the soil generally in accordance with a common plan.
- viii. Equal liability of all to work. Establishment of industrial armies, especially for agriculture.
- ix. Combination of agriculture with manufacturing industries, gradual abolition of all the distinction between town and country by a more equitable distribution of the populace over the country.
- x. Free education for all children in public schools. Abolition of children's factory labour in its present form. Combination of education and industrial production.

(See Marx and Engels 1848, p. 26 – 27).

### IV. SOCIALIST AND COMMUNIST LITERATURE

This section differentiates communism from other socialist doctrines that existed at that period. Aristocrats of England and France for instance wrote pamphlets against the bourgeoisie, but paradoxically, they also enjoy the “apples” that grow from the bourgeoisie gardens of exploitation – capitalism.

Marx and Engels categorised this section into reactionary socialism, critical-utopian socialism and communism and conservative or bourgeois socialism. The various perspectives approach towards capitalism varies but the authors dismiss them on the basis that they advocated reform which was impossible.

However, the position of the manifesto was a radical overthrow of the bourgeoisie which was only possible through the revolutionary struggle of the proletariat - the working class.

### V. POSITION OF THE COMMUNIST IN RELATION TO THE VARIOUS OPPOSITION PARTIES

This is the smallest section of the Communist Manifesto and the concluding part. Here, is a brief discussion of the communist position on struggles in various countries of the mid-nineteenth century such as Germany, France, Switzerland and Poland which were on the eve of bourgeois revolution.

The communists pledge support for every revolutionary movement against the existing social and political order of things. They declared that their mission can be attained only through the forcible overthrow of all existing social conditions. Lastly, they made a clarion call for the working class to unite – “Working Men of all Countries, Unite”.

### VI. APPLICATION TO CONTEMPORARY SITUATION IN NIGERIA

Contemporary Nigerian society is enmeshed in political and economic crises of various forms, intensity and pervasiveness. The state at best fits Marx and Engels description of the state as a committee of managing the affairs of the bourgeoisie and ruling class. Just as the advocacy that “the history of all hitherto society is the history of class struggle” is the Nigerian situation.

The state has transformed itself to the status of an entrepreneur that does business for the interest of its citizens and in the process promotes the interest or stakes of the ruling class (politicians) at the detriment of the larger majority - working class, students, women, children and the poor (peasants). In other words, the Nigerian state has the character of rent seeking, prebendalism and patrimony.

The entrepreneurial role of the Nigerian state has incorporated Nigeria into the global capitalist system. The Nigerian society however is merely a consumer nation that imports a variety of commodities from the advanced or developed countries. The advancement of Information and Communication Technology (ICT) has further maintained the dependency relation through online shopping where goods can be bought online via the use of the internet and delivered to consumer's door step across the globe.

Worst still, contemporary Nigerian state does not provide welfare for its citizens, but serves the interest of the politicians and elites, captains of industries, multinational corporations and CEOs of big conglomerates such as Alhaji Aliko Dangote. This often leads to reactions and conflicts between the two classes – oppressing and oppressed. Thus, strikes and protests by the Nigerian Labour Congress (NLC), Trade Union Congress (TUC), students unions and civil societies among others are often the order of the day.

Therefore, the way forward is when the Nigerian working class forms a consciousness of its own, free of personal rivalry and collectively oppose the Nigerian bourgeoisie and possibly overthrows it will there be change. This sounds utopian. However, it is pertinent for Nigeria to encounter a revolutionary

change from her existing social and political structures in order to move the country forward.

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# Leadership In Technical Vocational Training: An Analysis Of The Influence Of Leadership Commitment On The Competitiveness Of TVET Institutions In Kenya

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**Abstract-** TVET institutions have been recognized as key economic drivers in both developing and developed countries across the globe. The institutions have highly contributed to growth of industries especially the manufacturing sector through provision of the required skills. In Kenya, TVET institutions are yet to gain the required attention based on the fact that they are regarded as the last running point for academic failures. It is on this merit that the study sought to establish the influence of leadership commitment on competitiveness of TVET institutions in Kenya. Descriptive research design was used in the study and the target population was the 68 TVET institutions in Kenya. A census was employed whereby all the 68 institutions were included in the study. Principals/their representatives/ HoD ICT, R&D and Finance were the units of observation. The findings revealed that leadership commitment through strategic direction, employee involvement and proper decision making enhanced the competitiveness of TVET institutions in Kenya. The study recommended that the management of TVET institutions ought to embrace leadership commitment and ensure effective use of resources availed to steer the efficiency of their operations.

**Index Terms-** Leadership Commitment, TVET institutions Organizational Competitiveness

## I. INTRODUCTION

In the modern World, leadership stands to be one of the major enablers of organizational success both in performance and sustainability. Through a properly streamlined leadership framework and committed individuals, modern organizations have been able to turn around and become global leaders at a very short period of time (Lussier & Achua, 2017). McCleskey (2014) describes leadership as a wide area in any given organization hence it can be focused on in different aspects such as the commitment of those in leadership, their style of leadership, competency and approaches of a leader. In this paper, leadership commitment has been focused on. This is an aspect of strategic leadership where a strategic leader upholds commitment and willingness to go out of their way for the purpose of the organizational goals.

The capability to lead, guide and support generating ideas and promoting sustainable innovation behaviours is a common

denominator for committed leaders (Sosik et al., 2015). Leadership commitment is about increasing the opportunities for employees to take part in the development of activities, and strike a balance in order to make employees work on good ideas. Leadership commitment plays an essential role in directing employees' energy in the right direction and encouraging them to become more creative to do their job to the fullest. Leaders also need to focus on developing the innovation, creativity and risk-taking skills of the teams that work for innovation in organizations in order to have well-equipped teams to achieve successful innovation (Shuria, 2015).

Organizational competitiveness has been a subject of focus for many decades among scholars, practitioners and the general public. The main idea behind competitiveness has been the ability of an organization to stand-tall in the midst of competitors offering the same product in the same market. A competitive organization is able to capture the market and gain more market penetration than the competitors. Organizational competitiveness is not only tied to profit-making entities but also to public entities and non-profit organizations. TVET colleges mainly being public organizations ought to be competitive in order to enhance their impact to the society and steer their continued growth, development and sustainability.

Technical and Vocational Educational Training (TVET) institutions in Kenya have recently been upheld as key economic drivers and societal game-changers by their virtual of providing the market with the right technical skills required in the major industries in the country such as the manufacturing industry and the construction industry (GOK, 2017; Mwangi, 2019). While TVET colleges were recognized by the Kenya's vision 2030 as the key economic pillars in terms of bridging the skills gap, the institutions have highly gained focus and major expansion after 2013 where there has been a surge in the number of the institutions across the country. This was after the government embraced a programme of having a vocational training college in every constituency and increasingly encouraged the youth to join the institutions (MOE, 2015).

## II. PROBLEM STATEMENT

The main driver for the government to focus on TVET colleges was the need for equipping the citizens particularly the

youth with the appropriate technical (practical) skills that are directly absorbed into the market as opposed to managerial skills that do not directly translate to economic activity after school. This was the reason behind construction of TVET colleges across the country and continued awareness creation to have more youth enroll to technical courses. The goals of TVET education are however yet to be achieved as many TVET colleges across the country continue to record low numbers of intake with some having empty buildings with no learners. Other TVET institutions as reported by the Ministry of Education lack adequate personnel and teaching and learning materials thus affecting the effective flow of the learning process. It therefore raises a question on the ability of the management of the TVET colleges to play their role in enhancing the competitiveness of the institutions. This paper therefore sought to assess the influence of leadership commitment on the competitiveness of TVET Institutions in Kenya.

### Research Hypotheses

**H<sub>0</sub>:** Leadership commitment has no significant influence on competitiveness of TVET institutions in Kenya

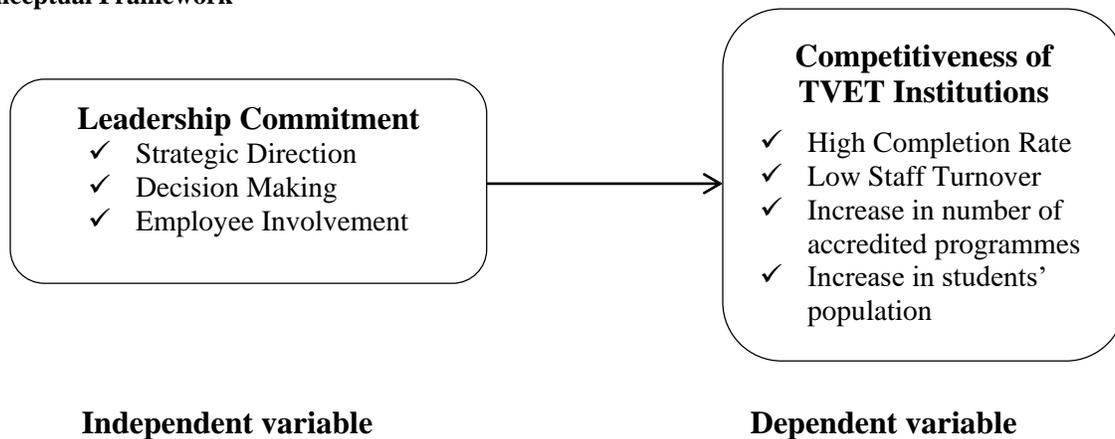
## III. LITERATURE REVIEW

### Theoretical Foundation

#### 2.2.1 Contingency Theory of Leadership

Contingency theory of leadership was first publicized by Woodward (1958) but has since then received tremendous improvements and reviews that have seen it stand as one of the

### Conceptual Framework



### Empirical Literature

Gongbing, Zhou and Cai (2014) carried out a study on the impacts of top leadership competencies on organizational agility. The researchers aimed at establishing the role played by organizational leadership's ability to perform high range of managerial duties on the performance of state corporations in China. The scholars found that the managerial competency of an organizational leadership was determined by the skills and capabilities within the employees of the organizations and therefore defining operational competencies of an organization was best done by establishing the competencies of the employees. Their conclusion was based on their findings that leadership

major commonly known theories of leadership. The theory is an organizational management theory that has extensively focused on leadership in an organization and how managers can be global leaders with leadership capabilities in different business areas. The theory attempts to contemplate that the methods of leadership and tactics used to provide leadership by a certain leader depends on the contextual situation in which the leader experiences (Robbins, Judge, & Campbell, 2010).

The theory states that leadership traits and methods used in one sector or organization cannot necessarily fit to be used in another sector or organization or a time period. This is based on the changing factors such as technology advancements, market changes, environmental vitality as well as changes in size of the organization. In this perspective therefore, when a leader is dealing with a different organization from the one he or she was before, or need for changes in organizational management, the leader should embrace changes in the leadership strategies as well so as to accommodate and be able to cope with the new changes (Aver & Cadez, 2009).

According to Robbins *et al.* (2010), with changes in time, most organizations expand and others start using new operational methods with changes in technology and innovations as well. This therefore means that for a manager to ensure success of such an organization, he or she should adopt new methods of leadership as well and change the direction of management to enhance success of the organization. Therefore, TVET institutions require strategic leaders to align the institutions with global changes and for competitiveness by providing strategic direction, decision making and staff involvement.

competencies of an organization contributed to a great extent to the competitiveness of the organizations and performance as well (Gongbing, et al., 2014).

Ismail and Abidin (2010) carried out a study on the Impact of managers' commitment on their performance in the Malaysian private service sector. They found that managers' competencies influence the productivity of the private sectors to a great extent. They also established that through their skills, innovations were highly upheld in Malaysia. Years of schooling, training received when working and human capital influences the competency of a manager which is essential for organizational performance (Ismail and Abidin, 2010).

Locally, Rono and Bomet (2019) studied the influence of leadership strategy on strategic plan implementation in public Technical Training Institutions in Kenya. The authors established that leadership was a key driver to the implementation of strategic plans and the overall performance of the technical training institutes. According to Rono and Bomet (2019), through appropriate leadership strategies, the employees are more likely to feel part of the organization thus being focused towards implementing the organization’s strategic goals.

#### IV. METHODOLOGY

##### Research Design

Descriptive research design was used in this study. It entails explanation of a phenomenon, estimating a proportion of a population with similar characteristics and ascertaining the relationship that occurs amid the variables under study (Myers, 2013; Saunders, Thornhill & Lewis, 2009).

##### Target Population and Sampling

The accredited TVET institutions in Kenya were targeted. According to Ministry of Education (MOE-2018), there were 68 registered operational TVET institutions in Kenya as of 2018. A census was used whereby all the 68 TVET institutions were selected while the principals, heads of finance department, heads of ICT and heads of R&D were purposively selected making the ample size to total to 272 respondents. The respondents were surveyed using a structured questionnaire.

##### Data Analysis

Both descriptive and inferential statistics were used to analyze quantitative data while the qualitative data was analysed through description and thematic analysis. Descriptive statistics

such as frequency distribution and measures of central tendency was used to analyse the demographic data. Testing of the hypothesis was done by calculating an F-Value using a two-way ANOVA.

#### V. FINDINGS

##### Leadership Commitment

The study sought to determine the influence of leadership commitment on the competitiveness of TVET institutions in Kenya. The main aspects of leadership focused on in the study included strategic direction, decision making, and employee involvement. According to Çetin, Karabay and Efe (2012), a committed leader shows the charisma, individual consideration, idealize influence, intellectual stimulation and inspirational motivation towards effective operation of the organization. The findings as shown in Table 1 revealed that majority of the respondents agreed with the statements on leadership commitment despite a significant number indicating that these aspects were not applied in their respective institutions. According to Rouleau and Giordano (2019), a leader who is keen to offer strategic direction to the followers (employees) ought to ensure that the vision and mission statements of the organizations are well communicated and set clear to all the employees. According to Dimitrios *et al.* (2013), leadership is about seeking support from the stakeholders and rallying them towards a common goal which is the key definition of inclusivity. Kitonga (2017) explains that leadership is a key aspect in an organizational performance but this is achieved through inclusivity and direction setting.

**Table 1: Descriptive Results on Leadership Commitment**

Statement	SD	D	N	A	SA	Mean	Std. Dev.
The institution has a clear, compelling and realistic map to the right destination	9.2%	18.3%	24.5%	21.8%	26.2%	3.37	1.29
There is a written mission and vision statements that clearly outlines who we are, what we do and for who	9.2%	14.4%	12.7%	36.7%	27.1%	3.58	1.27
The mission and Vision statement are regularly reviewed and if necessary revised	10.5%	10.9%	12.7%	37.6%	28.4%	3.62	1.28
There is robust and formal directional setting process (e.g strategic planning) that result in clear strategic direction	15.7%	12.7%	9.6%	31.9%	30.1%	3.48	1.43
Our decisions are inclusive, informed and bold at all level of the institution	5.7%	10.5%	21.4%	31.4%	31.0%	3.71	1.17
There are frequent consultative meetings with key stakeholders such as government officials, students, parents and staff	8.3%	13.1%	16.6%	33.6%	28.4%	3.60	1.25
Decisions are communicated among staff members, students and other key stakeholders	11.8%	17.0%	10.0%	28.8%	32.3%	3.52	1.39
The employees are involved and committed to the development and competitiveness of the institution	7.9%	13.5%	17.5%	32.8%	28.4%	3.60	1.24
Opinions of the employees are sought when making critical organizational decisions.	4.8%	12.7%	17.0%	39.7%	25.8%	3.69	1.12
There are effective communication channels to give feedback to the employees and exchange ideas with the management	3.9%	12.7%	13.1%	48.9%	21.4%	3.71	1.06

##### Competitiveness of the TVET Institutions

The study sought to establish the competitiveness of TVET colleges in Kenya and the major aspects of competitiveness used included the number of accredited courses, staff turnover, rates of completion and intake. According to UNESCO (2017), the success of technical training institutions is determined by their level and ability to compete with other higher learning institutions by attracting a reasonable number of students, offering variety courses and relevant to the market as well as instilling skills and competencies that can solve the modern-day problems. The findings as shown in Figure 2 revealed that the number of accredited courses across the TVET institutions increased

significantly from the year 2014 to 2018 while the number staff, graduated students, and admitted students had an insignificant trend which implies that the competitiveness was declining. According to Kyaw and Naing (2015), TVET colleges ought to come up with newer courses as frequently as possible as a show of enhanced innovation but they should not duplicate courses. Urdaneta (2017) indicates that the turnover rate in higher learning institutions especially the TVET colleges can be a major predictor of how things are as far as performance and competitiveness of these institutions is concerned.

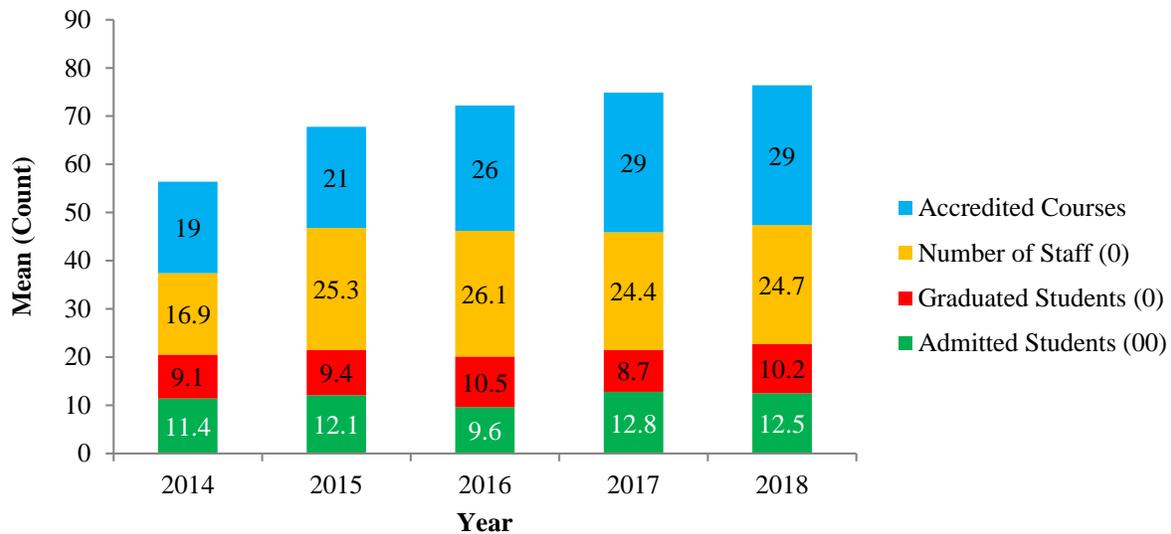


Figure 1: Competitiveness of TVET Institutions

### Hypothesis Testing

The model results are as shown in Table 2. The model summary revealed that the R-square ( $R^2$ ) for the variable was 0.375. This implies that leadership commitment could explain up to 37.5% variation in the competitiveness of TVET institutions. The ANOVA results show the F-Statistic for the model was 136.342 at a significance level of 0.000. This implies that the model could significantly explain statistically the relationship between leadership commitment and the competitiveness of the TVET institutions in Kenya.

The regression coefficients results revealed that the Beta coefficient for leadership commitment is 0.542 at a significance

level of 0.000. This is an implication that leadership commitment has a significant and positive influence on the competitiveness of the TVET institutions in Kenya. The proposed model;  $Y = \alpha + \beta_1 X_1 + e$ ; now become  $Y = 1.882 + 0.542X_1 + 0.046$ . This indicates that a unit change in leadership commitment would lead up to 54.2% increase in the competitiveness of TVET institutions in Kenya. To this end, the study therefore rejects the null hypothesis that leadership commitment has no significant influence on the competitiveness of TVET institutions in Kenya.

Table 2: Inferential Results

#### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.613 <sup>a</sup>	.375	.372	.84202

a. Predictors: (Constant), Leadership Commitment

#### Analysis of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	96.666	1	96.666	136.342	.000 <sup>b</sup>
	Residual	160.943	227	.709		
	Total	257.609	228			

a. Dependent Variable: Competitiveness

b. Predictors: (Constant), Leadership Commitment

**Regression Coefficients**

Model		Unstandardized Coefficients		Standardized	t	Sig.
		B	Std. Error	Coefficients		
1	(Constant)	1.882	.176		10.671	.000
	Leadership	.542	.046	.613	11.677	.000
	Commitment					

a. Dependent Variable: Competitiveness

**VI. CONCLUSION AND RECOMMENDATION**

Leaders in the TVET institutions were keen to establish strategic directions for the institutions while making the best use of employees through engagement and involvement in decision making processes. The institutions reaped from the outgoing nature of the leaders and ability to ensure that the mission, vision and core values of the institutions were upheld and reviewed to compel with the changes in the operating market.

It is recommended that the TVET institutions through the management embrace leadership commitment by ensuring that the leaders in whichever category draw a realistic and effective strategic direction for the organization. The TVET institutions ought to embrace effective involvement of the employees and other key stakeholders such as the community members in making critical decisions so as to reap support from the stakeholders.

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# Some Crucial Ideas Associated With Research Publication

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**Abstract-** Research is vital to higher education. Higher education is being promoted, and consequently, there certainly is an increase in student enrolments and an elevation in the number of teachers required by universities and other higher educational institutions. Even though the 'system' of higher education is expanding, awareness about some important concepts related to academic research and research publication is still low. It is very important that a modern-day researcher should have awareness of concepts like indexing of journals, journal metrics, open access, peer-review process, peer review scams, predatory publishing, reference management, etc. This article presents a brief overview of some crucial concepts and issues associated with research publication and is aimed at being an introductory guide that can be of some assistance to early career researchers when they begin exploring the landscape of scholarly publication.

**Index Terms-** Indexing, journal metrics, peer review, open access

## I. INTRODUCTION

The system of 'higher education' is gradually getting bigger- universities are expanding, and student enrolments are increasing in multiple countries around the world (Matthews, 2016). Nowadays, teachers and, quite often, students involved in higher education are expected to contribute to high-quality research in their fields. As a result of this increase in the sheer number of people involved in research, a lot of new 'knowledge', through high-quality research, is being created in a very short span of time. This is, for sure, good news but associated with this system of higher education is a bit of bad news too. In India (and probably in many other countries), there is a large section of student- researchers and even young teachers who are just unaware of some basic concepts and some 'must-have' ideas associated with research publication. A recent study conducted on a sample of university teachers in India from various disciplines and various parts of the country concluded that even university teachers have less than the desired level of awareness about important concepts, norms, and regulations associated with research in higher education (Kureethara, 2019). Early career researchers might be good at what they do, but if they don't know and appreciate the importance of something as basic as the concept of 'indexing', then they are much more likely to submit their innovative and brilliant ideas to journals that aren't indexed and end up negatively impacting the 'reach' of their ideas. Similarly, today, student researchers, young academicians, and scientists should also be informed enough to recognize predatory journals with very poor publication practices. There should be an understanding that having an impact factor is surely a mark of quality, but just because a journal does not have an impact factor, it doesn't automatically imply that it's completely fake or predatory. Young inexperienced researchers should know the existence of peer review scams so that they can make wise and informed decisions. The purpose of this article is to highlight some of the most crucial issues associated with research and research publication.

## II. The importance of Indexing

The reach of a research article surely gets reduced or suppressed if it is published in a journal that's not indexed. In this day and age of the internet, if a journal is not a part of an online search system, its chances of success are very slim, and being represented by any indexing service makes sure that a journal is indeed a part of that search system (Dhammi & Haq, 2016). Researchers consider indexes as one of the indicators of 'good quality academic work' and always prefer referencing articles from journals that are indexed (Padula, 2019). Padula (2019), an expert in the area, mentions that if a journal is included in indexes like Web of Science, JSTOR, MEDLINE, etc., then one can be almost certain that it follows some core publishing standards like having Digital Object Identifiers (DOIs), International Standard Serial Number (ISSN), a fixed publishing schedule, etc. Besides giving an assurance that a journal has some basic standards related to publishing, different indexing agencies have additional requirements for inclusion in their respective indexes like insisting journals to mention the full name and affiliation of their editors, making their peer review policy publicly available, etc.

These additional requirements increase the overall standard and indexes with higher standards are seen as more trustworthy by researchers (Padula, 2019). So nowadays, indexing plays a central role in reach and impact of research articles.

### III. Journal metrics

Indexing agencies use certain metrics like Impact Factor, Cite Score, etc. These metrics are mostly means of rating journals and giving researchers an idea of the overall 'quality' of the journals. As a journal metric, Impact Factor (IF) is probably one of the most popular among researchers. In this section, two different journal metrics have been briefly described, starting with Impact Factor. Impact Factor is a product of Clarivate Analytics and is based on the database of Web of Science. If we consider the research reports and reviews of a journal in year one and the next year and get an idea of the citation counts to these contents in the third year and then divide this citation count by the number of research reports and reviews in first and second year, we get IF (Pendlebury, 2009). In some disciplines like those related to medical sciences, rapid citations take place. Natural science and medical science based journals are more likely to have higher IF than Social Science and humanities journals. Even though it is commonly believed that higher IF indicates greater importance of a journal, there is also an understanding among some experts that just the 'number' of citations cannot be the sole parameter for determining journal quality (Walter, Bloch, Hunt & Fisher, 2003). Quality of an article won't be of much importance if it lacks or has little relevance to one's own work, and this, obviously, does play an important role in the selection of references (Aksnes, Langfeldt & Wouters, 2019). Numbers can be an indicator of popularity but whether it really is an indicator of quality is indeed worth pondering over and should impact factor be seen as a direct indicator of the importance of a journal is really a contentious issue in some academic circles. When Cite Score (the other metric that we will briefly see) was launched by Elsevier, some experts in the area saw it as a new metric that can compete with Impact Factor (Courtney, 2017). I, personally, do not see Cite Score as something 'better' or 'worse' than Impact Factor. I will elaborate on my position later in this section, but first, I will briefly introduce Cite Score and mention how an expert (who probably sees Cite Score as a competition of IF) makes a comparison of the two journal metrics.

Cite Score is calculated by first taking into account the number of citations a journal got in three previous years, and then this number is divided by the number of documents published in these three years ("Scholarly Publishing Resources", 2019). Comparing IF and Cite Score Courtney (2017), a research impact expert and a librarian, mentions that:

1. Cite Score can be accessed freely at no cost, while Journal Citation Reports (JCR) –the database for calculating IF, isn't free.
2. The journal list from where cite score is calculated is considerably larger than Web of Science's.
3. More humanities and social science journals are there in Scopus Journal List- the list on which Cite Score is based.
4. Cite Score has a 3-year citation window. Elsevier claims that in 'slower-moving' subject areas, i.e., subjects where rapid citations aren't the norm, two years' worth of data is too short to determine the influence or quality of a journal.
5. Besides regular articles, editorials, letters, or even just abstracts are included while calculating Cite Score. Impact factor, on the other hand, does not take them into account.

The comparison above might indicate that I am slightly biased towards Cite Score. I want to emphasize that I don't have any such bias. Impact Factor (IF), in fact, has helped the research community in a variety of ways for a long time. It has a special place in the research community as it has helped in making some important decisions related to job appointments, promotion, grant approval, etc. Some countries rely on IF to ensure the advancement of knowledge in their countries. Brazil has established a "Qualis" scale based on the average impact factor of their publications, which is used to grade students and faculty, and China offers monetary rewards to editors of different journals, and this distribution of rewards is based on IF (Ferreira, Antoneli & Briones, 2013; Hugget, 2012). There are experts who probably would have waited eagerly for the arrival of a formidable competitor of Impact Factor. They have their reasons for it. But my opinion about journal metrics differs slightly both from those who see cite score as their favorite and those who are positively biased towards Impact Factor. Even though I see the arrival of cite score largely as a good thing, but for me, there is no direct comparison and a consequent judgment that cite score is above or below IF. The arrival of cite score means there is another journal metric available, but I cannot claim that IF is better or worse than cite score. For me, these are just metrics, and choosing between them is a subjective decision that depends on a variety of factors (like the subject area, etc.). In my opinion, the primary concern of a modern-day researcher should be the platform where one's ideas (in the form of a research article) have been presented. Researchers should ensure that the platform provides a good enough reach for their ideas. If a journal X, covering a specific area or field of study, has a high Impact Factor then the conclusion I will draw is that X attracts a lot of good articles in that area, and it will indeed be a great platform to present my work. I will certainly assume that X will be a place where leading experts in the area provide valuable feedback after evaluating a submitted manuscript. But I will not obsess about getting a place in a high IF journal only. If, for some reasons, my ideas do not make it to journal X (with high IF), then looking for other journals would be the next logical step and, in my opinion, as long as the journal I choose next is indexed and provides a decent peer review, its fine for making a submission.

### IV. Some Indexing agencies and their policies and practices

The indexing agencies or organizations behind different indexes like Scopus, Ulrich's periodicals directory, CrossRef, etc., have certain policies, and after having a closer look at some of the policies of these organizations, one can become aware of one's responsibilities as well as rights as an author. Even though some of the 'requirements' from prospective authors of these journals can be 'usual' and 'not entirely unexpected' for many researchers, it's still worth glancing over. Elsevier (which manages the SCOPUS database), for example, asks authors to be careful about the selection of research areas and not submit articles that are mundane or redundant (Elsevier, n.d.). It is quite possible that reading up the policies of these indexing agencies can reintroduce one to the

importance of giving proper acknowledgment to the work of others. According to Elsevier's policy, meant for editors, a journal should encourage transparency and honest reporting. Elsevier also asks the editor to ensure that peer reviewers and authors have a clear understanding of what is expected from them (Elsevier, n.d.). Another important policy of the indexing agency acknowledges that editorial decisions can be appealed against, and for that, there should be a mechanism or a standard procedure, which should be transparent and unbiased. And similarly, yet another part of the policy cautions the editors against using any unpublished material which was disclosed in the research by someone, artificially increasing any journal metric, etc. (Elsevier, n.d.). Getting a sufficiently accurate idea about what is practiced in editorial offices of the journals indexed by this and other agencies can be beneficial to a lot of researchers.

#### **V. Peer Review and Peer Review Scams**

At the heart of the publication process is peer review. It is the review of a submitted article done by someone who is an expert in the area and generally outside the editorial board of the journal. Peer review assists the editor in making editorial decisions. It also helps the author in improving their paper by providing them constructive criticisms. Peer review is one of the most crucial ways to ensure quality in a publication (Masten & Ashcraft, 2016).

The peer review processes these days, unfortunately, are getting affected by peer review scams. Reporting on the issue Ferguson, Marcus & Oransky (2014) described a case where the process of the peer review was so quick (according to that journal's norms) that it baffled the editor of a certain journal. This journal, as part of their policy, invites authors to suggest the names of potential reviewers. When the journal followed up the case with that author, they found that this renowned researcher named himself and his close friends to do a peer review of his submissions. Since he or his colleagues did the reviewing, the process took no time to get completed. Acts like these are on the rise, and even very good journals that earlier used to ask authors to name a reviewer are re-examining their peer review policies (Ferguson, Marcus & Oransky, 2014).

#### **VI. Open Access and Predatory journals**

Journals require some resources to run. To keep publishing, they need to take care of the editorial and peer review costs. Traditionally, the publishers have had all the rights to the articles in their journals, and anyone who wants to use any article from the journal must obtain permission and/or pay some fees before it can be accessed (PLOS, n.d). Earlier, if one wanted an article from a journal, it simply implied that a person is in need of a copy that had to be printed and hence earlier, individuals were expected to pay printing costs too, but in this day and age of internet and online distribution, printing costs are not much relevant.

Today we have open access journals that help disseminate knowledge freely. These journals generally provide free and immediate access to readers almost anywhere in the world, and most don't put restrictions on the reuse of the contents of the journal. But these journals run their businesses by charging the researchers who wish to publish their works (Conte, n.d.). Generally called Article Processing Charges (APC), these charges can be as high as \$5000 (Conte, n.d). There are open access journals that charge much less, but the cost of publishing in these journals is one of the most vital factors that influence the decision of a researcher to go ahead with it. There is no doubt that publication in these journals increases the reach of an article enormously because prospective readers have to pay nothing to access them.

The 'author-pays' model of open access publishing is, unfortunately, being exploited nowadays by some publishers. Beall (2012) calls the journals released by these publishers as 'predatory'. Publishers of these journals are, quite simply, dishonest and just aim to make money by charging very heavy publication fees. They will accept articles with very questionable content and often have no peer review at all or a very improper one (Memon, 2019). Beall (2012) believes that because of growth of these types of journals genuine researchers and legitimate journals suffer the most. For researchers, especially the less experienced ones, getting their articles published in journals like these won't be much of a successful step towards expanding the reach of their ideas. And the 'good' journals now face a new kind of unhealthy trend in the publication business because of rise in unethical publication houses. When there are questionable publication houses in the market which offer a very small submission to publication time then for the 'good' journals, to stay in competition in this new market, the pressure to give prospective authors a much smaller submission to publication time only increases and this can negatively affect the whole peer review culture and might lead to creeping-in of some unethical practices even in 'good' quality journals (Beall, 2012).

Although Beall's list has been helpful to many researchers, it has been controversial and is not considered the final word when addressing the issue of ethics in research and questionable publication practices (Berger & Cirasella, 2015). The usage of the term 'predatory' has been especially criticized. It has been questioned that what exactly constitutes predatory behaviour in the publishing business. The word predatory actually covers a very broad spectrum of publication practices. At one end of this continuum are the less experienced and amateurish publication houses where younger, less experienced, but genuine scholars might submit their work. Probably the reviewers of these journals might not have the record of being rank holders of the universities they finished their degrees from, and they might not be ranked among the top twenty experts in the world in that field of study, but they still have good knowledge of the subject they will review. These publication venues can, at the most, be called low quality, but they don't have an intention to deceive. At the other end of this spectrum is a publishing house that deliberately misleads authors to make money and is not interested in the dissemination of knowledge of any kind (Berger, 2017). Probably in this kind of journal, no review at all might happen. Clubbing both of these types of journals or publication venues under the common term predatory is not an accurate description of things. Moreover, a large number of publication houses considered 'predatory' by Beall come from developing countries and some researchers feel that this might be because of a bias against non-western editorial boards (Emery, 2012). Further,

Berger and Cirasella (2015) believe that Jeffrey Beall doesn't have a very supportive view of the Open Access system itself. So Beall's list and the word predatory do have some significant criticisms that a modern researcher must know before making a strong conclusion and judging a journal.

## VII. Reference Management and Unique Identifiers

Any discussion of important concepts related to research publication will be incomplete without discussing reference management and unique identifiers. It will be an understatement to say that these concepts play significant roles in the universe of modern research publications. There was a time when references were simply written on small cards and stored in boxes (Fenner, Scheliga & Bartling, 2014). Reference management has come a long way since then. Reference managers are software packages that don't just allow all the scholarly publications relevant to one's work to be stored and managed digitally, but modern reference managers also do things like allowing retrieval of all kinds of citation-related information from online bibliographic databases (like SCOPUS), working together with word processing software (like MS Word) for easier and quicker in-text citation, sharing of reference information and provision of collaborative editing to all members of a small group of researchers working together on a single topic, etc. Reference managers rely on standard metadata formats like BibTeX and RIS. Almost all reference managers support one or both these formats and so switching from one reference manager to another is quite convenient. More importantly, making a backup of the reference list, which is totally independent of the reference manager software package one is currently using, is also possible. There are a lot of reference managers available today. The list includes EndNote, Mendeley, Zotero, RefWorks, CiteULike, etc. Mendeley is owned by Elsevier, and one of its remarkable features is the ease with which it can manage PDF files. Once a relevant PDF file gets imported into Mendeley, information like authors, title, etc., can be easily extracted by the reference manager. Another special feature of Mendeley is the recommendation of research papers to authors. This function is more or less similar to what an online shopping platform like Amazon does. On Amazon, often after buying a product X, a customer gets a notification that people who bought X also purchased Y. The recommendation system of Mendeley is somewhat similar. Other reference managers mentioned before (Zotero, EndNote, etc.) have their own set of special features, and no one is 'above' or 'better' than another. The choice of reference manager depends on the researcher. I have chosen to describe some features of Mendeley just to elaborate a point that modern reference management software packages are indeed helpful to researchers.

Unique identifier is another crucial concept that people involved in research should know and appreciate. Getting discovered in the sea of research publications is a challenge for any young researcher nowadays. The most common way, obviously, to identify someone is by his/her name, and traditionally researchers have been identified in the same way (Fenner & Haak, 2014). But this identification system is not reliable. Some names are very popular, and many people do change names (for example, often after marriage). Relying on an identification system based solely on names is not a good idea when decisions regarding grants and promotions are to be taken. A counter-argument can be made here that most interactions between researchers, nowadays, take place by simple online tools like email, videoconferencing, and other social media platforms, and emails do have a unique username, and so what's the need for an additional identifier. The concept being presented here is of a standard identifier which is widely recognized and used by different researchers, academic institutions, publishers, etc., and which connects the researcher with her/his work. Open researcher & Contributor ID (ORCID) is one such concept. The identifier is interdisciplinary and is not restricted to only one or a few disciplines. It's also not limited to any geographical area. When all research output –papers, monographs, books, data, etc. gets linked to a certain ORCID iD then not only identifying individual researchers in a more reliable way becomes possible, but it also saves valuable time of researchers as they do not have to spend hours on administrative activities. The usefulness of ORCID iD can be better understood in situations when one is required to properly communicate to a funder and is expected to be very careful when making a list of all relevant publications of any institution. Getting this unique digital identifier is absolutely free.

## VIII. Conclusion

The purpose of this article is to provide a brief overview of some of the most crucial concepts and issues associated with research publication. The world of research and research publication is a busy place these days. A lot of researchers are regularly presenting their ideas on appropriate platforms and are contributing to the generation of a lot of 'knowledge' very quickly. But before venturing out in this world and ensuring that their remarkable work finds a suitable venue, young researchers should acquaint themselves with some ideas and issues. The first among them is indexing. Indexing ensures that a journal is part of an online search system and is indeed discoverable. The quality or 'attractiveness' of an indexed journal is generally indicated by a metric like Impact Factor or Cite Score (or some other metric). Peer review is a very important part of the overall publication process and is the best source of constructive criticism. These days peer review scams do happen. Open access journals ensure free access to almost anybody, but they ask authors to pay heavier fees. The author-pays model can sometimes be a way to dupe researchers, and this is how a predatory journal runs its unethical business. The article closes with a short description of reference management packages and unique identifiers.

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# The utilization of “Awaiting Reports” option in Clinic Reconciliation Form and its impact over the overall Clinic Efficiency

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**Abstract-** The Consultant led specialist clinics are the main stay of treatment for patients referred by General Practitioners (GPs), on outpatient basis. NHS England has implemented a standard to reduce waiting time for those patients who are being referred for specialist clinics. 18 Week Maximum Waiting Time from Referral to Treatment means to patient as a right under the NHS Constitution to access services within maximum waiting time, unless choose to wait longer or it is clinically appropriate to wait longer. The NHS will take all reasonable steps to offer a range of alternative providers if this is not possible. Deviation from the set time on the clock may lead to additional cost to the provider organization by way of penalties.

The clinic reconciliation form is one of the main tools utilized in the documentation process of the patient care journey in a specialist outpatient clinic. There are several options available in the reconciliation form for a consultant to document his decision regarding patient care management. These clinic outcomes include “Booking follow-up appointment, Awaiting reports, Discharge patient back to GP, Discharge and Refer to other SFH consultant / AHP and Refer to another provider”.

“Awaiting reports option” is the method of reviewing patient’s investigation reports before discharging or booking a follow-up appointment. As no follow-up visit is booked before reviewing investigation reports, this option would mount to getting it right at first time (GIRFT) performance of the clinic. The 10% standard value was considered as the standard for the audit. The clinical outcomes of a total of 207 patients those who attended a consultant led clinic, as the first visits was analysed following the records and letters stored in the Winscribe software. Out of 207 patients, 100 (48.3%) patients have been discharged after reviewing reports without booking new follow up appointments and 24 patients (11.6%) were discharged from the clinic referring to another provider. Only 83 (40.1%) patients were booked new follow-up appointments after reviewing investigations reports. Therefore, the GIRFT was found to be 59.3% and this is very remarkable in the aspects of efficiency and effectiveness of clinic performances. Further, this option would invariably reduce the RTT as 59.3% of patients have been discharged from the clinic after the first visit.

**Index Terms-** Awaiting reports, Clinic efficiency, Consultant led clinics, Reconciliation form

## I. INTRODUCTION

Patients in England, by the NHS constitution, have the right to access certain services commissioned by NHS bodies within maximum waiting times, or for the NHS to take all reasonable steps to offer a range of suitable alternative providers should this is not possible. The constitutional standard of outpatient wait should be no longer than 18 weeks from GP referral to treatment. Trusts providing consultant led outpatient services are expected to adhere to this standard that is monitored nationally on regular basis by the NHS Improvement. Breaching the standard beyond to a level could make the trust liable for penalties to the Clinical Commissioning Group<sup>1,2,3,4</sup>.

The contemporary challenges that most NHS Trusts are confronted with such as lack of optimal clinical workforce, particularly for consultants, expectations of patients, communities and clinical commission groups, increasing number of referrals, and budgetary constraints, apply to Sherwood Forest Hospitals (SFH) as well. SFH provides services to a community of 420000 in Mid Nottinghamshire and adjacent parts of Derbyshire and Lincolnshire.

King’s Mill Hospital provides outpatient services for a population of 420,00 and from November 2016 to October 2017, King’s Treatment Centre has provided services for 518,039 outpatients. According to the Care Quality Commission (CQC) report published in August 2018, the e-referral system established in KMH has resulted in lack of clinic slot availability above the national target of 4% to 20%.<sup>6</sup> Therefore, it is vital to improve the clinic efficiency of the hospital.

Getting It Right First Time (GIRFT) aims to improve the care provided to the patients by identifying the best practices among the trusts and introduce those to other settings to minimize unwarranted variations in clinical practice and patient and trust performance outcomes<sup>5</sup>.

A range of measures have been proposed and implemented in UK, as well as globally, to improve the efficiency of outpatient clinics, by applying various principles to reduce direct consultations of specialists. These innovative measures are based on improving the outpatient system supported by strong and engaged clinical leadership to formulate and deliver a clear strategy, for supporting new outpatient service models using technology, underpinned by appropriately calculated costs and

adequately resourced plans. Approaches to be considered include adopting see-on-appearance of a symptom, and virtual clinic, use technology, allowing patients to self-manage their condition, avoid unnecessary travel, and to record and track outcomes. The proposed model includes incorporating the following into a bundle of strategies; E-clinical decision support for GP's, Patient initiated follow up, Group based follow up for some conditions versus individual appointments, PwSI model / community clinic model shifting care from hospitals to primary care, Nurse led OP care vs doctor led OP care, Technology – Telephone follow up, skype, video link & Tele care, Referral refinement – often used strategy in glaucoma, Identifying the super 6 of specialty, When patients are referred to OP clinics to implement a rapid assessment intervention and discharge (RAID) process and Dealing with inter-consultant and non GP referrals. In addition to these small changes in existing embedded process may result in changes to productivity and efficiency improving patient experience as well as promoting a better utilization of clinic resources.

After clinic attendance the clinician makes a decision as to whether a patient can be discharged with a clear care plan, referred onwards to a different specialist for treatment i.e. surgical, requires monitoring and observation over a period of time or requires further tests. Pre availability of such tests facilitates early diagnosis and initiation of treatment and may reduce need for follow up consultations.

At present the process in clinics is that first visit outcomes of patients referred to endocrinology clinic of the SFH by the GP are reconciled as "Booking follow-up appointment, Awaiting reports and Appointment to be given in later date, Discharge patient back to GP, Discharge and Refer to other SFH consultant / AHP and Refer to another provider"<sup>7</sup>. Consultants are required to determine these outcomes after consulting these patients.

First visits patients who are held on for awaiting reports under the outcome category of "appointment to be given at a later date" can be either discharged or referred to another provider without a follow up visit to endocrinology clinic once the reports are reviewed by the consultants. In such instances it as well contributes to the first visit outcomes. This could potentially save the time of the consultants that can be utilized to see more new patients. Also, it could reduce unnecessary visits of patients to hospital hence save their time and money. Holding on patients for awaiting reports rather than giving them another follow appointment can therefore be taken as a best practice contributing to GIRFT.

This study aims at describing the impact of awaiting reports in contributing to the first visit discharges at the endocrinology clinic of the SFH.

## II. AIMS

To Describe the impact of awaiting reports on the first visit discharges at a consultant led endocrinology clinic at King's Mill Hospital, SFH.

## III. METHODOLOGY

**Sampling:** 248 case notes of patients attended to a Consultant of the Endocrinology Clinic; whom reconciliation slips were marked as "Awaiting reports" were analyzed following the records and communication letters appearing in the Winscribe software. 207 patients out of 280 episodes were selected for study according to the inclusion criteria. Due to the duplication 33 episodes were excluded from the sample.

**Data collecting technique and study instruments:** The total sample of 207 patients who attended to the Endocrinology Clinic of a Consultant during year 2018 and 2019 were selected for this study. A data collection form was prepared under the guidance of the Supervisor and the sample was detailed by going through electronic record of clinic letters (EPRO) by accessing with permission to "Winscribe". Data were collected by reviewing all the communication letters from GP to Consultant and Consultant to GP. All the necessary information was extracted from the clinic letters and data collection form was completed.

A Specially designed excel sheet was used to enter and analyses the data. The different columns were designed to enter the Serial number, Date Referred by the GP, Clinic Appointment Date and Clinic outcome of the first visit.

**Data analysis:** The coding was done according for the clinic outcome of the first visit. (1 = Discharged, 2 = Follow-up and 3 = Refer to Another Provider). The data were analyzed and frequencies and percentages were calculated.

## IV. RESULTS

As a baseline assessment to define current practice we analysed a sample of 742 patients who were referred to the endocrinology clinic by the GPs in 2018/2019 revealed that "first visit discharge", "another appointment given today" or "appointment to be given at a later date" were 16.3%, 28.4% and 55.3% respectively. It was found that there were unwarranted variations in determining the outcomes of the patients among consultants.

A total of 207 patients were included in the study. All patients were categorized as "Awaiting Reports" after the first clinic visit. Out of 100 patients who were in the sample have been discharged from Endocrinology Clinic only after reviewing reports. This discharged patients' percentage was 48.3%.

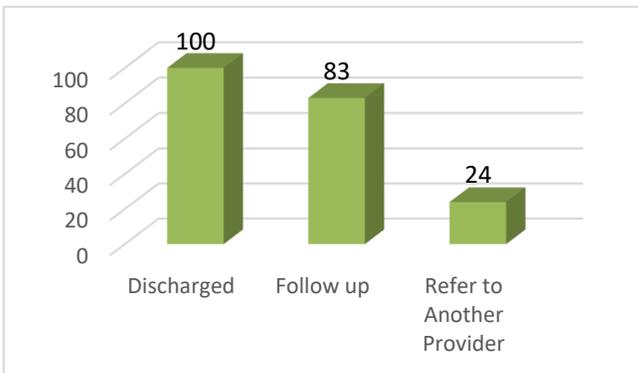
24 out of 207 patients were referred to another provider and their percentage was 11.6%. Only 83 out of 207 patients were booked with new follow-up appointments and this percentage was 40.1%.

There for, 124 out of 207 patients were discharged from the clinic and this percentage was 59.6%. this is the GRIFT performance of the clinic regarding "Awaiting Reports" option.

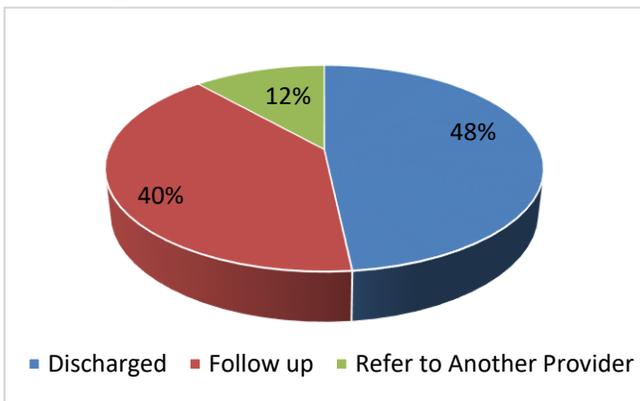
**Table 1: First Visit Clinic Outcome of Patients who were categorized as “Awaiting Reports” after the First Visit**

	Frequency	Percentages
Discharged	100	48.3%
Follow-up	83	40.1%
Refer to Another Provider	24	11.6%
Total	207	100%

**Figure.1.1 First Visit Clinic Outcome of Patients (Frequency)**



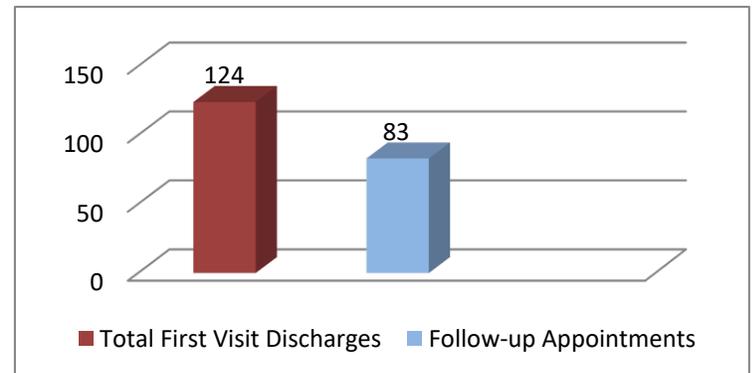
**Figure.1.2 First Visit Clinic Outcome of Patients (Percentage)**



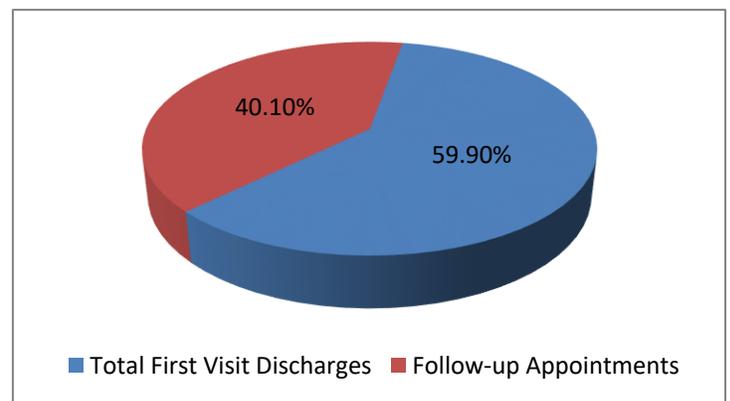
**Table 2: GIRFT of the First Visit Clinic Outcome of Patients who were categorized as “Awaiting Reports” after the First Visit**

	Frequency	Percentage
Total First Visit Discharges	124	59.9%
Follow-up Appointments	83	40.1%
Total	207	100%

**Figure.2.1 GIRFT of the First Visit Clinic Outcome of Patients (Frequency)**



**Figure.2.2 GIRFT of the First Visit Clinic Outcome of Patients (Percentage)**



## V. DISCUSSION AND CONCLUSION

“Awaiting reports” option is the method of reviewing patient’s investigation reports before discharging or booking a follow-up appointment. As no follow-up visit is booked before reviewing investigation reports, this option would mount to getting it right at first time (GIRFT) performance of the clinic<sup>6</sup>. The 10% standard value was considered as the standard for the audit. A total of 207 patients of a consultant led Endocrinology Clinic, King’s Mill Hospital were analysed using “Winscribe” software. Out of 207 patients, 100 (48.3%) patients have been discharged after reviewing reports without booking new follow up appointments and 24 patients (11.6%) were discharged from the clinic referring to another provider. Only 83 (40.1%) patients were booked new follow-up appointments after reviewing investigations reports. Therefore, the GRIFT was found to be 59.3% and this is very remarkable in the aspects of efficiency and effectiveness of clinic performances. Further, this option would invariably reduce the RTT as 59.3% of patients have been discharged from the clinic after the first visit.

It is revealed that the increased waits and hence prolonged RTT could be dealt with the appropriate use of reconciliation form documentation. A simple practice of ticking the “Awaiting Reports” option would dramatically increase the first-time discharges from the clinic. If the option is not selected and the sequela would be the booking of follow up appointment with the reports. This would invariably increase the follow up appointment requirement and hence prolonging the RTT. The number of patients who receive care at Sherwood increases year on year. In particular too many patients receive unnecessary outpatient appointments, which may not improve their health or wellbeing<sup>8</sup>. As the patient demand is persistently rising while the supply is limited, this study is an eye opener for utilizing existing system deal with the challenge to improve efficiency, quality, and productivity of the services<sup>9</sup>.

It is recommended to introduce this “Awaiting Report Option” as an essential path for patients who are needing follow-up appointments to review investigation reports and plan of management. Simply, the reports could be evaluated by the Specialist and inform relevant GP the management plan. This simple measure would reduce the patient burden to the clinic,

and it will also reduce the RTT of the patients.

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# Action research in Islamic education at primary schools in Bahrain

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**Abstract-** In order to accomplish, the objectives of the study and applies a variety of methods in the context of the existing research. I have perceived that qualitative research is the appropriate approach, as it enables me (as a researcher) to obtain a deeper understanding of the topic and thereby offers me a chance to explore the matters from the viewpoints of teachers and students; to discuss their interpretations and reflect on Problem Based Learning (PBL) in teaching and learning; as Flick (2009) argued that enhancing perceptions and the academics' reflects on their studies as part of the procedure of data construction. In the same light of the thoughts of Siegel (2002:1), confirms that the data in qualitative research does not approach by specific questions to answer or hypotheses to test but through " understanding behaviour from the subject's own frame of reference".

For achieving my main goal of developing students' higher thinking skills and abilities to face problems in primary school in Bahrain, I found Action Research (AR) is a suitable strategy for achieving my aim. The purpose of using AR in my research, was to generate new knowledge which can support into a new theory, develop learning and improve practice. Therefore, the research is furnished towards enhancing the processes of learning and teaching in Kingdom of Bahrain. Throughout the investigation, the researcher will use a multiple of research methodology to gather the data. In addition, the studies will be conducted in two stages to integrate theory and practice: The first stage, aims to investigate the teaching methods of IE in primary schools, in KB to identify the teaching method employed by the teachers and how it relates to the subject at hand. This section, demonstrate the current teaching methods in IE in KB, in order to discover the varieties of pedagogy by which Bahraini students are taught, this stage investigates the context: what's currently happening in classrooms? Data collected through face-to-face interviews with three sector Quality Assurance (QA), specialist supervisors in IE, and Islamic teacher in state schools. The second stage, the therapeutic stage, examines the impact of PBL on students taught via the 'Learning Pack' - which was designed based on the PBL approach. This stage, is managed by a multi-methods approach including: teachers' dairies, co-teaching, observation, weekly discussion with team teaching, initial focus group discussion, second focus group discussion plus face-to-face interviews with team teachers and students. In addition, a positivist measure will be used to augment the results through pre-tests and post-tests both of which provide additional measurements for the purpose of using numerical results, to help provide me with a complete view of the data and to support my understanding. The multiplicity of approaches assists me to easily organise and analyse unstructured

information. The investigation will take place in primary schools to boost students' and teachers' performance, in order to provide solutions to classroom issues. Hence, the research bases on qualitative approach and the test assess the students' higher thinking skills uses and the process of PBL.

**Index Terms-** Action Research, Islamic Education, Primary school

## I. INTRODUCTION

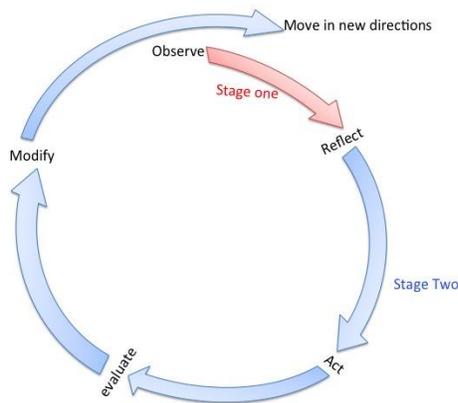
Action research (AR) is a suitable strategy for achieving the research objectives. As Richards and Farrell (2005:171), has mentioned that the word action research refers to "a systematic approach to carrying out investigations and collect information that is designed to illuminate an issue or problem and to improve classroom practice". Nixon (1981:92) indicates that AR is "qualitative rather than quantitative measurement" due to the fact that all qualitative research is similar; the researcher is responsible for generating interpretations and making decisions. nonetheless, Creswell (2012) evaluated action research by arguing that both quantitative and qualitative data should be collected to better analyse the problem.

Additionally, there various of advantages that AR comprehend: one of which Richards and Farrell (2005) and Creswell (2012) has mentioned it enables teachers to develop a deeper understanding of many issues in teaching and learning, as well as it acquires useful classroom investigation skill, which stage one will be focusing on. Another advantage, critique which Carr and Kemmis (1983)(cited in Somekh, 2006) stated that it is impossible to reflect on self-critique, while discovering the notion of this observation which is based on a critique, that prerequisites between the teachers, students and researchers, as the concept of reflexive critique targets to develop the ability of individuals to rationally appraise a given situation (Elliot, 1991; O'Brien, 1998). A further advantage of the AR cyclical process combines practice and research theory, as Smoekh (2005) indicate that the existing division between research and practice, could be overcome by AR. Also, the objective of educational action research, as observed by Servan et all (2009), is to enhance all aspects related to the educational process, including conditions contexts and outcomes. AR will help me explore the professional competence of the teaching team through subjective experience, as Richards and Farrell (2005) and Creswell (2012) emphasised that AR provide teachers with efficient skills through teachers reflecting on their own profession. Forbye, AR will serve as a new methodological

approach in KB. Ram Punia (2004), confirms that action research is not applied on a regular basis in developing nations. Organisations such as the United Nations have started to promote the production and use of local practical knowledge, which can be achieved based on action research methodology.

## II. THE STAGES PROCEDURE

The stages created accordingly to the object of the action-reflection cycle, that been designed by Whitehead and Mcniff (2012) presents two stages. Under stage one, there are two methods of observation and reflection. And under stage two, there are three stages Act, Evaluate and Modify. Those staged were organise according to the following of the study- see figure ( 1)



**Figure 1: action –research cycle**

As Richards and Farrell commented: “Data collected before the action research enables one to examine the issue or problem in depth in order to arrive at a way of addressing the problem. Data collected after the intervention will enable the teacher to decide if the action taken solved the problem” (2005: 180). Consequently, the first stage contemplates the current teaching methods in IE in KB in order to discover the varieties of pedagogy by which Bahraini students are taught. This stage investigates the context: what’s currently happening in classrooms? Data is collected through face-to-face interviews with three sector Quality Assurance (QA), specialist supervisors in IE and Islamic teacher in state schools. The second stage, the therapeutic stage, investigates and evaluates the impact of PBL on students taught via the ‘Learning Pack’, which was designed based on the PBL approach. This stage is managed using multi-methods approach including teachers’ dairies, co-teaching, observation, weekly discussion with team teaching, initial focus group discussion and second focus group discuss students. In addition, a rationalised measure will be used to enhance the results through pre-tests and post-tests, both of them provide additional measurements for the resolution of using numerical results, to provide with a complete view of the data. The multiplicity of approaches succours me to easily organise and analyse unstructured information.

(As it is shown from the image above I intend to return to work in education after completing my research to obtain in-depth understanding of the same or similar situation).

## III. SAMPLE

The current observation utilises a case-study; the research will be applied in primary schools, for girls and boys with a size sample at approximately 60 students in two classrooms with two teachers, AR can be carried out with a limited number of participants, even a single student (Fisher, 2012). The research focuses on a boy’s school and on a girl’s school; I will be involved in the research as a participant and an observer monitoring the students, as well as the research process. Moreover, the underlying premise of an action project is that the research has a chance to gain Information in-depth. One of the potential drawbacks of the current study is it as the research is locked into a specific time, location and a unique set of circumstances. It’s proper to acknowledge that findings from action research cannot be generalised, however, the validity is to examine a situation in greater detail, reaching the root of the issue, and thus enabling comparisons with other similar situations (Winter 2006; Fisher 2012).

## IV. DATA COLLECTION INSTRUMENTS

Throughout the observation, the researcher will use a multiple of investigation methods to gather the data. The study will be conducted in two stages to integrate theory and practice.

### 4.1 First Stage

The first stage aims to investigate the teaching methods of IE in primary schools in KB to identify the teaching method employed by the teachers and how it relates to the subject at hand. How can it be changed to enhance the learning process? What proof is there that the teaching method is filled with errors? Is the issue actually worthy of examination? - My intuition is that current teaching methods are not promoting high order thinking skills. It is worth noting here that my opinion about current educational methods is not arbitrary, but founded on my considerable experience as an educational professional.

This first stage of the research sets out to substantiate this hunch. Interviews will be conducted to collect data from the three sectors mentioned above. Three members from QA, eight from ‘Specialist supervisors’ and four Islamic teachers. The collection of data will help the researcher to evaluate whether these teaching methods are sufficient to develop critical thinking and problem-solving. The discovery will able to assist in explaining current teaching methods in IE in primary schools in Bahrain. Furthermore, Face-to-face interviews will be conducted to discuss the topic in depth. According to Hennink et al. (2011), the manner of gathering data ‘one-to-one’ involves an investigator and a candidate discussing the matter in depth. In addition, the study will include semi-structured interviews, which are “introduced by an open question and ended by a confrontational question and the relations formulated in these questions serve the purpose of making the interviewee’s implicit knowledge more explicit” (Flick, 2009:156-157). The interviews will be conducted in a triangular direction; The motive for selecting these three sectors includes the fact that QA is a separate authority from the MoE, which is intended to improve the quality of learning. Besides, specialist supervisors in IE supervise schools regularly and have

long experience in assessing the learning process. What's more, Islamic teachers have outstanding knowledge and information about this subject. The compilation of data from this triangular direction will lead to validity in this detection. Considerably, in terms of the ethical issues of this method, the researcher has to obtain permission and informed consent from the three sectors. The study will commit to the confidentiality of the interviews and the identities of the schools and teachers will remain anonymous.

#### 4.2 Second stage

In order to collect data to address the problem, the second stage will be managed using a multi-method approach. The 'Learning Pack' which will be run in stage two is devised as an intervention to address the problem. The purpose of the present study is to create a 'Learning Pack' based on PBL that will help students to develop a number of competencies, such as the ability to solve problems and development of higher thinking skills. As emphasised by Elliott (1991), Denscombe (2010) and Winter (2006a), researchers must exhibit the need for change to analyse and to assess a situation in order to enhance the learning process. The devised Learning Pack will take the form of an issue, which will be faced by the student - in which the problem serves as the stimulus for learning. Students will then use their problem-solving skills to find the legal provision independently without intervention from teachers according to the available evidence of the holy texts or with reference to a legitimate source if the information is not available in the Holy Quran and Sunnah.

A couple of limitation faces the new approach, which means that it's still uncertain what impact problem-based learning (PBL) will have on teachers and students alike. Nevertheless, the observation of Smith and Harland (2009) have revealed that teachers had positive attitudes towards PBL. Other limitations as a number of authors (Bernstein et al. 1995; Smith and Harland 2009; Creswell 2012; Winter 2006) have stated that it is highly important to carefully establish the considerations of the working relationship in order to allay the worries that individuals might have regarding a perceived absence of structure. However, prior to the implementation of the 'Learning Pack', the participant teachers requested the chance to evaluate it, thus becoming active arbitrators in the research. In the second stage, the preliminary outline of the research methodology included a number of methods.

##### 4.2.1 Co-teaching

AR approach basic on the concept of collaborative, this cooperation between the researcher and the two teachers, I will take the role of professional experiences and part insider in order to make better sense of the topic, acquire a deeper, wider view and obtain a comprehensive collection of evidence. As a competent theorist and practitioner-researcher, this approach can provide me with insight, while the role of participant teachers is to provide an insider perspective; the great significance of collaboration is the fact that it has the ability to attract other participants to actively engage in the research process (Richards and Farrell, 2005). Along the same lines of thought, Smoekh (2008) argued that the teachers selected to take part in research studies, not only contribute greatly to their academic institutions, but have possessed extensive knowledge and skills. Another core reason for using co-teaching in this study is the need to prevent the status of the individuals who

puts forth an idea from having a negative influence on the validity of that idea (O'Brien, 1998). A number of promoters of action projects advocate careful negotiation achieve this situation and the collaboration will be employed equally between the team workers. In accordance with Creswell's suggestion (2012), the teachers were all on an equal footing in the action research process, despite various power issues between the practitioners. For that reason, a theoretical researcher myself and a part insider I will support teachers with essential knowledge, in the form of a training course, in which could enhance the professional growth of the teachers, Somekh (2005) and Somekh et al. (2008) confirms that outside researchers who have an understanding of the professional context are boosted by other practitioners (teachers). Thereby, the training course will be run for two hours over five days. Likewise, the participant teachers are willing to cooperate with the researcher in teaching the new design and have undertaken a training course to assist them, in dealing smoothly with the procedure of solving problems, since they believe that change and creativity are required in this era. On the other hand, the teachers have an in-depth comprehension of their work and surroundings; thus, being better informed about their actions, practitioners can expand the knowledge base related to their profession (Somekh, 2006; Somekh et al., 2008). Other boundaries coincided with co-teaching, as revealed by Fisher (2012), is that many teachers find it difficult to combine research with professional practice, as this adds a considerable weight to their workload. Nevertheless, the objective of this study is to provide teachers with the opportunity to develop and consolidate their competences, as well as to implement diverse research methods on any given subject in their field of expertise. Besides, the study enables teachers to outline their own teaching methods by emulating the projects and applying them in different contexts (Richards and Farrell 2005). Being a new face in the classroom will affect teachers and students; however, to minimise my impact in the classroom. I will be alert the teachers and students that I will not collect data to examine, then I will be there to impartially, as far as possible, observe what happens.

##### 4.2.2 Observation

Another method that will be manoeuvred to collect data for this observation, as the focus is on the impact of PBL on students. This observation will be enacted by the practitioners (the researcher and teachers interchangeably), the focus of the observation will be on the role of the facilitator, the role of the student groups and learners and how processes of PBL are run. The team also perceive the mutual interactions and reactions in small groups and their participation in the whole-class discussion. The grouping of students will be based on the result of pre-tests and teachers' comments; teachers make use of their own perceptual patterns that they have developed over time to appraise the actions of the students (Nias 2006). To gather data directly from the observer's position, the observer will be located close to the groups to monitor the students. Data triangulation is able to offer a different perspective on the matter, as each individual has different nurture and life experiences (Nias 2006). Furthermore, data triangulation affords new insights into the matter, as it emphasises the incongruities between different perspectives, as well as within a single perspective. As noted by Grandau (2005), this endows action exploration with depth and expansiveness.

#### 4.2.3 Weekly discussion with cooperating teachers

Weekly discussion with two teachers in order to generate an in-depth practical apprehension of problems and to enable the creation of practical solutions to these issues, this technique will develop my cognisance of the difficult situations in practice and will promote forward thinking as well as effective changes in practice (Smoeckh, 2006; Creswell, 2012). In particular, the purpose of the weekly discussions is to structure the workflow and to determine and remedy any existing weak points in the learning process. Moreover, the verbal interim reports presented during the discussion meetings were intended to stimulate the participants to actively engage in the research process (Smoeckh 2006), as they were formulated not as final results but as a basis for continuing discussions (O'Brien, 1998).

#### 4.2.6 Face to face interviews with teachers and students

In order to obtain a wide and profound interpretation. Face-to-face interviews will be employed with the two teachers and the students. The student sample will be selected depending on the results of the tests, for example, I will select the learner whose result has changed considerably and the student whose outcome is unchanged to investigate the impact of the approach. Semi-structured interviews will help me understand other individuals' views. This process will be active after the test to assess teaching and learning using the PPL approach, to compare it with other teaching methods, and to detect its effect on the students. For instance: if there were any changes in students' behaviour and learning throughout the period? When did the changes occur? Was the effect negative or positive? Ultimately, drawing on the researcher's initial plan of the research process could lead to changes through implementation, (as I mention earlier) flexibility is inevitable in action research because we are working in live conditions, not controlled laboratory conditions, the techniques mentioned above may need to be conducted more than once; the researcher needs to take a subtle approach to obtain specific data. Taking into consideration, the mood of teachers and students may change due to work and study pressures.

Finally, after the evaluation of the impact of the PBL approach through the analysis of methods mentioned above, the purpose of the action project is to progress the findings through a sequence of periods in rotation between data-gathering and analysis (Winter, 2006a). From the results of the tests: is it possible to observe any changes? What is the extent of these changes? This provides the study with numerical results.

### V. DATA ANALYSIS

After the required information was gathered, analysing became the decisive phase. I will go through the research and the associated literature to guide the data analysis. A researcher diary will be maintained during the research to record all procedures and describe the atmosphere. The interviews in stage one will be recorded to ensure that no data are omitted. The analysis will be conducted using NVivo software to produce qualitative data. The programme will help the researcher to draw links, comparisons and sound conclusions from the data. The inductive method will be employed for the analysis of the data in the second stage. This method enables certain themes to be outlined through the

systematic reading of the entire body of data (Thomas, 2006, cited in Smith and Harland, 2009). Despite the fact that the number of 'concepts' may be significant, the limited number of scripts meant that the majority of ideas would not occur frequently. The inductive method is capable of de-constructing the scripts, generating an ordinary general interpretation (Winter, 2006b). The organisation of data by one set of data was then used to organise other data, the process consisting of alternating stages of data collection and examination (Winter, 2000b). Thus, the methodology requires repeated readings and intuition, with certain themes emerging from this process. As a result, a crucial structure of ideas will be generated based on the number of times they are recorded. In this way, more accurate and reliable results will be obtained. An action research report displays information about events organised in chronological order over a period of time (Winter, 2006a). The use of multi-methods and the continuing evaluation process in the current study will enhance the validity of this study; action research involves a constant process of accumulating and analysing data, generating interpretations, making decisions and assessments (Altrichter and Poach, 1989, cited in Somekh, 2006). As indicated by Somekh et al. (2008), hypotheses are substantiated directly through practice; they are not tested separately and then implemented in practice. The accumulated data will be employed in support of the formulated hypotheses. In addition, by applying the 'Learning Pack' in two different samples (two classrooms) from the population, comparisons with other similar cases will be carried out to enhance the validity and reliability of the proposed hypotheses even more. Another part of analysis quantities' data seems possible and useful. Consequently, a T-Test will be run to obtain these data. In general, this measures significances between the average groups before and after the application of the new approach and then measure each category of higher thinking skills and problem-solving skills. In time the researcher drew up an initial plan of the process of the examination which could be changed through implementation depending on the changing situations. Furthermore, the plans and methodology of AR are flexible and can be adjusted as the process of action research unfolds (Cohen 2010; Somekh and Lewin 2005), due to the fact that the actions of people are deeply embedded in everyday habits, created through time and are influenced by individual perceptions and beliefs (Somekh, 2006). O'Brien (1998) labels this principle 'Risk', arguing that this openness of interpretations and exchange of ideas may have a negative effect, but he argues that whatever the findings 'learning will take place' (P: 1). Eventually, the interpretations and findings from the second stage contribute to the evaluation of the first stage in terms of the effectiveness of the PBL approach, how it might enhance the learning process and how far it could mature the thinking skills of students.

### VI. ETHICS

Ethics is an important part of the study, in which the researcher has considered the matter. Anonymity, maintaining confidentiality plus protecting identities will be considered and applied throughout the research. Moreover, the study obtained permission from the authorities to conduct the research, including the observation, interviews and apply the new 'Learning Pack',

although they stipulated that the MoE would have to agree to the new 'Learning Pack' before its application.

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# Ethnobotanical survey & Conservation status of the herbs around Sri Nrusinghanath Temple, Bargarh, Odisha, India

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**Abstract-** Sri Nrusinghanath Temple, Odisha is an International tourist place for its religious importance along with diverse flora with hills, numerous waterfalls and springs. This area is covered by Gandhamardan forest range, the iconic medicinal plant forest mentioned in The Ramayana. Due to its unique biodiversity, government of Odisha has halted the exploration and mining activities in this place, which is otherwise one of the richest sources of Bauxite in Asia. Few studies were conducted previously to map the floras of Gandhamardan Hill forest range but none have attempted to map the floras around the temple. The present study is considered to assess the threat level to plants found around the famous Nrusinghanath Temple, Bargarh Odisha and its Ethnomedicinal use among the locals.

**Index Terms-** Bauxite, The Ramayana, Ethnomedicinal

## I. INTRODUCTION

India is blessed with a rich cultural diversity which is reflected in the formal and informal system of medicines that are practised in different states, different sects. AYUSH system of medicines is practised and wholeheartedly accepted for its century old proven records, high safety index & cost effectiveness. Out of AYUSH, the siddha system is practised mostly in Tamil Nadu. Unani system is practised among all but especially Muslim communities, Yogais incorporated in Metros as part of lifestyle. This is one example of diversity of different systems of medicines in India.

In Odisha the biological diversity is found everywhere & specially in Northern & Western Odisha. Western Odisha is blessed with many biological hotspots and one among them is The Gandhamardan Hill forest range. It is quite famous among tourists and researchers for its diverse flora. Every year hundreds of researchers from many Premier institutes such as ILS, IPS Bhubaneswar (Odisha) IMS, BHU(Varanasi), IPGTRA (Jamnagar), AIIA(Delhi), BSI(Kolkata) etc visits here to witness the flora and to get their research material. Here we have tried to

map the floras (herbs) around the Site at the bottom of hill, around the religious site.

The geographical location of Nrusinghanath Temple is 21.178583°N, 84.452080°E<sup>1</sup>. This place was also the centre of Buddhist scriptural learning centre according to Huen Tsang, the famous Chinese traveller<sup>2</sup>. Bargarh district is home to many indigenous tribes and these peoples use herbal medications as the first line of treatment from forest healers or Baidyas or Folklore physicians. These Folklore practitioners use plants from the adjoining forest for treatment purpose. The collections are mostly unscientific in nature which may lead to partial loss of few floras. So, it is aimed to survey the area and report the threat level of the flora so as to devise new policies based on this data.

## II. MATERIAL & METHODS

Field trips were arranged for moving to different areas around the temple during this study period. The local healers, folklore practitioners, temple priests, and old persons of this area were interviewed to record the ethnobotanical use of surveyed plants and their local names were recorded. The plants collected were identified with the help of the flora books (HH Haines, 1921-1925 & Brahmam, Saxena, 1994-1996). The latest botanical nomenclatures were crosschecked with <https://www.theplantlist.org> for authenticity. The herbarium specimen was deposited in the Dravyaguna department Herbarium store, SSN Ayurveda college & RI, Paikmal.

## III. RESULTS

The collected specimen species were enumerated below in a table format. A total of 160 numbers of species were recorded. Few species were planted earlier and rest are wild, propagated naturally from the reserve forest. Few aquatic plants were seen and were duly recorded. The folklore therapeutic uses were mentioned & the collected flora was labelled according to their conservation status.

**Table 1.**

SR NO	NAME SANS/LOCAL	BOTANICAL NAME	FAMILY	STATUS
1	Somalata	<i>Sarcostemma acidum</i> (Roxb.)	Apocynaceae	Endangered
2	Sumerkhai	<i>Byttneria herbacea</i> (Roxb.)	Malvaceae	Threatened
3	Shati	<i>Curcuma zedoaria</i> (Christm.) Roscoe.	Zinzeberaceae	Threatened
4	Haridra	<i>Curcuma longa</i> L.	Zinzeberaceae	Data deficient
5	Krishna haridra	<i>Curcuma caesia</i> (Roxb.)	Zinzeberaceae	Critically endangered
6	Brihat ela	<i>Amomum subulatum</i> (Roxb.)	Zinzeberaceae	Data deficient
7	Tulsi	<i>Oscimum tenuiflorum</i> L.	Lamiaceae	Vulnerable
8	Dahana	<i>Ocimum basilicum</i> L.	Lamiaceae	Vulnerable
9	Sadabahr(p)	<i>Catharanthus roseus</i> var. <i>angustus</i>	Apocynaceae	Endangered
10	Sadabahr(w)	<i>Catharanthus roseus</i> var. <i>albus</i>	Apocynaceae	Endangered
11	Shala parni	<i>Desmodium gangeticum</i> (L.) DC.	Fabaceae	Vulnerable
12	Prishna parni	<i>Uraria picta</i> (Jacq.) DC.	Fabaceae	Vulnerable
13	Mashaparni	<i>Teramnus labialis</i> (L.f.) Spreng	Fabaceae	Vulnerable
14	Nili	<i>Indigofera tinctoria</i> L.	Fabaceae	Vulnerable
15	Sarapunkha	<i>Tephrosia purpurea</i> (L.) Pers	Fabaceae	Vulnerable
16	Gunja (White)	<i>Abrus precatorius</i> L.	Fabaceae	Endangered
17	Gunja (Red)	<i>Abrus precatorius</i> L.	Fabaceae	Endangered
18	Gunja (Black)	<i>Abrus precatorius</i> L.	Fabaceae	Endangered
19	Aparajita(n)	<i>Clitoria terniata</i> L.	Fabaceae	Vulnerable
20	Aparajita (White)	<i>Clitoria terniata</i> L.	Fabaceae	Vulnerable
21	Bverberihati	<i>Solanum indicum</i> L.	Solanaceae	Susceptible
22	Kantakari	<i>Solanum surattense</i> Burm. F.	Solanaceae	Endangered
23	Bharangi (1)	<i>Clerodendrum indicum</i> (L.) Kuntze.	Verbenaceae	Vulnerable
24	Bharangi (2)	<i>Clerodendrum serratum</i> (L.) Moon	Verbenaceae	Vulnerable
25	Danti	<i>Baliospermum montanum</i> (Willd.) Muell-Arg	Euphorbiaceae	Vulnerable
26	Dravanti	<i>Jatropha glandulifera</i> Roxb.	Euphorbiaceae	Vulnerable
27	Aswagandha	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Endangered
28	Patalagaruda	<i>Cocculus hirsutus</i> (L.) Diels	Menispermaceae	Endangered

29	Dhanwantari	<i>Cymbopogon citratus</i> (DC.)	Poaceae	Least concern.
30	Surana	<i>Amorphophallus campanulatus</i> (Roxb.) Blume ex Decne.	Araceae	Least concern.
31	Chitraka(s)	<i>Plumbago zeylenica</i> L.	Plumbaginaceae	Vulnerable
32	Chitraka(r)	<i>Plumbago indica</i> L.	Plumbaginaceae	Endangered
33	Tanduliyaka	<i>Amaranthus spinosum</i> L.	Amaranthaceae	Least concern
34	Palua	<i>Maranta arundinaceae</i> L.	Marantaceae	Vulnerable
35	Churia kanda	<i>Eulophia laura</i> Lindl.	Orchidaceae	Endangered
36	Vana palandu (r)	<i>Urginea indica</i> (Roxb.) Kunth	Liliaceae	Vulnerable
37	Musta	<i>Cyperus rotundus</i> L.	Cyperaceae	Least concern
38	Nakchini	<i>Centipeda orbicularis</i> Lour.	Asteraceae	Least concern
39	Mundi/Bhumi - kadamba	<i>Sphaeranthus indicus</i> Linn.	Asteraceae	Least concern
40	Kokilakshya	<i>Astercantha longifolia</i> (L.) Nees.	Acanthaceae	Least concern
41	Kaphgajari	<i>Aclypha indica</i> L.	Euphorbiaceae	Data deficient
42	Telia kand	<i>Remusatia vivipara</i> (Roxb.) Schott.	Araceae	Least concern
43	Gandha sunthi-1	<i>Hedychium spicatum</i> (Ham-ex-Smith)	Zinzeberaceae	Endangered
44	Gandha Sunthi-2	<i>Hedychium spicatum</i> (Ham-ex-Smith) species.	Zinzeberaceae	Endangered
45	Kebuka- 1	<i>Costus speciosus</i> (J. Koenig) Sm.	Zinzeberaceae	Threatened
46	Kebuka -2	<i>Costus speciosus</i> (J. Koenig) Sm.	Zinzeberaceae	Threatened
47	Ushira	<i>Vitiveria zizanioides</i> (L.) Nash.	Poaceae	Threatened
48	Stevia	<i>Stevia rebaudiana</i> Bertoni	Asteraceae	Vulnerable
49	Jyotishmati	<i>Celastrus paniculatus</i> Willd.	Celastraceae	Vulnerable.
50	Meshasringi	<i>Gymnema sylvestris</i> (Retz.) Schult.	Apocynaceae	Endangered
51	Pippali(small)	<i>Piper longum</i> L.	Piperaceae	Endangered
52	Pippali (Big)	<i>Piper chaba</i> Hunter	Piperaceae	Endangered
53	Pippali Mula	<i>Piper longum</i> L.	Piperaceae	Endangered
54	Gajapippali	<i>Scindapsus officinalis</i> (Roxb) Schott.	Araceae	Vulnerable
55	Trivrit (Sweta)	<i>Operculina tupethum</i> (Linn) Silva Manso	Convolvulaceae	Endangered
56	Trivrit (Rakta)	<i>Operculina tupethum</i> (Linn) Silva Manso	Convolvulaceae	Endangered
57	Vacha	<i>Acorus calamus</i> . (AC) Linn.	Araceae	Endangered
58	Ghoda Vacha	<i>Alpinia galanga</i> (L.) Willd.	Zinzeberaceae	Endangered
59	Amra haridra	<i>Curcuma amada</i> Roxb.	Zinzeberaceae	Vulnerable
60	Kakamachi	<i>Solanum nigrum</i> L.	Solanaceae	Data deficient

61	Tankari	<i>Physalis minima</i> L.	Solanaceae	Data deficient
62	Kakajangha	<i>Peristrophe bicalyculata</i> (Retz.) Nees	Acanthaceae	Not evaluated
63	Gandhaprasarani	<i>Paederia foetida</i> L.	Rubiaceae	Not evaluated
64	Langali	<i>Glorisa superba</i> L.	Colchicaceae	Rare.
65	Asthi srimkhala	<i>Cissus quadrangularis</i> L.	Vitaceae	Vulnerable
66	Jeevanti	<i>Leptadenia reticulata</i> (Retz.) Wight	Apocynaceae	Threatened
67	Bishalyakarani	<i>Tridax procumbens</i> L.	Asteraceae	Threatened
68	Arka puspi	<i>Holostemma ada-kodien</i> (Schult.)	Apocynaceae	Endangered
69	Kalamegha	<i>Andrographis paniculata</i> (Burm.fil.) Nees	Acanthaceae	Endangered
70	Satyanasi	<i>Argemone mexicana</i> Linn.	Euphorbiaceae	Least concern
71	Mandooka parni	<i>Centella asiatica</i> L.	Apiaceae	Vulnerable
72	Bramhi	<i>Bacopa monnieri</i> L.	Plantaginaceae	Vulnerable
73	Palandu	<i>Allium cepa</i> L.	Amaryllidaceae	Data deficient
74	Lasuna	<i>Allium sativum</i> L.	Amaryllidaceae	Data deficient
75	Ghritakumari	<i>Aloe vera</i> (L.) Burm.f.	Liliaceae	Vulnerable
76	Chopchini 1	<i>Smilax china</i> L.	Liliaceae	Critically endangered
77	Parna yavani	<i>Coleus amboinicus</i> Benth.	Lamiaceae	Susceptible
78	Mastaksha	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Amaranthaceae	Data deficient
79	Pita saag	<i>Glinus oppositifolius</i> (L.) Aug.DC.	Molluginaceae	Vulnerable
80	Changeri	<i>Oxalis corniculata</i> L.	Oxalidaceae	Least concern
81	Sahadevi	<i>Vernonia cinerea</i> L.	Euphorbiaceae	Least concern
82	Raja patha	<i>Cyclea peltate</i> Hook. f. & Thoms.	Menispermaceae	Vulnerable
83	Vridhdadaruka	<i>Argyreia nervosa</i> (Burm.fil.) Bojer	Convolvulaceae	Critically endangered
84	Gojihva	<i>Elephantopus scaber</i> Auct.non L.	Boraginaceae	Least concern.
85	Madhavi	<i>Hiptage benghalensis</i> (L.) Kuntze.	Malpighiaceae	Invasive weed.
86	Bhringaraja white	<i>Eclipta alba</i> L.	Asteraceae	Least concern
87	Bhringaraja yellow	<i>Wedelia chinensis</i> Osbeck.	Asteraceae	Least concern
88	Ayappan	<i>Ayapana triplinervis</i> (Vahl) R.M. King	Asteraceae	Data deficient
89	Kanisiri	<i>Commelina benghalensis</i> L.	Commelinaceae	Least concern
90	Vakuchi	<i>Psoralea corylifolia</i> L.	Fabaceae	Endangered
91	Gokshura (Big)	<i>Pedaliium murex</i> L.	Pedaliaceae	Threatened
92	Sariva	<i>Hemidesmus indicus</i> (L.) R.Br.	Apocynaceae	Susceptible

93	Krushna sariva	<i>Ichnocarpus frutescens</i> (L.) W.T. Aiton	Apocynaceae	Susceptible
94	Bhumi amalaka	<i>Phyllanthus niruri</i> L.	Euphorbiaceae	Susceptible
95	Shatavari	<i>Asparagus racemosus</i> Willd.	Liliaceae	Threatened.
96	Barahi kanda	<i>Dioscorea bulbifera</i> L.	Diascoreaceae	Vulnerable
97	Vidari kanda	<i>Pueraria tuberosa</i> (Willd.) DC.	Fabaceae	Susceptible
98	Parpataka	<i>Fumaria indica</i> (Hauskn.) Pugsley.	Fumariaceae	Threatened
99	Dronopuspi	<i>Leucas cephalotes</i> (Roth.) Spreng	Lamiaceae	Data deficient
100	Adha puspi	<i>Tricodesma indicum</i> (L.) R.Br.	Boraginaceae	Data deficient
101	Shiva lingi	<i>Bryonia laciniata</i> Linn.	Cucurbitaceae	Data deficient
102	Murba	<i>Marsdenia tenacissima</i> Wight. & Arn.	Asclepiadaceae	Vulnerable
103	Lazzalu	<i>Mimosa pudica</i> L.	Mimosaceae	Vulnerable
104	Hastikarna palasha	<i>Butea frondosa</i> K.D. Koenig ex Roxb.	Fabaceae	Endangered
105	Latakasturi	<i>Hibiscus abelmoschus</i> Medik.	Malvaceae	Endangered
106	Guduchi	<i>Tinospora cordifolia</i> (Willd.) Miers.	Menispermaceae	Vulnerable
107	Uturali	<i>Pergularia daemia</i> (Forsskal) Chiov.	Apocynaceae	Susceptible
108	Apamarga	<i>Achyranthes aspera</i> L.	Amaranthaceae	Least concern
109	Vanya haridra -1	<i>Curcuma aromatica</i> Salisb.	Zinzeberaceae	Threatened.
110	Mahakala	<i>Trichosanthes bracteata</i> (Lam.) Voigt.	Cucurbitaceae	Data deficient
111	Patra sizu	<i>Euphorbia thymefolia</i> L.	Euphorbiaceae	Not evaluated
112	Sapta pheni	<i>Opuntia dillenii</i> (Ker Gawl.) Haw.	Cactaceae	Least concern
113	Vamsi gopala	<i>Peucedanum nagpurensis</i> (C.B Clarke)	Apiaceae	Endangered
114	Girel	<i>Indigofera cassioides</i> DC.	Fabaceae	Data deficient
115	Punarnava	<i>Boerhaavia diffusa</i> L.	Nyctaginaceae	Threatened
116	Barshabhu	<i>Trianthema portulacastrum</i> L.	Aizoaceae	Not evaluated
117	Hulhulia	<i>Gynandropsis gynandra</i> L.	Cleomaceae	Not evaluated
118	Parna veeja 1	<i>Bryophyllum pinnatum</i> (Lam.) Kurz.	Crassulaceae	Data deficient
119	Chakra marda	<i>Cassia tora</i> Linn.	Fabaceae	Least concern
120	Datura	<i>Calotropis procera</i> (Aiton)	Apocynaceae	Vulnerable
121	Sweta mushali	<i>Chlorophytum borivilianum</i> Linn.	Asperagaceae	Vulnerable
122	Krishana mushali	<i>Curculigo orchoides</i> Gaertn.	Hypoxidaceae	Endangered
123	Mayura chulia	<i>Elephantopus scaber</i> Linn.	Asteraceae	Not evaluated
124	Bala	<i>Sida cordifolia</i> Linn.	Malvaceae	Least concern

125	Badhuani bala	<i>Sida acuta</i> Burm.	Malvaceae	Least concern
126	Ghusuri bala	<i>Sida prostate</i> Linn	Malvaceae	Least concern
127	Ashadhua	<i>Capparis zeylenica</i> L.	Capperidaceae	Threatened
128	Jala Lavanga	<i>Ludwigia octovalvis</i> (Jacq.)	Onagraceae.	Least concern
129	Gopa kanhu	<i>Cryptolepis buchmanii</i> . Romer & Schultes.	Apocynaceae	Least concern
130	Chakra kedar	<i>Anamirta cocculus</i> (L.) Wight & Arn.	Menispermaceae	Threatened
131	Rakta mahajala	<i>Lygodium flexuosum</i> (L.) Sw.	Lygodiaceae	Least concern
132	Kukurungu	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae	Least concern
133	Pani bael	<i>Cissus repanda</i> Vahl.	Vitaceae	Rare
134	Rasna	<i>Pluchea lanceolata</i> L. (Oliver & Hiern)	Asteraceae	Endangered
135	Rasna	<i>Pluchea indica</i> (L.) Less.	Asteraceae	Endangered
136	Rasna zadi	<i>Blepharispermum Subsessile</i> DC.	Asteraceae	Endangered
137	Rasna (vanda)	<i>Vanda roxburghii</i> R. Br	Orchidaceae	Endangered
138	Dayana.	<i>Artemisia vulgaris</i> L.	Asteraceae	Vulnerable
139	Kapikachhu 1	<i>Mucuna pruriens</i> (L.) DC.	Fabaceae	Threatened.
140	Kapikachhu 2	<i>Mucuna bracteata</i> (L.) DC.	Fabaceae	Least concern.
141	Saireyaka	<i>Barleria prionitis</i>	Acanthaceae	Threatened.
142	Pasanaveda1	<i>Bergenia ligulata</i>	Saxifragaceae	Critically endangered
143	Pasanaveda 2	<i>Aerva lanata</i> (L.) Juss. ex. Schult.	Amaranthaceae	Critically endangered
144	Muturi	<i>Smilax zeylenica</i> L.	Liliaceae	Vulnerable
145	Mendha mund	<i>Wattakaka volubillis</i> (L.fil). Stapf.	Apocynaceae	Threatened
146	Mudga parni	<i>Vigna trilobata</i> (L.) Verdc.	Fabaceae	Least concern
147	Pudina	<i>Mentha spicata</i> L.	Lamiaceae	Least concern
148	Dhanyaka	<i>Coriandrum sativum</i> L.	Apiaceae	Data deficient
149	Mithipatti	<i>Scoparia dulcis</i>	Plantaginaceae	Data deficient
150	Khela Ghas	<i>Dactyloctenium aegyptium</i> (L.) Willd	Poaceae	Not Evaluated.
151	Phuli jhadu	<i>Thysanolaena maxima</i> (Roxb.) Kuntze.	Poaceae	Not Evaluated.
152	Gokshura (Small)	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Threatened
153	Patha	<i>Cissampelos pareira</i> L.	Menispermaceae	Vulnerable
154	Ana sorisha	<i>Cleome gynandra</i> L.	Cleomaceae	Vulnerable
155	Sanapuspi	<i>Crotalaria hirsuta</i> Willd.	Fabaceae	Vulnerable
156	Mahabala	<i>Abutilon indicum</i> (L.) Sweet.	Malvaceae	Endangered

157	Gandhia ghch	<i>Ageratum conyzoides</i> L.	Fabaceae	Vulnerable
158	Nakali bhringaraj	<i>Eclipta prostate</i> (L.) L.	Asteraceae	Data deficient.
159	Dam buti	<i>Tylophora indica</i> (Burm.f) Merr.	Apocynaceae	Endangered
160	Telegraph plant	<i>Codariocalyx motorius</i> (Houtt.) H	Fabaceae	Endangered

#### IV. RESULT & DISCUSSION

Biological richness of any area plays a vital role in determining its social, economic, cultural and ethnic identity. The floral diversity of this area is very unique in nature and, this is incorporated in the lifestyle of local populations. This area in the Nrusinghnath forest division is completely unexplored from floristic (Herbs) & from its conservation status. Total 160 herbs were collected and recorded. Leaves were used the most at 73%, whole plant is 2<sup>nd</sup> most used at 18%, Seeds & flowers were used at 7% & tubers are used at 2%. Total 45 numbers of different family were found to be involved & Fabaceae family is predominant with maximum representation with 23 times. The present paper highlights 34 Endangered plant species, 18 Threatened, Critically Endangered 5, Vulnerable 38, Rare 2, Susceptible 7, Least concern 28, Invasive weeds 1, and 8 plant species which are not evaluated yet.

The present study put into record of some novel use of medicinal plants not mentioned anywhere, e.g. Resin of *Boswellia serrata* used for leucorrhoea, the black variety of *Smilax zeylenica* used for Poly Cystic Ovarian Disorders, the bark of *Alstonia scholaris* decoction as immunobooster, Treatment of marital discord by the telegraph plant, the young leaves of *Chlorophytum borivilianum* is used to treat loss of libido, Root of *Pueraria tuberosa* is used to enhance lactation and to treat hydrocoele. Etc.

#### V. CONCLUSION

Increasing demand and unscientific collection & annual forest fire are responsible for destruction of medicinal herbs which leads to its extinction in future. What is observed, the most destructive aspect being the forest fire. The fire remains for months mainly from April to June and repeated forest fire increases the alkalinity of soil which is not be very ideal for regrowth of herbs and care must be taken at higher level to prevent and control these dwindling immensely valuable herb species.

**Conflict of Interest:** Nil

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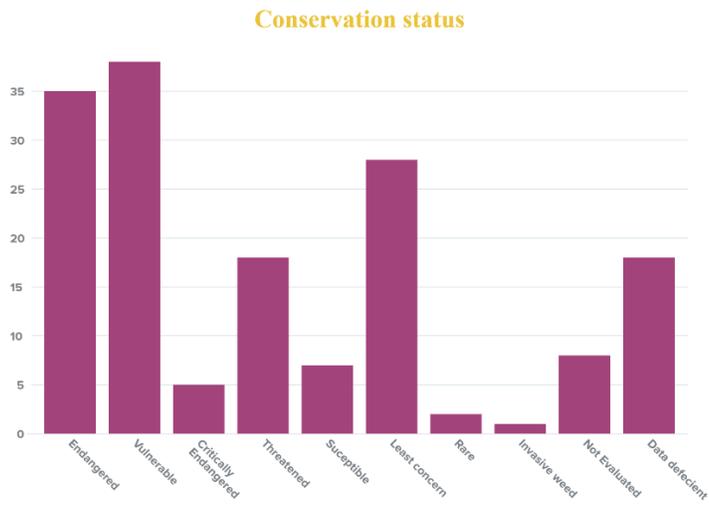
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Graph 1.



# A Comparative Study of Unemployment in India and USA

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**Abstract-** Unemployment is a major problem in India. There are various factors that are the causes for this problem. The Government has taken various steps with regard to curb this problem. But then also this is increasing day by day. The present research has shown the status of unemployment in India, its comparison with USA, the status of educational unemployment, the rate of unemployment prevailing in various states and union territories of India, the growth of population and various types of unemployment prevailing in India. The paper has also tried to give some suggestions to fight with this problem. Continuous efforts are needed to get rid of this problem.

**Index Terms-** Unemployment, USA, India, Employment, Population.

(CMIE), the unemployment rate rise to 7.2% in 2019, the worst in 28 months. The total no. of employed person in India in 2019 is estimated at 400 million as compared to 406 million in 2018 and 407.5 million in 2017. The Labour Force Participation Rate in India fell from 43.2% in Jan.2019 to 42.7% in Feb.2019. While the total no. of employed person in USA in 2019 is about 156.95 million as compared to 155.21 million in 2018 and around 153.34 million in 2017. The Labour Force Participation Rate of USA in Jan.2019 & Feb.2019 is same is 63.20%.

There are many factors which are the reason for unemployment such as caste system, slow economic growth, population increment, agriculture as seasonal occupation, joint family system, slow growth of Industrialisation, imbalance of saving and investment, expansion of universities, gap between the supply and demand of labour and immobility of labour.

## I. INTRODUCTION

Unemployment is also known as joblessness. This is the situation of actively looking for employment, but not being currently employed. It is increasing day by day in India. In India, every people want to do a real job in their life but only some person is getting their satisfying jobs. It is the biggest problem behind the Indian poverty. It is one of the biggest challenges for Indian Government to curb it.

There are several causes behind this problem like day by day increasing population, joint family system, only one earner in a family, slow economic growth, agriculture: a seasonal occupation etc. In today's time, many companies do not want to spend their time and money in giving training to freshers. So, they appoint experienced persons as their employees. This results in unemployment. It is one of the main reasons behind decrease in development rate of any country. India has second highest population after China in the world. Population of India is increasing day by day and this is also one of the reasons behind increasing unemployment as all people do not get their satisfied jobs. The current population of India is 1364736834(2019) based on United Nations' estimates which is equivalent to 17.74% of total world population and unemployment rate of India (2019) is 7.2% . While the current population of USA is 328462485(2019) based on latest United Nations' estimates which is equivalent to 4.27% of total world population and unemployment rate of USA (2019) is 3.8%.

This problem results in increasing criminal activities, low standard of living, low economic development, less growth in GDP & national income of our country, poverty etc. According to data compiled by the Centre for Monitoring Indian Economy

## II. REVIEW OF LITERATURE

Kumar Ashwani (2016) studied that unemployment in India was a serious social issue. He also stated that unemployment reports in India were kept by Ministry of Labour & Employment of India. He told about various types of unemployment, its causes & some solutions to curb it. Jabir Hasan Khan & Shamshad (2012) found that the level of unemployment was high in Northern Parts of India as compared to Southern Parts of India. They discovered the connection between unemployment (dependent variable) & socio-economic variables of deprivation (independent variables) in India. According to NSS (66<sup>th</sup> round) report from Ministry of Statistics & Programme Implementation, Government of India (2013) Kerala had the highest unemployment rate while Rajasthan and Gujarat had the least unemployment rate.

Ritu and Naresh Kumar (2013) analysed that Indian economy is the third largest economy in the world but at the same time its growth is very slow. At the end, they concluded that unemployment can be reduced by expansionary fiscal policies. Kirandeep Kaur (2014) focused on the relationship between unemployment, GDP Growth Rate, inflation rate and exchange rate in India. Data collection was done from secondary data like World Bank, Reserve Bank and Economic Survey of India from 1990 to 2013. This article concluded that inflation rate and exchange rate were suggestively affecting the unemployment. Bhavika Joshi and Serene Shek Nher (2015) focused on finding factors of unemployment, rural and urban unemployment scenario of India. As per the article, projected global youth unemployment rate was 12.6%. India takes seventh place in unemployment as compared to other countries in the world. The estimated rural and

urban unemployment was 16% and 34% respectively. This study concluded that the entrepreneurship would reduce the unemployment in India and it would lead to economic growth in India. Elena Philip and Anthonia K. Robin (2015) analysed globalization, Indian economy, employment and unemployment in India. As per the study, there were around 550 million people working as employees worldwide and at the same time 20% of employees were working as working poor in various situations around the world. Their daily wages were less than \$1. This report showed that there is 2.8% of open unemployment and 4.41% of under unemployment. Overall unemployment rate was 7.32%. The Jawahar Rozgar Yojana & the Prime Ministers Gram Rozgar Yojana would hope to reduce the level of under unemployment.

UN ILO Report (2017) opined that in percentage terms, unemployment rate will remain at 3.4% in the year of 2017-2018 like as unemployment rate 3.8% in the year of 2011-2012. It was concluded that inflation & unemployment were positively associated with each other. Singh (2018) studied that inflation was found as insignificantly influential for GDP & unemployment with negative correlation. She concluded that inflation possess a role which is influential but for GDP and unemployment with insignificant levels in macroeconomic factors of India. Singh Rubee (2018) stated that India has 17.5% population of the world & 1.21 crore people according to Indian Census of 2011. The

research study by various charts and data proved that unemployment is a major problem in India. It is one of the big challenge in the way of development of India. According to report Tripura has highest unemployment & Gujarat has least unemployment.

### III. RESEARCH METHODOLOGY

Our research methodology requires gathering relevant data from the specified documents & compiling databases in order to analyse the material arrive at a more complete understanding. We tried to shed light on the questions through my study. The present study is explanatory and descriptive. Data has been collected from secondary sources such as articles, journal and internet. Bar diagrams and percentage method has been used for analysis the data.

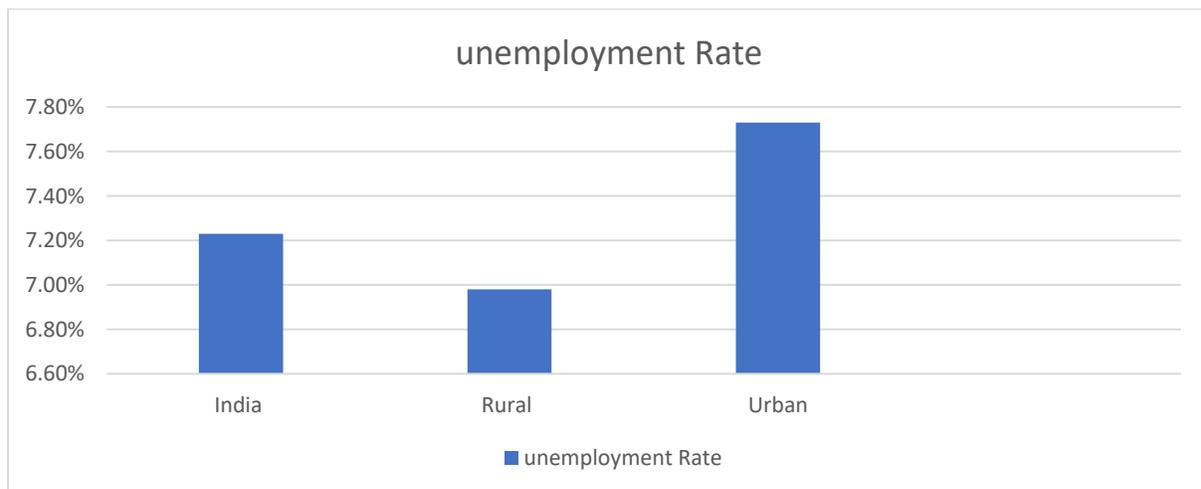
Following are the main objectives of this study:-

- 1) To study the scenario of unemployment in India.
- 2) To compare the unemployment in India with that in USA.

### IV. DATA ANALYSIS AND INTERPRETATION

#### A. Unemployment rate in India

Month	India Unemployment Rate	Rural Unemployment Rate	Urban Unemployment Rate
Feb 2019	7.23%	6.98%	7.73%



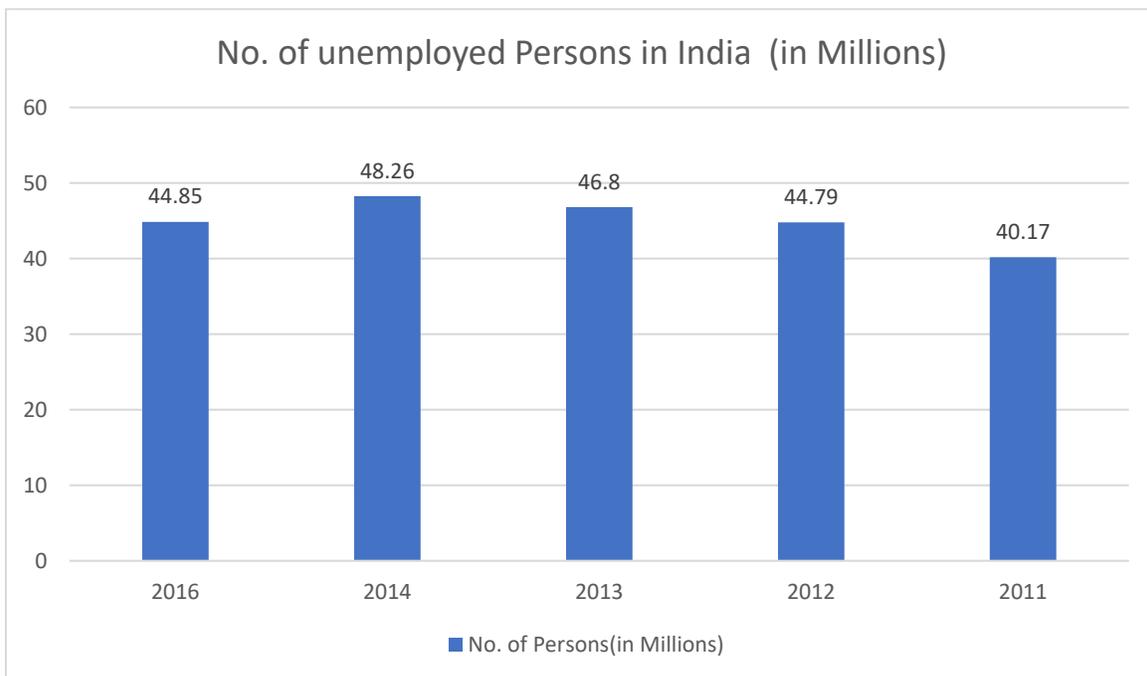
Interpretation:-

The above table and diagram helps us to interpret following points:

- The unemployment rate in India is 7.23% .
- The rural unemployment rate in India is 6.98% while urban unemployment rate in India is 7.73% .
- This means that the unemployment in urban areas is more than that in rural areas.

B. Unemployed persons in India across different years

Year	No. of Persons(in Millions)
2016	44.85
2014	48.26
2013	46.80
2012	44.79
2011	40.17



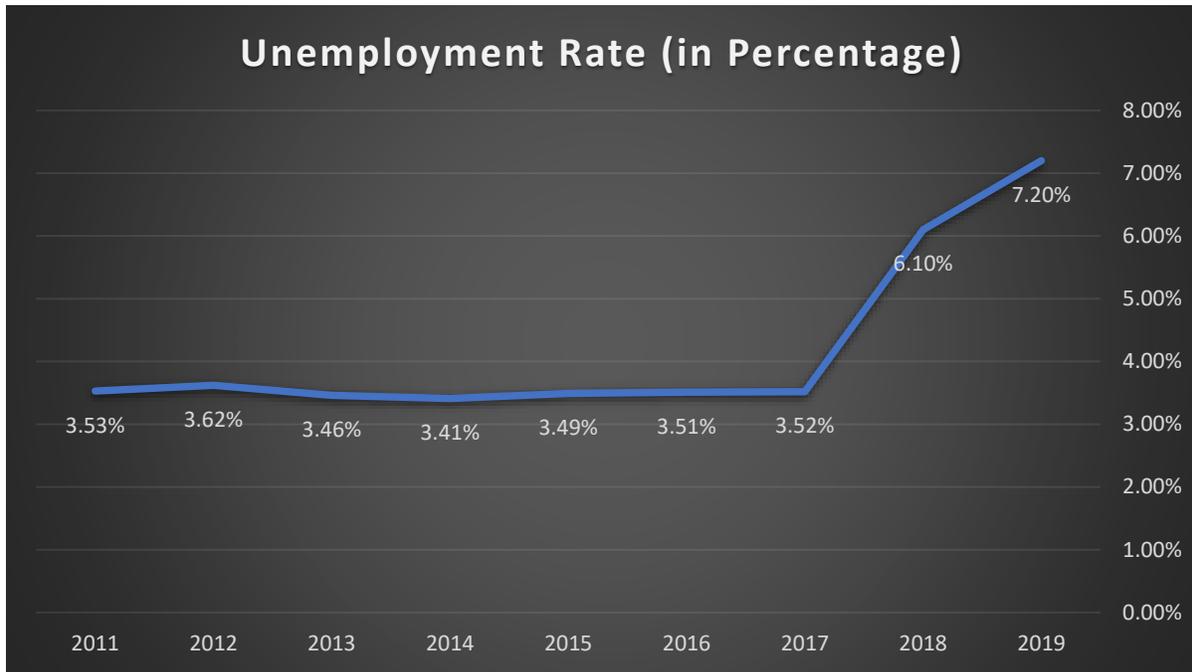
Interpretation:-

The above chart and table helps us to know the following points:

- The no. of unemployed persons was highest in India in 2014 and least in 2011.
- The no. of unemployed persons was increasing in India.

C. .Population of India and Unemployment Rate

Year	Population (in Millions)	Unemployment Rate (in %)
2011	1247.44 M	3.53%
2012	1263.58 M	3.62%
2013	1279.49 M	3.46%
2014	1295.29 M	3.41%
2015	1311.05 M	3.49%
2016	1326.80 M	3.51%
2017	1342.51 M	3.52%
2018	1358.13 M	6.1%
2019	1364.73 M	7.2%



Interpretation: \_

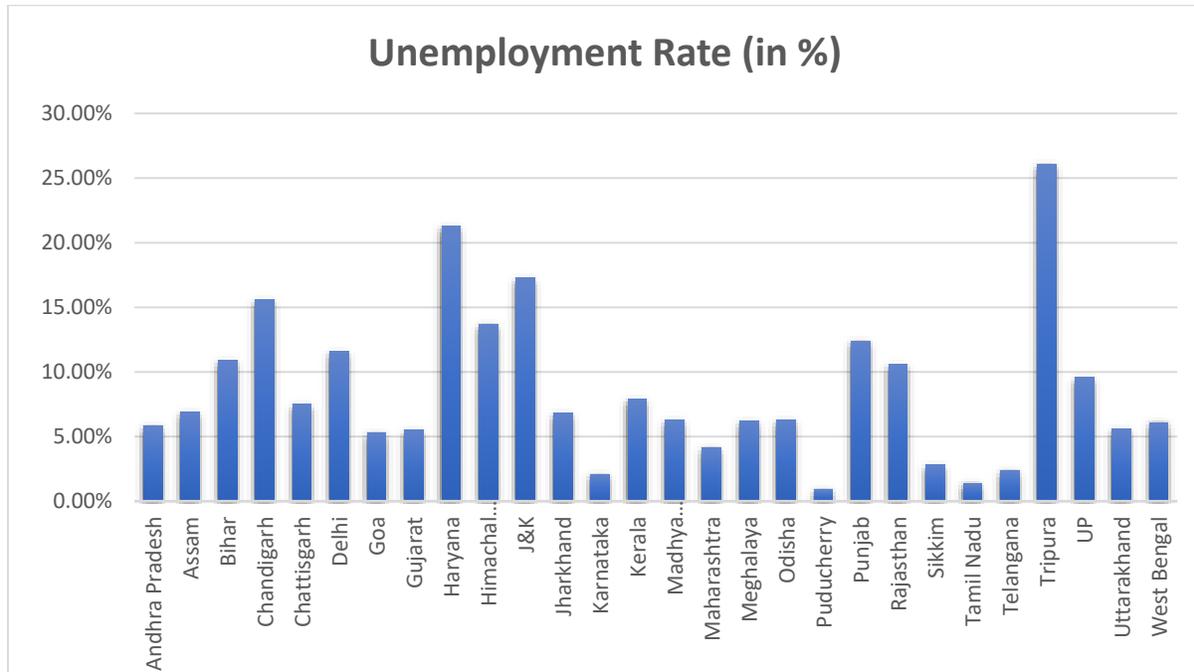
The above chart and table helps us to know the following things :-

- ❖ The population of India was increasing every year.
- ❖ The unemployment rate of India was first increasing, then start decreasing and then again start increasing.
- ❖ The unemployment rate was highest in 2019 and it was least in 2014.

D. Unemployment Rate in India across different States in 2019

States	Unemployment Rate (in %)
Andhra Pradesh	5.8%
Assam	6.9%
Bihar	10.9%
Chandigarh	15.6%
Chattisgarh	7.5%
Delhi	11.6%
Goa	5.3%
Gujarat	5.5%
Haryana	21.3%
Himachal Pradesh	13.7%
J&K	17.3%
Jharkhand	6.8%
Karnataka	2.1%
Kerala	7.9%
Madhya Pradesh	6.3%
Maharashtra	4.1%
Meghalaya	6.2%
Odisha	6.3%

Puducherry	0.9%
Punjab	12.4%
Rajasthan	10.6%
Sikkim	2.8%
Tamil Nadu	1.4%
Telangana	2.4%
Tripura	26.1%
UP	9.6%
Uttarakhand	5.6%
West Bengal	6.1%



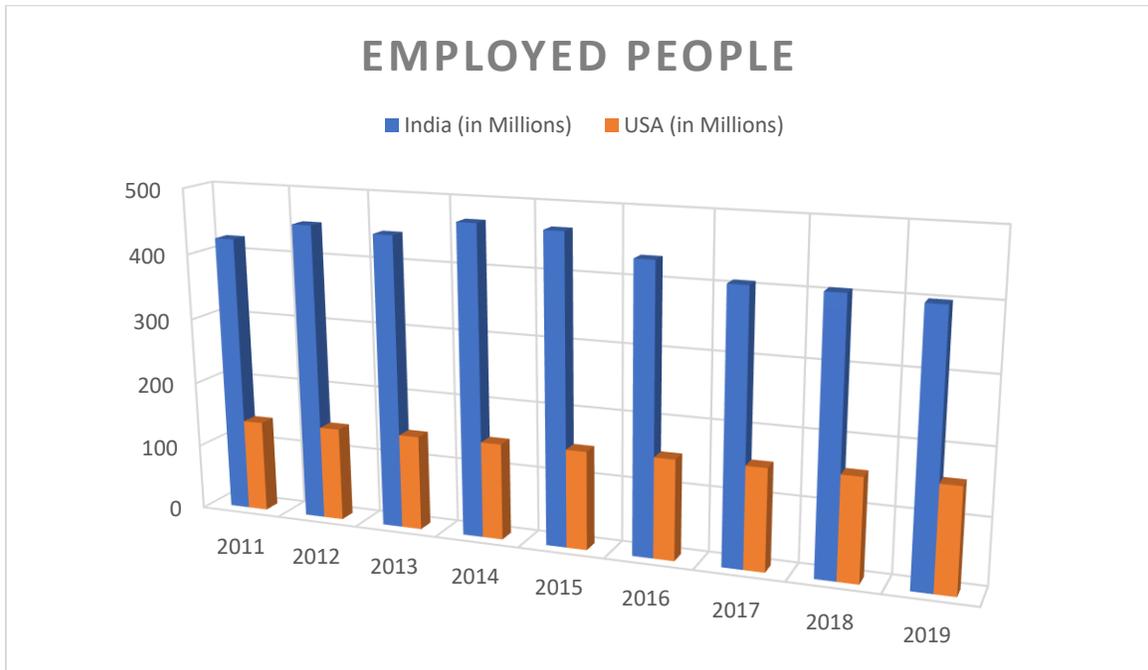
Interpretation:-

The above statistics helps us to know the following things:-

- The unemployment rate across different states and union territories in India is different.
- The unemployment rate was highest in Tripura which was 26.1%.
- The unemployment rate was least in Puducherry which was 0.9%.

E. Employed people in India and USA across different years

Year	India (in Millions)	USA (in Millions)
2011	423.1	139.89
2012	451.56	142.48
2013	444.78	143.94
2014	469.65	146.32
2015	465.8	148.85
2016	433.6	151.44
2017	407.5	153.34
2018	406	155.21
2019	400	156.95

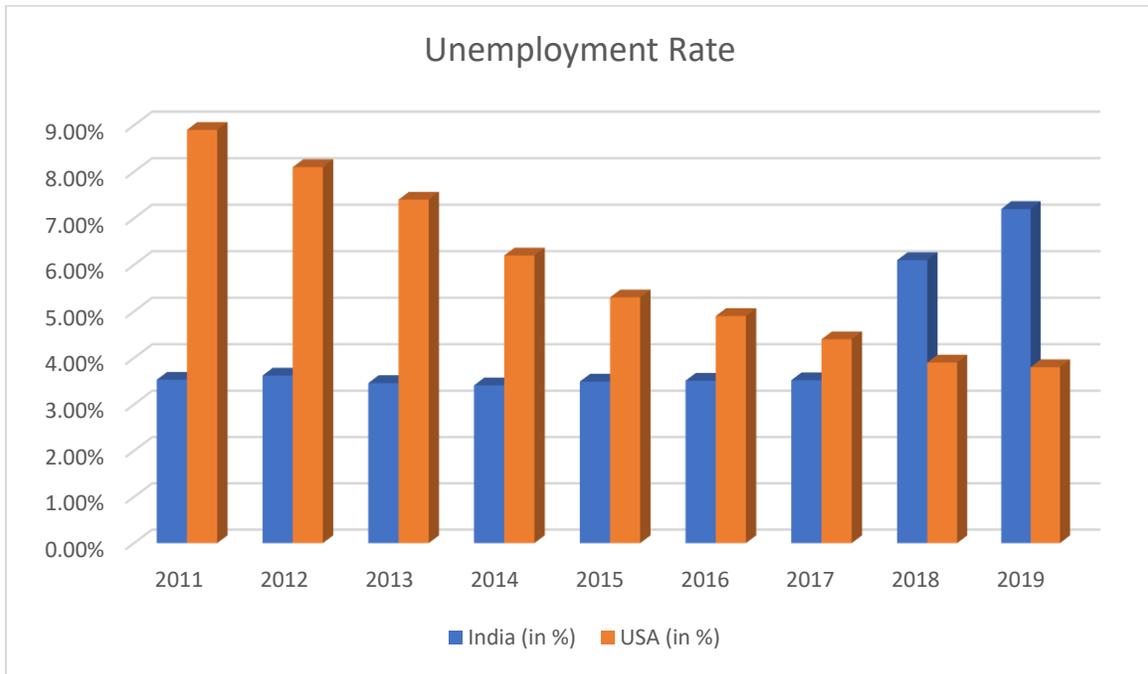


Interpretation:-

The above provided information let us know the following facts:-

- Here we have done the comparison of trend of no. of employed persons in India and USA.
  - The no. of employed person in India first decrease, then increase and then starts decreasing while that in USA was increasing every year.
  - The no. of employed person was highest in India in 2014 while that in USA was in 2019.
  - The no. of employed person was least in India in 2019 while that in USA was in 2011.
- F. Unemployment Rate in India and USA across different years

Year	India (in %)	USA (in %)
2011	3.53%	8.9%
2012	3.62%	8.1%
2013	3.46%	7.4%
2014	3.41%	6.2%
2015	3.49%	5.3%
2016	3.51%	4.9%
2017	3.52%	4.4%
2018	6.1%	3.9%
2019	7.2%	3.8%



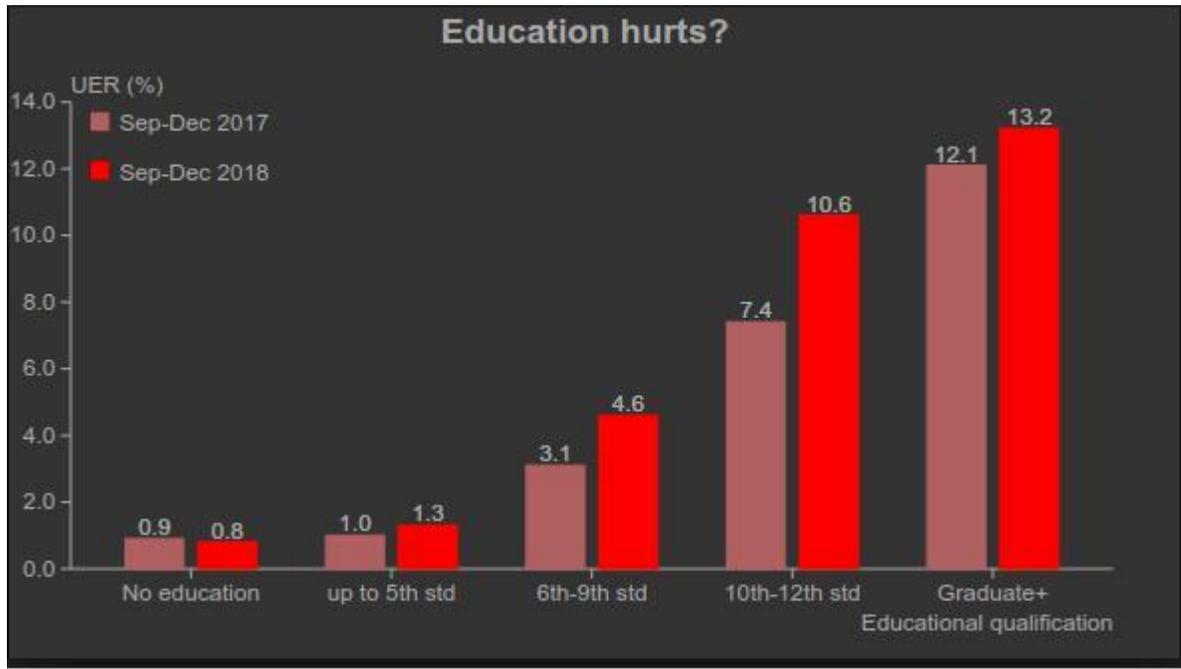
Interpretation:-

The above given information tells us following things:-

- Here we have done the comparison of the trend of unemployment rate prevailing in India and USA.
- The unemployment rate in USA was decreasing every year while that in India first increase, then decrease and then starts increasing again every year.
- The unemployment rate in India was highest in 2019 while that in USA was in 2011.
- The unemployment rate in India was least in 2014 while that in USA was in 2019.

G. Educated Unemployment in India

Education Qualification	Sept.-Dec.2017	Sept.- Dec.2018
No Education	0.9	0.8
Upto 5 <sup>th</sup> Standard	1.0	1.3
6 <sup>th</sup> -9 <sup>th</sup> Standard	3.1	4.6
10 <sup>th</sup> -12 <sup>th</sup> Standard	7.4	10.6
Graduate+	12.1	13.2



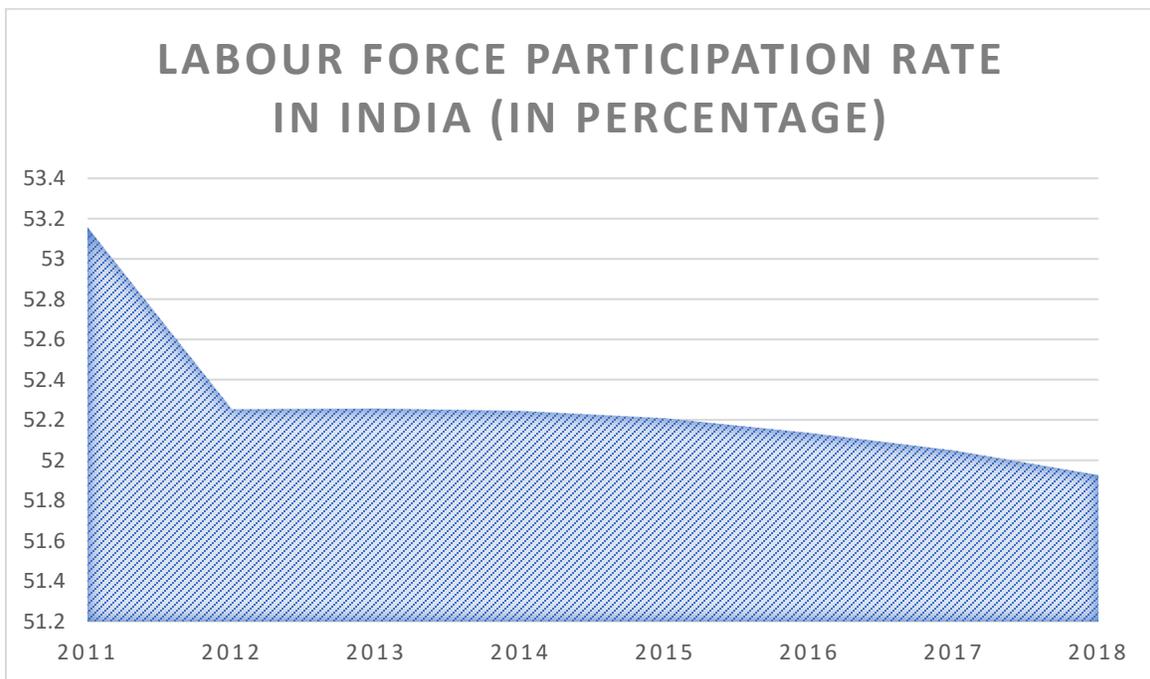
Interpretation:-

The above information tells us following things:-

- The unemployment rate in India having Educational Qualification more than Graduation is highest.
- The unemployment rate in India having No Education is least.
- As the educational qualification increase the unemployment rate also increase in India.

H. India's Labour Force Participation Rate across Different Years

Year	LPR(in%)
2011	53.155
2012	52.252
2013	52.256
2014	52.244
2015	52.208
2016	52.135
2017	52.048
2018	51.926



Interpretation:-

The above information tells us following things:

- Generally the labour force participation rate of India is declining yearly.
- The labour force participation rate was highest in 2011 which was 53.155%.
- The labour force participation rate was lowest in 2018.

#### V. FINDINGS

Followings are the facts found in the research: -

- It was found that the unemployment rate in urban areas is more than that in rural areas.
- It was found that the number of unemployed persons in India is increasing every year.
- Then it was found that as the population of India has increased from 1247.44 million to 1364.73 million so the unemployment rate in India has increased from 3.53% to 7.2% from 2011 to 2019
- Then it was found that the unemployment rate is highest in Tripura while it was least in Puducherry in 2019.
- When we did the comparison of employed people in India to that in USA it was found that the no. of employed people in India is decreasing while that in USA is increasing from 2011 to 2019.
- Later it was found that the unemployment rate in India is increasing while that in USA is decreasing
- Then it was found that the person having educational qualification more than Graduation are having maximum educational unemployment.
- Then it was found that the labour force participation rate is decreasing every year in India

#### VI. RECOMMENDATIONS

Unemployment is a major problem behind the slow development of the country. Following are some of the recommendation to solve it such as

- There is need to change the technique used in industry specially labour intensive technology.
- There is requirement to amend the policy related to the seasonal employment in agricultural sector by applying various strategies such as multiple cropping, cotton industries and animal husbandry should be encouraged.
- There is necessity for the reforms in the educational system specially in vocational study.
- There is need to open more employment exchange so that this will help to minimize the gap between the supply and demand of employment.
- More policies should be framed for self-employed people. Development of small and cottage industries should be encouraged.
- There should be encouraged to industries in co-operative sector. Like Keral government has set up a policy to minimize the co-operative society.

## VII. CONCLUSION

It was concluded from the project that unemployment is a big problem in India. The unemployment rate in India is continuously increasing in India and its one cause is continuous increase in population of India and as a result continuous increase in no. of unemployed persons. Educated unemployment is one of the type of unemployment prevailing in India. The unemployment in urban areas is more than that in rural areas. When the unemployment in India is compared to that in USA, it was found that it is increasing in India while it is decreasing in USA.

The government and even though the people of India needs to do their contribution to solve this problem in India. It is necessary to do this to make our country India a developed country.

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# Air pollution caused devastating impacts on children's health in urban area of Sri Lanka

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**Abstract :** Indoor and outdoor air pollution have become a public health challenge in Sri Lanka, majorly with the introduction of open economic policy in 1978. The emissions from motor vehicles (55%), industries (25%) and domestic sources (20%) collectively contributed to air pollution (Ministry of Environment, 2012). Sri Lanka produced over 90% of power demand from hydroelectricity two decades before and it was gradually reduced to 40-50% approx. as of now, due to the usage of thermal and coal power plants to produce electricity. Over 50% of the vehicles, 70% of industries and many thermal power plants are located in the urban area of Sri Lanka (Ileperuma, 2019). Open dumping and burning of solid waste in the urban areas by both households and local authorities-at the waste dumpsites, and continue decomposition process of waste emit dust particles, methane, toxic and other greenhouse gases to the atmosphere (Ruzaik, 2015). The culmination of all the above factors subsidized for air pollution and it subsequently impacted for health of the general public, including children of the nation. The children are highly exposed to polluted air in the home and school environment. However, the policymakers does not provide more priority; although it is a dangerous and silent hazard, which is positively correlated with communicable and non-communicable diseases. Hence, this analytical study is carried out with the objective of identifying causes and potential health impacts and to provide possible remedial measures to mitigate and manage this issue at a minimum risk rate. Predominantly, the data and information from published and unpublished secondary sources were used. MS-Office was used to analyze the data, following both quantitative and qualitative approaches. Analysis reveals that World Health Organization(WHO) estimated the number of deaths attributed by air pollution in Sri Lanka is approx.. 5,200 (Nandasena, et al. 2012) and 60% of the children visit to the Lady Ridgeway-Children hospital for medical treatments on respiratory diseases (Ruzaik, 2015). Dharshana and Coowanitong,(2008) showed that PM<sub>10</sub> has the strongest association to bronchitis, emphysema and other chronic obstructive pulmonary diseases among children with a correlation coefficient of 0.717 at 99% confidence. Approximately 20% of asthma patients at the Lady Ridgeway children's hospital could be due to exposure to high PM<sub>10</sub> levels. This study majorly recommends to promote habits of wearing facemasks in outdoor, especially for children and suggested the Government of Sri Lanka to prepare a national level policy strategy to provide "Clean Air to all in 2030".

**Keywords:** Air pollution, atmosphere, emission, hazard and health impacts.

## 1. Introduction

Air Pollution is an acute and growing environmental problem in Sri Lanka, due to the continuous process of changing the economic structure from agriculture to industrial-based status by introducing frequent manufacturing and industrialization policies by changing Governments since 1978 with the introduction of open economic policy in Sri Lanka. The increasing trend of importation of various types of vehicles, absence of well-planned road network, ample traffic congestions during peak hours and incineration of solid waste-especially in the urban areas, fuelwood combustion for cooking, use of mosquito coils, industrial emission *etc.* have collectively caused for polluting air in the atmosphere. This has resulted for high significance of human health hazards, as the various toxic gases and fine particles emitted to the air, beyond its natural capacity of the environment. The

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gaseous air pollutants, such as sulphur dioxide, nitrogen dioxide and carbon monoxide are directly dilute with the air; as a result of combustion of fossil fuel of automobiles, and power plants, industries and biomass burning. In 1992, the whole of Sri Lanka was considered as one free trade zone to promote manufacturing, industry-based exports and allow foreign investors. This has become a major cause for emissions of toxic gases together with vehicular emissions and crates toxicological, respiratory and cardiovascular diseases to the human while generating more impacts on children.

## 2. Objectives

The objectives of this study are as follows,

- To assess the causes and potential health effects of air pollutions in Sri Lanka.
- To analyze the existing status of health impacts together with children in urban Sri Lanka.
- To provide possible remedial measures to mitigate and manage health impacts.

## 3. Methodology

This analysis was carried out, following the qualitative approach and predominantly extracted data from secondary sources, using PubMed and MEDLINE resources guide (<https://pubmed.ncbi.nlm.nih.gov/>). A few literatures have been identified on air pollution and health impacts in Sri Lanka. Manual search to identify relevant studies and conference proceedings published in the journals have provided a few articles and research papers on this title. All citations and due references are given in the TEXT and reference list below MS-Office was used to analyze the data.

## 4. Overview of air pollution and health impacts

Air pollutants can be defined as a substance present, in a sufficient concentration to produce a harmful effect on human, animals and other living organisms of nature; resulted from the seepage of chemicals, particulate matters (referred to as PM), criteria pollutants (ground-level ozone (O<sup>3</sup>), carbon monoxide (CO<sub>2</sub>), sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), and lead (Pb)), or biological materials into the atmosphere, which could affect the health of humans, as well as the health of plants and animals (United States Environmental Protection Agency, year 2018). According to the World Health Organization (WHO, 2018), the highest portion of harmful pollutants are emitted by industries and vehicles. Greenpeace Southeast Asia and the Centre for Research on Energy and Clean Air, (2018) stated that the burning gas, coal and oil results in three times as many deaths as road traffic accidents worldwide and it is estimated that air pollution has a \$2.9 trillion economic cost, equating to 3.3 percent of the world's GDP. It was linked to 4.5 million deaths with PM<sub>2.5</sub> pollution also responsible for 1.8 billion days of work absence, 4 million new cases of childhood asthma and 2 million preterm births. Further, the disability from chronic diseases cost the world's economy \$200 billion in 2018, with sick leave and preterm births costing \$100 billion and \$90 billion respectively.

Above statistics clearly shows that air pollution and corresponding damages to the human health will have large impacts on the respective country's economy in multiple ways, such as health and welfare cost to the government, inability to work and lower participation rates in the labour force. Children are the high significant group for health impacts (mostly respiratory diseases) and possibilities for not attending schools and subsequently adversely affect to their learning too. Their parents also devote more time on their health care activities and they are compelled to apply leave for their workplace. It will badly effect to country's economy and to create a good future generation.

Air pollution accounts for 1 in 8 deaths worldwide, approximately 7 million (WHO,2012) deaths have been attributed annually by polluted air. Out of which, 4 million deaths were occurred, due to indoor air pollution and 3 million from outdoor air pollution (WHO, 2014). Air pollution impacts on human health by way of short and long-term basis, depending on the individuals' health conditions react to the pollutants. Children (300,000 deaths below 5 years) and elderly people are most vulnerable to air pollution, due to their weaker status of immunity strength and defensive ability of the body. Accordingly, the 24% (1.4 million) of deaths due to strokes, 25% (2.4 million) of deaths caused by heart diseases, and 43% (1.8 million) of deaths instigated by lung disease and lung cancer have occurred every year as a result of air pollution. This polluted air contains high levels of dangerous particulate matter, which are small enough to enter into the human bloodstream, through the lungs and contributes to premature deaths. The continuous process of such negative situation will ultimately lead to negative impacts on the global economy, especially for low-income countries (UN,2020).

In Sri Lanka, indoor air pollution is high especially in the rural area, as they use of firewood for cooking and use mosquito coils and outdoor air pollution is considerably more in the urban area of Sri Lanka, as result of emission from motor vehicles, traffic congestions, incineration of solid and plastic and industrial emission *etc.* The 80% households in the rural area use firewood for cooking with lack of adequate ventilation in the kitchen, which produces highly toxic air pollutants, affecting the health of people. This situation has become a cause for respiratory diseases; such as asthma, bronchitis, pneumonia and chronic obstructive pulmonary disease (COPD) and non-respiratory diseases. Further, the fossil fuel combustion yields fine particles, especially those with less than 10  $\mu\text{m}$  in diameter, which can penetrate deep inside the lung and causing many undesirable health effects (Ileperuma, 2004; Ileperuma and Mubarek, 2019).

According to Ileperuma, (2018), Dr. Anoma Siribaddana, Consultant Chest Physician at the Kandy General hospital, the number of children with Chronic Obstructive Pulmonary Disease (COPD) is on the rise. This condition normally affects middle-aged and older adults and habitual smokers. There is no cure apart from controlling the symptoms of this serious health condition. Hospital statistics also show an increase in the number of asthma patients, who spend time in the city. In addition, the air pollution has economic impacts, due to increased mortality and illness, the degradation of crops and property and to tourism, since tourists avoiding or shortening visits to cities that are heavily polluted (Ileperuma, 2015).

## 5. Causes of air pollution in Sri Lanka

Air pollution, both indoors and outdoors, is a major environmental health problem affecting people in both developed and developing countries. Although air pollutants are many, the most important are particle pollution (often referred to as particulate matter (PM)), ground-level ozone ( $\text{O}^3$ ), carbon monoxide (CO), sulfur oxides ( $\text{SO}_x$ ), nitrogen oxides ( $\text{NO}_x$ ), and lead (Pb) which are found in the ambient air (also known as "criteria pollutants"); PM, CO,  $\text{SO}_x$ ,  $\text{NO}_x$ , environmental tobacco smoke (ETS), formaldehyde and polycyclic organic matter are found indoors (WHO, 2018).

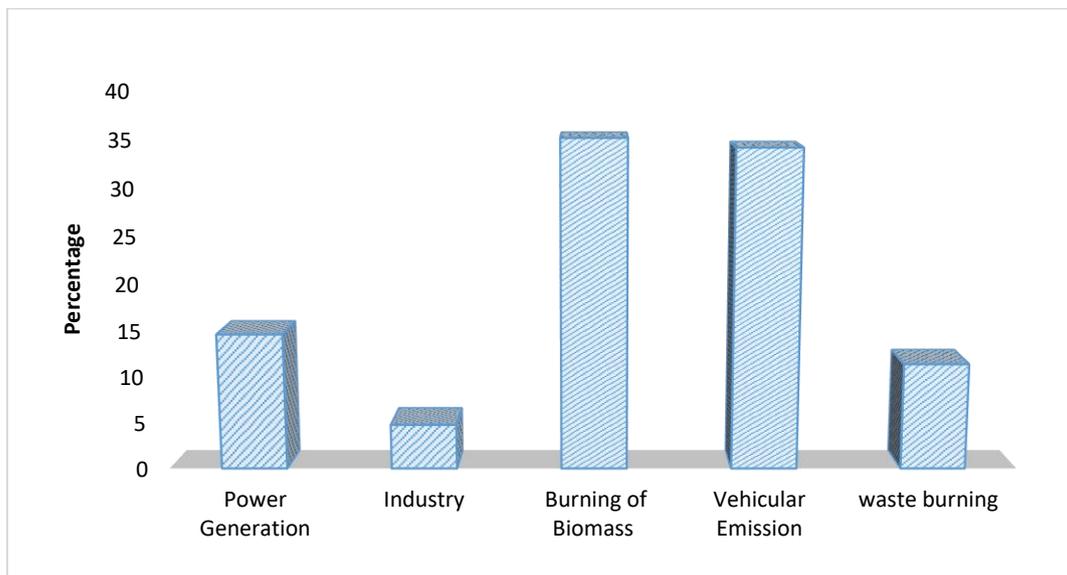
The causes of air pollution can be categorized into three basic groups: transport, industry (including power generation) and domestic source. The below figure-1 depicts the emissions from power generation (15%), motor vehicles (34%), industries (5%), waste incineration (11%) and burning/domestic source (35%) collectively contributed for air pollution (Ministry of Environment, 2019). Sri Lanka produced over 90% of power demand from hydroelectricity two decades before and it was gradually reduced into 40-50% approx. as of now, due to the usage of thermal and coal power plants to produce electricity. Over 50% of the vehicles, 70% of industries and many thermal power plants are located in the urban area of Sri Lanka (Ileperuma, 2019). The vehicular emissions could be observed in the urban areas, due to the ever-increasing number of vehicles, insufficient road network and traffic congestions.

In 2017 Sri Lanka's motor vehicle population grew by 7% to 7.2 million. The consumer goods imports volume index was increased by 9.6% in 2018 and decreased by 20.7% in 2019 mainly due to the significant decline in vehicle imports (Ceylon Chamber of Commerce, 2018). The vehicle imports and registration will further decrease in the year 2020 too, due to the import restrictions imposed by the Central bank of Sri Lanka, during the second quarter of this year. Although it is a good sign in terms of air pollution, we have excess vehicles in the urban areas, which resulted in more pollution, traffic jams in the peak hours and loss of productivity due to more time consumptions for traveling. The average speeds under urban driving is varied from 40-50 km/hr, but unable to travel with uniform speed as the over traffic, which will emit soot, carbon monoxide and unburnt hydrocarbons to the atmosphere.

Another major factor for air pollution is use of fossil fuels for coal and oil petroleum, gas products in thermal power generation plants. According to the National Energy policy and strategies of Sri Lanka, increased demand will necessitate power generation using more and more fossil fuel. The fossil fuel combustion in Sri Lanka is more than 50%, CO<sub>2</sub> emission from manufacturing industries account for 6% (www.indexmundi.com, date 27.11.2020). In the domestic source, the fuelwood use for cooking, especially in rural areas (90% of households) is also contributed for air pollution in a large scale.

Similarly, the air pollution occurs largely through inefficient haphazard open dumping and burning of waste (11%), which produces CO<sub>2</sub>, hydrogen, nitrogen, organic compounds, dust and another form of toxic gases being generated during the waste degradation process, which also contributed for emission of greenhouse gases at 45% approx. (Ruzaik, 2015).

The below diagram shows the major contributors to air pollution in Sri Lanka.



**Figure-1: Causes of air pollution in sri lanka**

Source: Prepared, based on the statistics of NBRO report, (2018/2019)

Above statistical information reveal that seriousness of air pollution in Sri Lanka. The pollutants and fine particles discharge from exhaust gases from motor vehicles, burning of biomass and burning of solid was are filtered through the nose and the upper respiratory tract, even it is lesser than PM<sub>10</sub> (10 microns fraction) in diameter will have hazardous impact on human health. The children are more vulnerable, since their undeveloped body conditions.

## 6. Analysis and discussion

This paper attempt to discuss the health impacts of air pollution, providing a special reference to children's health issues, since the children, who are living within the urban area are more vulnerable and at high risk. According to the Global Climate Risk Index-2020, Sri Lanka has been ranked 6<sup>th</sup> most affected country by environment-related hazards; such as floods, heatwaves, storms, landslides that occurred in the recent past. The Central Environmental Authority (CEA) has issued 17 Environmental Impact Assessment (EIA) and 266 Initial Environmental Evaluation (IEE) certificates in 2019. In order to regulate environmental pollution, the CEA granted Environmental Protection Licenses (EPL) to the companies of potentially polluting industries. In November 2019, we observed that the air pollution level in Colombo City increased remarkably, which was more likely due to transboundary air pollution emanating from India (CBSL, 2019). However, the urban population are at risk, in terms of inhaling bad air.

### 6.1. Air pollutants and its consequences

The following table-1 depicts the sources of air pollutants, its nature, sources and impacts in summarized form.

**Table-1: Air pollutants and its consequences**

Pollutant	Description	Sources	Effects
<b>Carbon Monoxide (CO)</b>	CO is an odorless, colourless, and poisonous gas produced by the incomplete burning of fossil fuels (gasoline, oil and natural gas).	Vehicles, such as cars, trucks, buses and small engines and some industrial processes are major sources of CO. In urban areas; motor vehicles discharge nearly 90% of CO. Wood stoves, cigarette smoke and forest fires are also contributed for CO emissions.	CO interferes with the blood's ability to carry oxygen, slowing reflexes and causing drowsiness. In high concentrations, CO can cause death. Headaches and stress on the heart can result from exposure to CO.
<b>Nitrogen Oxides (NOx)</b>	Nitrogen and oxygen combine during combustion (burning) forms NOx. Many NOx are colorless and odorless gases.	NOx come from burning fuels in motor vehicles, power plants, industrial boilers and other industrial, commercial and residential sources that burn fuels.	NOx can make the body vulnerable to respiratory infections, lung disease, and possibly cancer. NOx contributes to the brownish haze seen over congested areas and to acid rain. NOx easily dissolves in water and forms acids which can cause metal corrosion and fading/deterioration of fabrics.
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>	SO <sub>2</sub> is a gas produced by chemical interactions between sulfur and	SO <sub>2</sub> comes largely from burning fossil fuels (gasoline, oil and natural	SO <sub>2</sub> easily dissolves in water and forms an acid which contributes to acid rain.

	oxygen.	gas). It is released from petroleum refineries, paper mills, chemical and coal burning power plants.	Lakes, forests, metals, and stone can be damaged by acid rain.
<b>Volatile Organic Compounds (VOCs)</b>	VOCs are organic (contain carbon) compounds that vaporize easily. Gasoline, benzene, toluene and xylene are examples of VOCs.	VOCs are emitted as gases (fumes). Sources of VOCs are burning of fuels, solvents, cleaning supplies, paints and glues. Cars are a major source of VOCs	VOCs contribute to smog formation and can cause serious health problems such as cancer. They may also harm plants.
<b>Suspended particulate matter (SPM)/(Air-borne particulate matter)</b>	SPM and aerosols (liquid particles) suspended in the air, as dust, smoke and haze.	Air-borne particulate matters are produced due to the natural processes and as a result of human activities. Combustion of fossil fuels (e.g. from power stations and motor vehicles), industrial operations, incinerators and earth-moving activities contribute to generate air-borne particulate matter.	Exposure to such particles can affect both your lungs and your heart. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: premature death in people with heart or lung disease. Non-fatal heart attacks.
<b>Lead (Pb) and other heavy metals</b>	Metals smelters are the main source of airborne heavy metals and battery manufacturing plants, and leaded gasoline are the leading sources of air-borne lead	Motor vehicle emissions are a included with air -borne contaminants including arsenic, cadmium, cobalt, nickel, lead, antimony, vanadium, zinc, platinum, palladium and rhodium.	Lead affects the central nervous system of human and children neurological. Also it effects the intellectual development of children, causing learning disabilities. Pb create high blood pressure (in higher concentrations), kidney diseases or anemia.

Source: Prepared, based on the WHO database, 2018/2019.

Above

table

was compiled with the information extracted from WHO database (2018/2019) to elaborate the combination of pollutants, assorted in the polluted air and its health impacts. According to the automated air quality monitoring stations (Colombo and Kandy) statistical information (2019), the pollutants available in the air are below the average standards, except the fine particles (PM<sub>10</sub> and PM<sub>2.5</sub>), which are always above the national standard in Sri Lanka. Air quality in Kandy is comparatively polluted than the Colombo, due to its geographical location, over capacity of vehicles and traffic congestion. Topographical features of the Kandy City surrounded by hilly areas is lacking its natural air purification process, resulted from more Sulphur dioxide (41%), nitrogen dioxide (14%) and ozone levels (28%) in the air during the period 2001-2005 (Ileperuma, 2020).

## 6.2. Health effects of air pollution in Sri Lanka

Air pollution is a major cause of diseases and subsequent death, which accounts estimation of 7 million premature deaths/annum (WHO,2019). Approximately, 91% (i.e. 9 out of 10) of the world's population lives in places, where air quality levels exceed WHO standards ( $<10 \mu\text{g}/\text{m}^3$ ) of pollutants. Pollutants such as particulate matter ( $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ),  $\text{SO}_2$ ,  $\text{CO}_2$ ,  $\text{NO}_2$  and  $\text{O}_3$  cause of lung cancer (WHO, 2005).

This study identified that there are no comprehensive research on "air pollution and health impacts" have been carried out in Sri Lanka, except a few research in brief (eg. Nandasena et al. (2013), Chandrasiri, (2006) and Ileperuma (2020)); selecting prominent urban areas for the case study. Hence, it is required to extend a comprehensive study for the island very soon on air pollution and related issues. According to WHO guidelines, the air quality in Sri Lanka is considered moderately unsafe-the most recent data indicates the country's annual mean concentration of  $\text{PM}_{2.5}$  is  $11 \mu\text{g}/\text{m}^3$ , exceeding the recommended maximum of  $10 \mu\text{g}/\text{m}^3$  ([www.who.int/](http://www.who.int/).accessed on 27.11.2020).

While analyzing collected literature, it was revealed that the concentration level of particulate matter (PM) in the air is used for measuring quality of the air, such particles that could impact the human health. The size of the particulate matters are measured at two concentration level with its diameter- less than  $2.5 \mu\text{m}$  or  $\text{PM}_{2.5}$  and less than  $10 \mu\text{m}$  or  $\text{PM}_{10}$ . The WHO's air quality guidelines recommend that the annual mean concentrations of  $\text{PM}_{2.5}$  should not exceed  $<10 \mu\text{g}/\text{m}^3$  and  $<20 \mu\text{g}/\text{m}^3$  for  $\text{PM}_{10}$ . Continuous process of inhaling fine particles lesser than  $\text{PM}_{2.5}$  too will create repertory issues in the human body, because it will travel deeper into the cardiopulmonary system and caused for long-term health issues.

According to this analysis, the outdoor air pollution is a mix of particulate matters, chemicals and other materials will form tiny hazardous particles and mix in the air; which will contribute for breathing problems, chronic diseases, increased hospitalization, and premature mortality. The expose to the polluted air will have short term and long term symptoms and diseases. The eyes irritation, running nose, throat pain, wheezing, coughing, shortness of breath, chest pain, headaches, nausea, and upper respiratory infections are short-term symptoms, which could be ended-up with asthma, tubercular and emphysema *etc.* In long term, it will lead to lung cancer, cardiovascular disease, chronic respiratory illness, developing allergies, heart attacks and strokes *etc.*

Analysis of ambient air quality data monitored at Colombo Fort monitoring unit clearly revealed that  $\text{PM}_{10}$  is the dominant air pollutant in the Colombo atmosphere. Further investigation showed that  $\text{PM}_{10}$  has strong associations with three types of respiratory illnesses, especially among children. Among these associations, the disease category which includes bronchitis, emphysema and other chronic obstructive pulmonary diseases showed a prominent association with a correlation coefficient of 0.717 at 99% confidence. In addition, an application of health impact assessment software developed by WHO revealed that nearly 20% of Asthma patients recorded at LRH (the Lady Ridgeway Hospital for Children) in 2005 could be attributed to exposure to  $\text{PM}_{10}$  in Colombo. It was observed that nearly 60% of the respiratory cases occurred at reasonably lower concentrations (below  $80 \mu\text{g}/\text{m}^3$ ) thus, future management plans aiming toward positive health impacts should focus on shifting the entire  $\text{PM}_{10}$  pollution distribution towards lower ends (Thishan D. & Nowarat Coowanitwong, 2007).

$\text{PM}_{2.5}$  was measured in the primary living area in a sub-sample of households ( $n = 198$ ). Indoor  $\text{PM}_{2.5}$  measurements from 132 urban homes showed a mean of  $84.4 \mu\text{g}/\text{m}^3$  and a range of  $25.2 \mu\text{g}/\text{m}^3$  to  $620.6 \mu\text{g}/\text{m}^3$ . The 66 rural homes had a mean of  $94.4 \mu\text{g}/\text{m}^3$  and a range of  $5.9 \mu\text{g}/\text{m}^3$  to  $755.0 \mu\text{g}/\text{m}^3$ . The highest indoor  $\text{PM}_{2.5}$  measurements were reported from homes that burned biomass for cooking in the urban setting (mean of  $243.2 \mu\text{g}/\text{m}^3$  and a range of  $40.7 \mu\text{g}/\text{m}^3$  to  $620.6 \mu\text{g}/\text{m}^3$ ) (Nandasena et al. (2012). According to the Senanayake et al., (2011), Venous and umbilical cord blood samples of 24 mother-baby combinations from Colombo have been analyzed and only one mother-baby combination had no lead in their blood. Measurements of blood

lead levels in children living in a traffic congested area of Colombo showed that 6% of the children had blood lead levels above 10 µg/dL and not a single child had a blood lead level >10 µg/dl. Further, the children in the urban area had a significantly higher prevalence of wheezing when compared to those in the semi-urban area.

According to Perera et al. (2007), the drivers, three-wheeler drivers, street vendors and shopkeepers in the urban area are at high risk by exposing with polluted air-bus drivers were affected by NO<sub>2</sub> (57.36 µg/m<sup>3</sup>) and SO<sub>2</sub> (82.70 µg/m<sup>3</sup>), three-wheeler drivers (NO<sub>2</sub> - 50.18 µg/m<sup>3</sup>; SO<sub>2</sub> - 78.36 µg/m<sup>3</sup>), shop keepers (NO<sub>2</sub> - 54.91 µg/m<sup>3</sup>; SO<sub>2</sub> - 63.29 µg/m<sup>3</sup>) and outdoor vendors (NO<sub>2</sub>- 37.66 µg/m<sup>3</sup>; SO<sub>2</sub> - 35.25 µg/m<sup>3</sup>). Accordingly, they are high prevalence of respiratory diseases.

Siritunga et al. (2006) stated that effects of outdoor air pollution on the respiratory health of school children selected from a rural and an urban area in the Kandy district and correlated the results with the ambient air pollution levels. A total of 510 children from each area was the sample and their respiratory illnesses were recorded using the diary method. Average pollutant concentrations of SO<sub>2</sub>, NO<sub>2</sub> and O<sub>3</sub> were three to five times higher in the city school premises compared to the rural area and these can be readily correlated to the respiratory symptoms. Thus, in the city school, occurrence of cough was 1.8 times higher, nasal discharges were 1.4 times higher and throat irritation was 1.8 times higher.

This analysis shows that air pollution and subsequent health impacts in the urban area are high, due to the emissions from motor vehicles, industries and domestic sources. High prevalence of reparatory diseases are common among the people, those who have highly exposed to the polluted air. The urban children are victimized as the polluted air in the atmosphere. The children are happened to expose to the polluted air in the home and school environment, especially in the urban areas; while long waiting for school buses, travelling with opened windows, lack of space in the residential environment *etc.* The positive correlation with air pollution and human health impacts will lead to unhealthy population and future generations. The government has spent approximately LKR 21.6 billion in 2018 and LKR 28.4 million in 2019 for healthcare sector (CBSL Report, 2019. Pg 124). This is approximately 1.6% of GDP.

### **6.3. Impacts of air pollution on children's health in Sri Lanka**

Air pollution is a major environmental health hazard to children as stated above. The health of children living in urban areas more vulnerable, due to the air pollution. Globally, 93% of children (630 million children below 5 years) are exposed to air pollution. Approximately average 550,000 children, lesser than 5 years, infected with respiratory tract infections, which led to deaths. The major reason behind this is children's immune systems and lungs are not fully developed to resist such impacts. Further, just like the arms and legs, the largest portion of a child's lungs will grow long after he or she is born, eg. 80% of their tiny air sacs develop after birth. Those sacs, called the alveoli, are where the life-sustaining transfer of oxygen to the blood takes place. The lungs and their alveoli are not fully grown until children become adults (Friedrich, 2018).

Above statements reveals that defensive mechanism in the children's body to react against the sickness (antibody) are very lesser than the adults. We observe in our vicinity that the Children have more respiratory infections than adults. The reasons behind this are, they like to play outside the home environment and expose to polluted air continuously; although their immunity system weaker than the adults. This behavior resulted various health impacts, such as asthma, bronchitis and other respiratory infections and other diseases, because growing lungs may be most vulnerable to permanent adverse effects. According to Dr. Anoma Siribaddana (Consultant Chest Physician at the Kandy General hospital), the number of children with Chronic Obstructive Pulmonary Disease (COPD) is on the rise (Ileperuma, 2015). This statistics clearly revealed that the trend of airborne diseases are serious and create unhealthy future generation.

It was found that approximately over 10,000 children in Sri Lanka has some sort of respiratory systems until they reach their 10th year of age. This may be running nose, frequent fever, cough, bronchitis, common cold and similar other symptoms. The major causes behind this are genetic issues and expose with air pollution. Out of 4.2 million premature deaths in the world, almost 300,000-350,000 are children under the age of 5 years (WHO, 2014). In Sri Lanka too over 45% of the admissions of children to the hospitals are due to air pollution (Dharshana and Coowanitong, 2008)

Below table-3 explains that the children have faster respiratory rates than adults and the "normal" respiratory rate can vary significantly by age, which is depicted below.

**Table-3: Average respiratory rates of children**

Age	Rates (number of breaths/minute)
Newborn	30-60
Infant (1-12 months)	30 - 60
Toddler (1-2 years)	24 - 40
Preschooler ((3-5 years)	22 - 34
School age (6-12 years)	18 - 30
Adolescent (13-18 years)	12 - 16

Source: <https://www.verywellhealth.com/what-is-a-normal-respiratory-rate-2248932> accessed on 03.08.2020

Belo table was prepared based on the information extracted from literatures on age wise children health impacts of a few urban areas, which provides evidences for vulnerability of children of air pollution.

**Table-4: Age wise children health impacts of air pollution in Sri Lanka**

Location	Children Age groups	Air pollutants	Health impact	Reasons
Colombo North teaching hospital	1-10 years	SO <sub>2</sub> NO <sub>2</sub> PM <sub>10</sub>	Asthma	Dusty home enviroment is a significant risk factor for Asthma
Colombo Urban area	9 – 15 years	SO <sub>2</sub> NO <sub>2</sub> PM <sub>10</sub>	Respiratory symptoms	Respiratory symptoms were higher in Colombo as compared to the rural area due to household risk factors.
Lady Ridgeway . Children's Hospital, Colombo	Below 12 years	SO <sub>2</sub> NO <sub>2</sub> PM <sub>2.5</sub>	Wheezing and breathing difficulties	Episodes of nebulization positively correlated with most polluted days as children are exposed to outdoor dusty environment.
Kotte Medical	5-11 years	Dust pollutants	Respiratory symptoms	Respiratory symptoms were significantly higher

Officer of Health area				in houses as use of firewood
Kandy urban area	2-16 years	PM <sub>10</sub>	Respiratory Health issues- running nose, cough & cold	32% of children from village school and 8% from the city school had health issues as inhaling particular matters with air.
Galle urban area	3-14 years	Not identified the pollutants type	Wheezing	Occurrences of wheezing was higher in Galle due to polluted urban air pollution.
Gampaha urban area	5-11 years	Not identified the pollutants type	Asthma	Prevalence of asthma was significantly higher in the presence of firewood smoke
Gampaha urban area	1-12 years	Not identified the pollutants type	Respiratory symptoms & peak flow rate	Higher rate of respiratory symptoms identified in the Industrialized area.
Ampara urban area	9 –15 years	SO <sub>2</sub> NO <sub>2</sub> PM <sub>10</sub>	Respiratory symptoms	Respiratory symptoms were higher due PM.

Source: Nandasena, et al. , 2012.

Intact, the schoolchildren, below 12 years are more exposed to high levels of pollutants, especially in the urban areas of Sri Lanka, due to its overcrowding and vehicular congestions. The impacts of air pollution are significantly high, among the schoolchildren. The elements of NO<sub>2</sub>, SO<sub>2</sub>, and TSP levels are significantly higher in the school premises of the urban area, compared to the rural school. The respiratory health issues of schoolchildren (12 to 16 years), residing around Colombo and Kandy city is significantly reached to PM<sub>10</sub> level. Similarly, the children are exposed to the bad air in the home environment too, due to the cooking and burning of multiple materials in the home environment (Nandasena, et al. 2012).

The air pollutant levels measured at the Colombo Fort monitoring station show that the hospitalizing rates of children for indoor treatment to the Lady Ridgeway Hospital is approx.. 31,000 children/annum; anticipating nebulizer therapy in the emergency treatment unit. The highest number of cases recorded for nebulization, during the most polluted day. According to the above monitoring center, the prevalence of bronchitis, emphysema, and other chronic obstructive pulmonary diseases had a strong association with PM<sub>10</sub> levels of air, which shows such air is polluted and availability of particles. Nearly 20% of children affected with asthma have been admitted to the Lady Ridgeway Hospital due to exposure to PM<sub>10</sub> level air (Dharshana and Coowanitong, 2008).

Accordingly, it was found that the children, those who are exposed to indoor or outdoor air pollution, are high prevalence of contracting with communicable and non-communicable diseases, especially school children and children in the shanties in the urban area. It is a timely requirement to find remedial measures to overcome these issues, especially for urban population.

## 7. Conclusion and recommendations

### 7.1. Conclusion

Breathing clean and quality air directly influence to the health of every organs in the human body, especially the lungs. An increasing trend of importation of various types of vehicles, absence of well-planned road network, traffic congestions during peak hours and incineration of solid waste especially in the urban areas, fuel wood combustion for cooking and use of mosquito coils especially in the rural area, industrial emission etc. have collectively induced indoor and outdoor air pollutions, creating human health impacts such respiratory and chronic diseases. Although, the percentage of pollutants mixed in the air is below average standards of WHO, the harmful particles with PM<sub>10</sub> level could be observed, according to the statistical information of automated air quality monitoring stations in Colombo and Kandy. Most vulnerable group in Sri Lanka is aged and children population, since their immune system and lungs are not fully developed or weak for resistance. Hence, ambient air pollution causes multifarious human health hazards and become a national challenge in Sri Lanka, where all stakeholders together with the general public should be come to gather to mitigate and manage this issue at an acceptable level and reduces adverse health effects.

### 7.2. Recommendations

- Suggested to prepare a national level policy strategy to provide “Clean Air to all in 2030” should be launched by the Government of Sri Lanka.
- It is suggested to establish an effective integrated mechanism with the participation of all stakeholders (including private sectors), based on a holistic policy and well-defined strategies with regard to the air quality and related issues to achieve proposed 2030 targets.
- Current habits/practice of wearing facemasks (legalized) should be promoted and continued after the current COVID pandemic situation too. This practice should be mandatory, while travelling, public places and especially in urban area.
- 09 automated air quality monitoring stations to monitor SO<sub>2</sub> and NO<sub>2</sub> in the air are available in Sri Lanka; however 41 urban councils and 24 Municipal councils are existed in Sri Lanka. Establishing more number of automated air quality monitoring stations at least to cover
- This study recommends to carry out a Health Impact Risk Assessment (HIRA) for every projects that are subjected to EIA, under the provision of National Environmental (Ambient Air Quality) Regulations of 1994. The Central Environmental Authority (CEA) has issued 17 Environmental Impact Assessment (EIA) and 266 Initial Environmental Evaluation (IEE) certificates in 2019. In order to regulate the environmental pollution, the CEA granted Environmental Protection Licenses (EPL) to the companies of potentially polluting industries. It is suggested implement a separate process to issue HIRA with EIA and EPL with support of Ministry of health.
- Transport plan is suggested to reduce the traffic congestion in the peak hours in the urban Sri Lanka and to improve the public transport system is the most efficient method to control vehicular pollution.
- Existing vehicle emission testing program should be re-evaluated and should be provided with productive guidelines to prevent vehicular smoke mixing-up with the environment.
- The citizens of Sri Lanka must be used fuel wood for their cooking outsides the residents with more ventilations or use any other alternative option affordable to them with less smoke and must be avoided children expose to smoke.

- The citizens of Sri Lanka must be encouraged to use mosquito nets instead of coils.
- It is suggested to have more researches on air pollution and related health issues in Sri Lanka, merging social-science and scientific research methodologies and to have a digitalize data base with quantitative and qualitative data, enabling everyone to access.
- It is recommended to introduce more courses or curriculums in University level to produce experts on air quality management and air quality measurements techniques *etc.*
- Medias contributions to educate and aware the public with regard to the dangers of both indoor and outdoor air pollutions.

### Acknowledgement

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# Overview On Electric Propulsion Systems

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**Abstract-** This paper provides a brief overview of electric propulsion systems and their working. Novel systems and designs for electric propulsion is classified as electrothermal, electrostatic, electromagnetic and even hybrid systems which can be two or more types combined. The various types described here include DC heated Resistojets, Arcjets, Field emission electric propulsion thrusters, magneto-plasma dynamic thrusters, Hall Effect thruster, Colloid and Electro spray thrusters, High efficiency multistage plasma thruster, Pulsed plasma thruster, Electrode-less thrusters, VASIMR, and the gridded and radio frequency ion engines. Each thruster system can be used on the basis of the mission characteristics and determining factors may include cargo weight, thrust required, power budgets, simplicity etcetera. Choice of propellant can also be varied according availability. This paper hopes to provide a basic knowledge of these systems and their properties.

**Index Terms-** Resistojet, Arcjet, FEED, HET, Taylor cones, MPDT, ELT, Electro spray, VASIMR, HEMPT, QCT, GID, RF ION, PPT, azimuthal orbit, ECR, RF couplers.

## I. INTRODUCTION

### WHAT IS AN ELECTRIC PROPULSION SYSTEM?

An Electric Propulsion (EP) system is a class of electrically powered spacecraft propulsion system with components arranged that make use of electric/magnetic fields to accelerate a propellant and convert electric energy to kinetic energy from power systems of the spacecraft. EP systems usually use much less fuel than chemical rockets because they operate at a higher specific impulse (higher exhaust speed) than chemical systems, the thrust is much weaker compared to chemical systems, but electric propulsion can provide that small thrust for a long time. EP systems can eventually accelerate to really high speeds and hence work better than chemical systems for deep space missions.

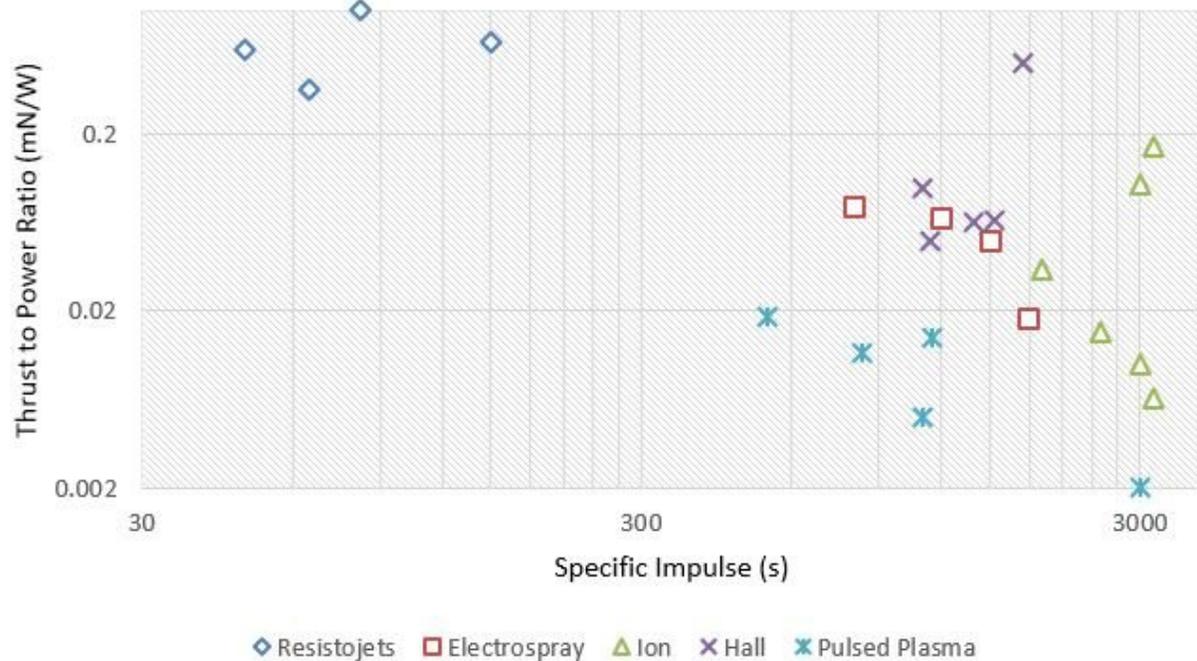
The typical EP system consists of a power processing unit (PPU), a fluid management system or propellant components, an optional pointing mechanism and the crucial thruster component. The power system supplies regulated dc bus power to the PPU, where the PPU processes raw power to suit the thruster,

as well as to heaters, valves, etcetera. The piping usually includes series and parallel valves, pyrotechnically opening or closing valves, etcetera, the designing of precise flow controls and valves are not an easy task as they are required to conation flow for long periods of time. Commands are supplied by the computer of the spacecraft, which also handle a variety of signals from pressure, sun, magnetometers, passive and other sensors.

The balance of the EP system is quite burdensome to designers as it requires the most effort and also is bulky and expensive. Fortunately, the system is not that different from the familiar cold-gas or monopropellant systems, except from a few PPU details.

Electric thrusters work by accelerating propellant atoms to high velocities. The velocity, thrust and specific impulse are directly proportional from a given amount of propellant. The propellant velocity can be increased even more in electric thrusters by charging up propellant particles and accelerating the charged particles with high voltages. The most efficient electric thrusters used today are ion thrusters and Hall thrusters. In chemical propulsion, the energy produced is limited by how much energy there is in the chemical bonds of the propellant. For different types of missions there are operational challenges such as electric transfer from GTO to GEO, station keeping, interorbital transfer, interplanetary cruise, fine agile attitude control, Long-endurance missions, etc. The addition of energy to the working fluid from some electrical source is seen in all EP systems in various physical structuring designs. The propellant and operation can be chosen according to requirement for mission, propellant can be xenon (most common due to it being unreactive and easily ionized and has a high atomic mass) or other noble gases, materials with low melting point like indium, cesium etcetera, chemical monopropellants or solid propellants. Operation can be pulsed or steady and the gas acceleration can be hybrid, thermal, electromagnetic or electrostatic. The gross performance of any electrothermal thruster is crudely forecast by means of a rudimentary one-dimensional energy argument that limits the exhaust speed of the stream from an expanded nozzle to velocity  $\leq \sqrt{2C_p T_c}$ , where  $C_p$  is the specific heat at constant pressure per unit mass of the propellant and  $T_c$  is the maximum tolerable chamber temperature (Ghostscript wrapper for C:\TEMP\AcademicPress).

## Thrust to Power Ratio vs Specific Impulse



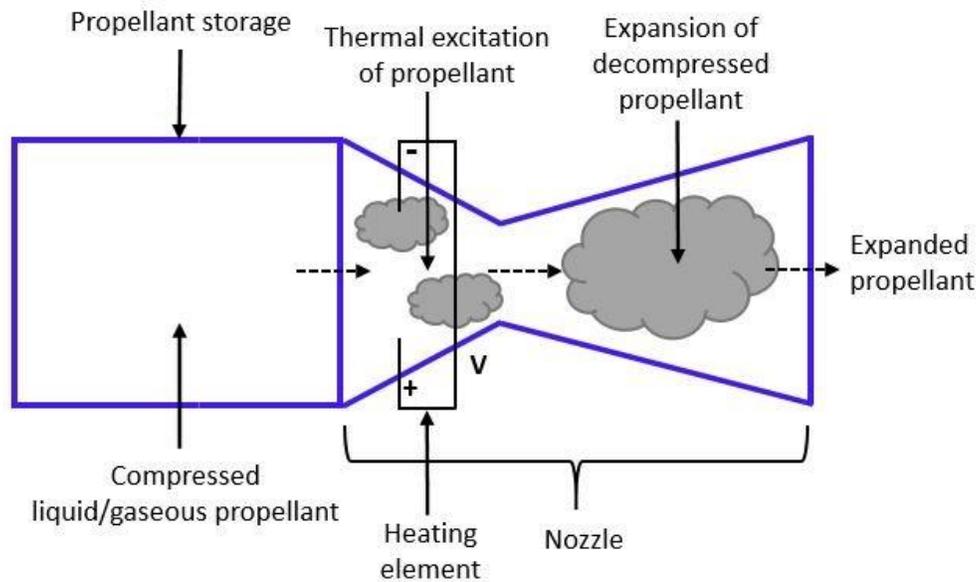
Tummala, A.R. & Dutta, A.. (2017). An Overview of Cube-Satellite Propulsion Technologies and Trends. Aerospace. 4. 10.3390/aerospace4040058.

### II. DC HEATED RESISTOJETS

Resistojets are an electrothermal thrust device that provide propulsion by heating the propellant by passing gaseous propellant around an electrical heater, sending electricity through a coiled resistor that consists of a hot incandescent filament, usually around tubes to be heated radiatively externally with the gas passing through the tube and getting heated, the expanded gas is expelled through a conventional nozzle to generate thrust. This heating increases specific impulse as  $\sqrt{T}$  by reducing gas flow rate through nozzle area. Any gas compatible with the high temperature heater according to suit of mission. Resistojets have also been proposed as means of using biowaste as reaction mass, particularly with catalytically decomposed Hydrazine which fortunately has familiar fuel systems as in hydrazine monopropellant applications. The heaters have a low input voltage and so do not require special power conditioning. A spacecraft power system requires a regulator due to the high voltage variations (>20%). In case of heater failure, as plume is not ionized and has no threat of dangerous or unusual heater failure, operation in non-superheated mode can continue. Platinum and alloy strengthened platinum were studied, pure platinum was seen to have weak thermal

resistance to the high heater temperatures, disregarding their anti-oxidative property. Two types of dispersion-strengthened platinum are currently available: one is strengthened with yttria and with zirconia (pmr-v32-i1-002-010.pdf) Although the platinum-thoria alloy was compatible with requirements of thermal, oxidative and strength issues, it is no longer manufactured. Current materials allow a maximum specific impulse of 300 sec as the temperature is limited to 2700 K, using hydrogen can give a specific impulse of 840 sec (approx) but hydrogen is not an overall optimal propellant. The main factor affecting specific impulse is molecular weight of propellant hence hydrogen is just not effective compared to oxygen, xenon, ammonia, methane and nitrogen. Efficiency ranges from 65%-85%.

The resistojet is the simplest of all EP designs, is easy to control and has simple power conditioning, but have the lowest specific impulse of all EP systems, has substantial loss of heat and gas dissociation. The heat transfer provided to the gas stream from the coil is not efficient, indirect heating and erosion of material is common. Some new designs work to reduce heat loss from coils by wire designed parallel or perpendicular to the propellant stream, and some designs have geometric structures to be immersed in the stream for heating by current flow as the stream flows around the body.



**Tummala, A.R. & Dutta, A.. (2017). An Overview of Cube-Satellite Propulsion Technologies and Trends. Aerospace. 4. 10.3390/aerospace4040058.**

### III. ARCJETS

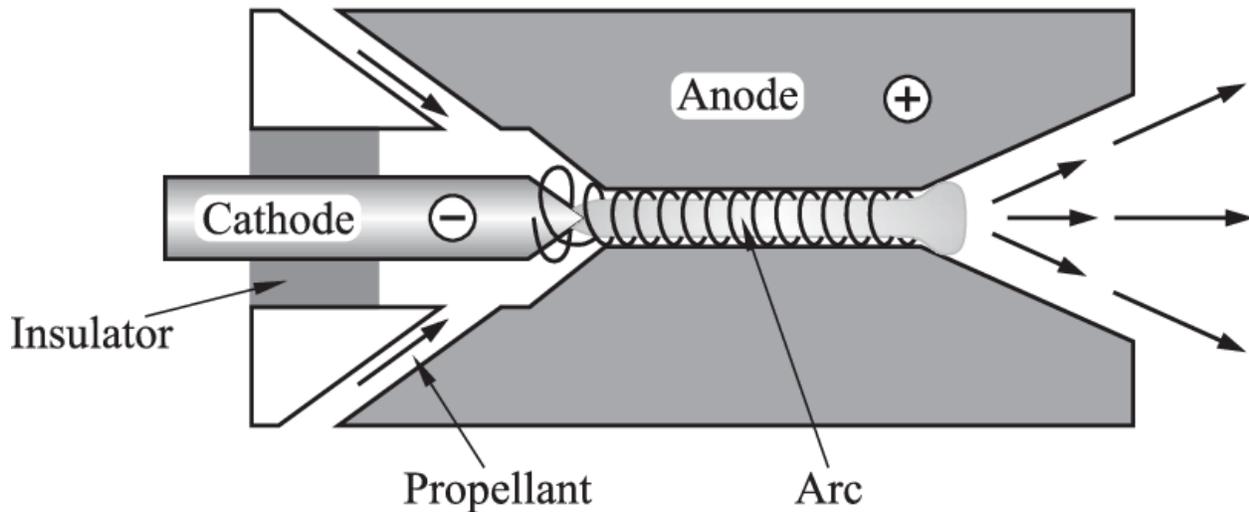
This electrothermal configuration is substantially more complex than the resistojet. Arcjets use an electric arc to heat the propellant directly between a concentric upstream rod cathode and a downstream rod anode, depositing power internally which makes it so the temperature limitation and losses in transfer from walls to gas are overcome. The anode also acts as the supersonic nozzle. The arc core has a range of temperature of 10,000– 20,000 K and the intermediate layer at about 2000 K, hence the flow at nozzle neck is extremely non uniform and the flow at the core is practically absent. This leads to high specific impulse as it reduces fluid flow without affecting pressure integral. The non-uniformity of the stream reduces the efficiency of propulsion as when heat is added uniformly across the stream, the maximum thrust is obtained. The general thrust equation is then given by:

$$F = (\dot{m} * V)e - (\dot{m} * V)0 + (pe - p0) * Ae ;$$

There are substantial losses in dissociation and power that was used to ionize the arc gases. Local heat losses are included that consist of near-electrode voltage drops. Similar to resistojets, the gas to be used will have to be considered according to mission and craft specifics and as with resistojets, hydrazine is a preferred choice as an evolutionary development from other monopropellants and familiarity of use. Arcjets using hydrazine can reach up to 600 sec of specific impulse, but the thrust

efficiency limits to about 35%-50%, which could be acceptable as per priority of power savings or fuel. Hydrazine operated arcjets have power of about 1.5 kW and up to 6000m/sec exhaust velocity. Future designs should allow the arc to cover a larger area and reduce thermal losses and resulting damages. Hydrogen as a fuel can again seem to be optimal as specific impulse reaches up to 2000 sec but low storage density and cryogenic nature of the fuel; it might become practical for missions with continuous thrusting, where the tank could be cooled by the evaporation of the feed (JOURNAL OF PROPULSION AND POWER Vol. 14, No. 5, September – October 1998). Ammonia can reach specific impulses of 800-900 sec but EP system is complex which can be unsafe for handling. The PPU is complex and requires at least a DC-DC conversion for the voltages are higher than average DC bus voltages and is often heavy to control the negative impedance characteristic of the arc, with special transitions. Erosion at high powers and bulky electrical systems are also drawbacks.

The constricted arcjet arrangement includes a central upstream cathode and a downstream anode ring, which maximizes the of heat transfer by heating the stream of gas in small cross-sectional areas. Arcjets do pose dangers related to the range of stagnation pressures used (arc stability) limiting blowdown system to the arcjet portion becoming relatively small. Arcjets are an intermediate among EP systems but could be a viable option for its high power savings, larger satellite payload, propellant efficiency and specific impulse features.



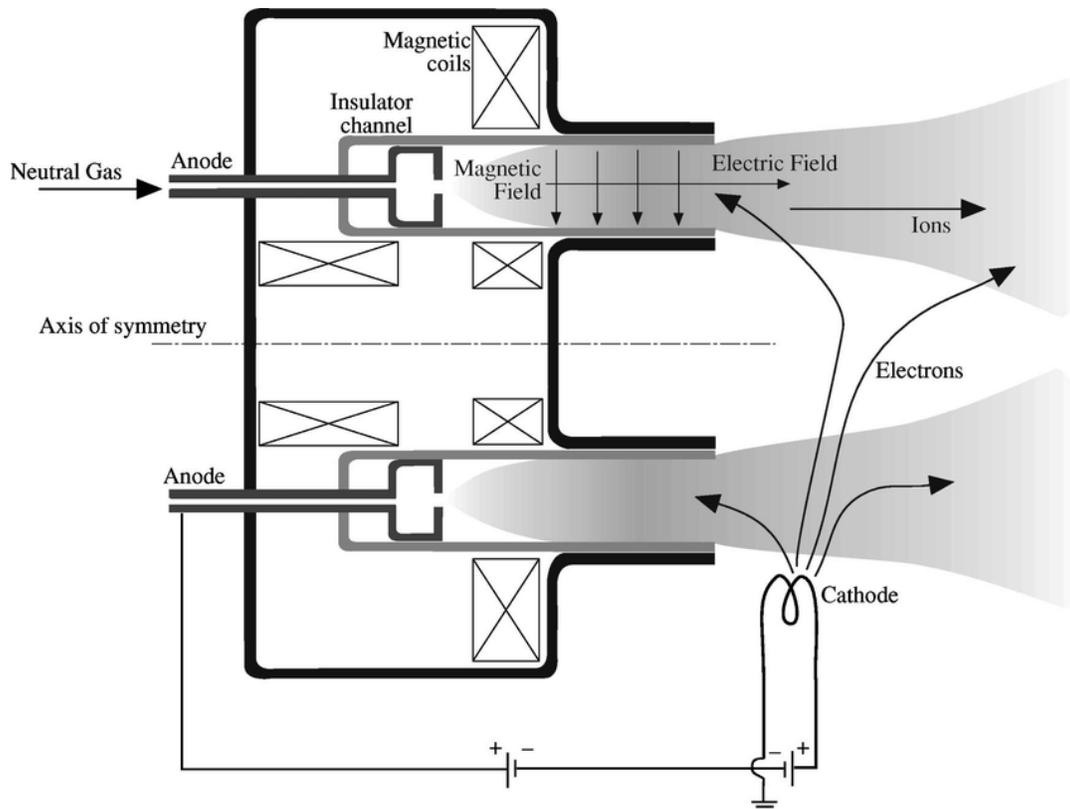
Bock, D. & Herdrich, Georg & Lau, Matthias & Lengowski, Michael & Schönherr, Tony & Steinmetz, Fabian & Wollenhaupt, B. & Zeile, Oliver & Röser, H.-P. (2012). Electric Propulsion Systems for Small Satellites: The Low Earth Orbit Mission Perseus. 10.1051/eucass/201102629.

#### IV. HALL EFFECT THRUSTERS(HET)

The Hall-effect thruster is an electrostatic ion accelerator that utilizes a cross-field cycloidal motion discharge of ions accelerated by an electrostatic field in the stream of propellant to generate plasma, the plasma electrons interact with a magnetic field to produce the electrostatic field which is described by the Hall Effect. The perpendicular fields electrostatically accelerate the ions to high velocities. The magnetic coils are set perpendicular to the main discharge for simplicity and some additional control can be established. This type of thruster is both an electrostatic and electromagnetic EP system. The electrons follow a particular closed drift path perpendicular to current flow and magnetic field(Hall Effect). The structure a Hall thruster consists of an annular discharge chamber with a radial magnetic field between a cylindrical ferromagnetic pole and an external ferromagnetic ring. the chamber forms an exit for the accelerated ions one end. The electrons travel from the cathode to anode in an externally applied electric field, the radial magnetic field results in a perpendicular force from both fields, causing them to drift in an azimuthal direction(hence formed Hall current). When the electron is being moving towards the anode(accelerated), the gyroradius increases than when it is moving towards the cathode(decelerated), giving rise to a net azimuthal drift(Hall effect). the electrons are proficiently trapped in an azimuthal orbit near the area of maximum field strength. Axial electron mobility is eradicated, allowing the plasma to sustain a very high electric field along the axis of the discharge chamber. An external cathode is present, which provides additional electrons to neutralize the accelerated ions from the discharge chamber.

Hall thrusters require relatively simple power conditioning and provide desirable specific impulse range, but

since the only propellant that can be used safely is xenon, it does not provide any choice in propellant, very few models like the HT 5K HET allow use of alternate propellants like krypton. The motion of the Hall current leads to a high beam divergence, lowering thrust axially. Erosion unfortunately takes place within the chamber. The thrusters optimize performance at very low power. Exhaust velocities can reach up to more than 65000 m/s and their power ranges from around 200 W up to tens of kW. They have propellant efficiencies of well over 50%, thrust efficiency of about 45– 55% and a thrust of more than 70mN, they have high specific impulse of 1,000–8,000 sec. there is a 5% loss in specific impulse due to propellant flow in the hollow cathode. The wide plume angle poses concern as it aligns at around 40 degrees to solar arrays and other delicate areas. Current fluctuations and some conditions may cause communications problems if the plume disrupts the antenna pattern. There are no dissociation losses even with the plume mostly or fully ionized, but it has higher operating voltage. The low gas density ensures almost collision-less stream drift, leaving the positive ions to freely accelerate downstream. So, it is much larger than an arcjet of similar power but still more compact than ion engines. The thrust, specific impulse and power can be controlled through the voltage and current is controlled by the flow rate by either varying the gas viscosity in the feed capillaries thermally or with electromechanical valves. The PPU has to manage magnetic current, flow and plasma shifts, making it much more complex than the arcjet. Some designs thruster designs include the ceramic-lined stationary plasma thruster(SPT) and the metal-walled thruster with an anode layer(TAL). The thruster specific impulse and efficiency is sort of less than that in ion thrusters, but the thrust is higher and the device is quite simple and requires lesser power apparatus to operate.



Choueiri, Edgar. (2001). Plasma oscillations in Hall thrusters. *Physics of Plasmas*. 8. 10.1063/1.1354644.

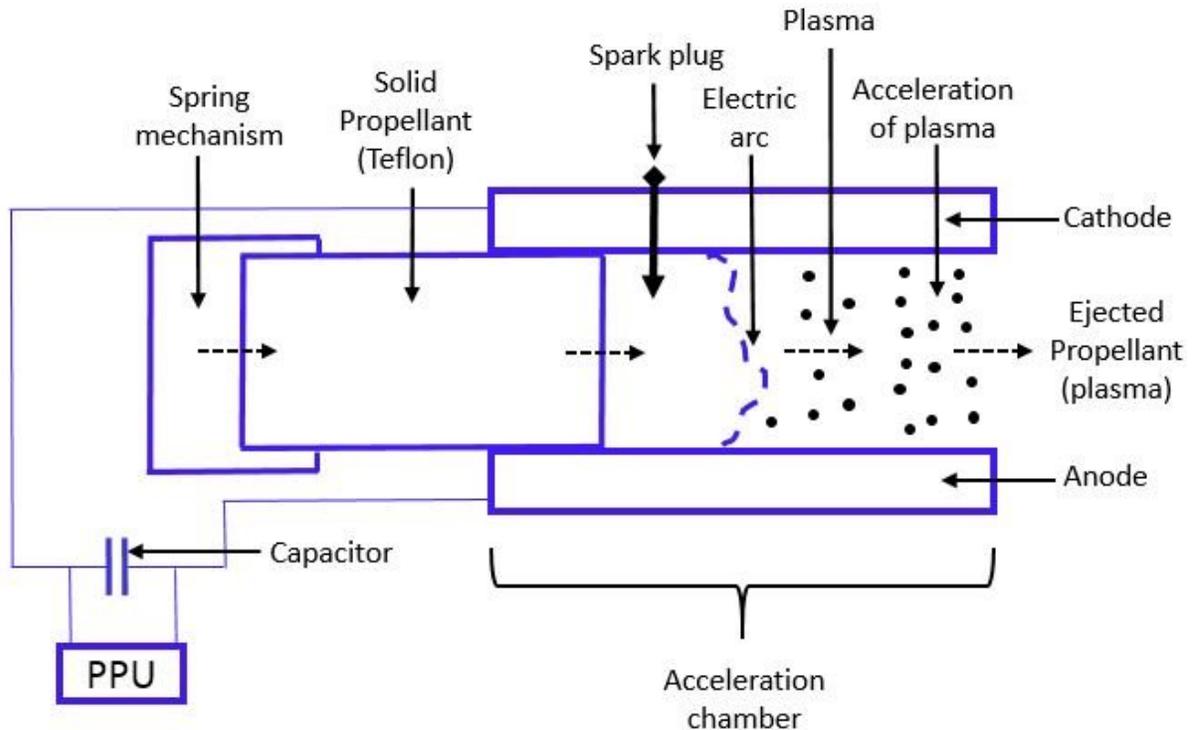
## V. PULSED PLASMA THRUSTERS(PPT)

A pulsed plasma thruster (PPT) is an electromagnetic thruster that utilizes a pulsed discharge to ionize a fraction of a solid propellant ablated into a plasma arc, and electromagnetic effects in the pulse to accelerate the ions to high exit velocity. The pulse repetition rate is used to determine the thrust level. These unique thrusters are driven in short pulse bursts of approximately 10 micro sec of high instantaneous power(10MW approx), although the instantaneous power provided by the thruster is significantly higher than the total power consumption which ranges around 10-100 W the energy for use is stored in a capacitor bank charged from the primary power supply and are delivered rapidly across the electrode propellants by a spring pushing the solid bar. They use a solid propellant, mainly Teflon or the most commonly used propellant today, Polytetrafluoroethylene(and some alternatives like acrylic plastic, polythene, PTFE variations with added LiOH and InBr or carbon or multilayered laminated propellant, Hydroxyl-terminated polybutadiene). An ignition of the spark plug, which can be either a low energy high-voltage spark gap discharge or a semiconductor spark plug, initiates the discharge delivering negligible energy. the self-induced magnetic field from the instantaneous current creates a magnetic pressure in the ionized layer similar to the gas kinetic pressure and both accelerate the gas slug close to the Alfvén velocity, at which the kinetic and the ionization energies are equal. The thruster is a single compact unit, making it safe, a given device can operate over a wide range of mean power or thrust by varying the repetition rate. The specific impulse can reach up to 5000 sec or

even more. The efficiency is only around 8-30% with the thruster extremely large for this and ones with higher efficiencies developed in the 1960s(GF-PPT systems). The higher efficiencies can probably be achieved by pulse tailoring, nozzle recovery of the thermal energy and using higher instantaneous power. There are dangers from the toxic reaction products of Teflon reactants and major disadvantages of plume contamination and widening. There have been newer models using liquid fuel injected PPTs which have similar or larger pulse durations and other similar features, and improved performance and ensure clean plume status. Some examples of liquid propellant used are pentaphenyl trimethyl trisiloxane, liquid perfluoropolyether, Ethylene tetrafluoroethylene, water, alcohol etcetera. Gas injected propellant thrusters, although very rare, provide high efficiencies and clean plume but strain implementation in spacecrafts which have limited volumetric capabilities(CubeSats) but liquid propellants promise to overcome the limited success of solid and gaseous propellants in small satellites and spacecraft like CubeSats.

Future innovation with capacitors and storage units can help reduce mass of the unit, and some research suggest discarding the electromagnetic valves for simplicity in the form of simple ablative pulsed plasma thruster(major disadvantages of this thruster the low efficiencies and spacecraft contamination) Reliability and precision control are major benefits of the PPT and are suitable for light propulsion applications. ESPs or electric solid propellants are gaining interest for their applications in propulsions with exothermal decomposition of an electrically ignited propellant that can continue till electricity is removed, one material with higher specific impulse and conductivity is a Hydroxyl-Ammonium-Nitrate (HAN) based material. Another

material researched was Sulphur, specifically for application in CubeSats.

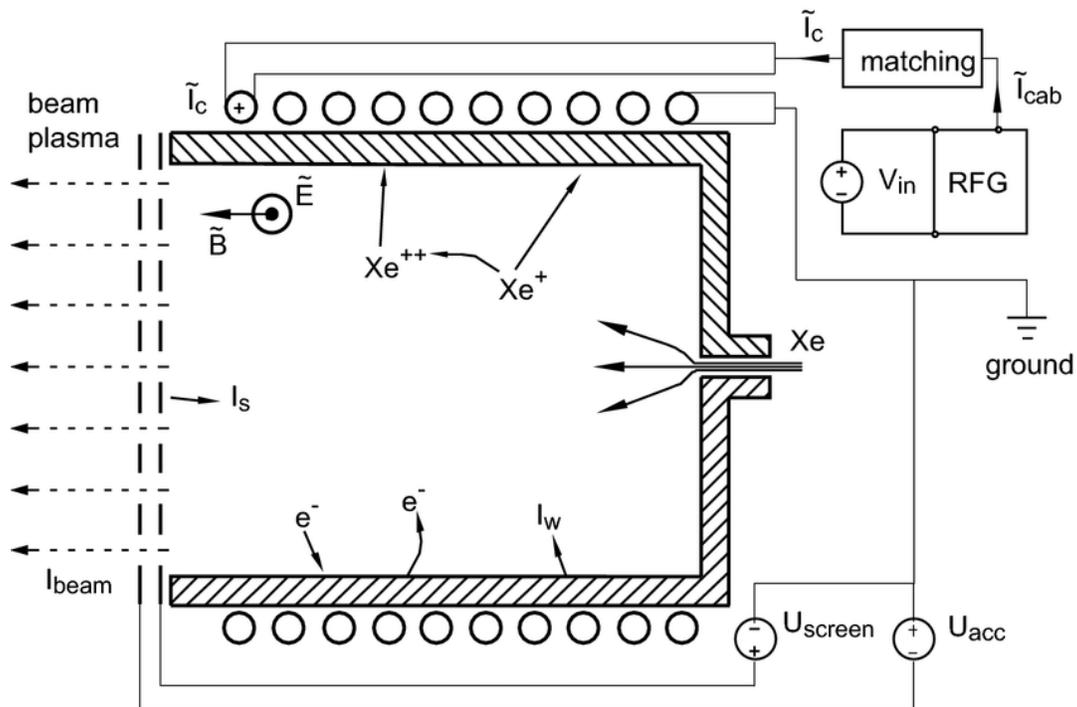


Tummala, A.R. & Dutta, A.. (2017). An Overview of Cube-Satellite Propulsion Technologies and Trends. Aerospace. 4. 10.3390/aerospace4040058.

## VI. RADIO FREQUENCY ION THUSTER(RF ION)

This thruster idea has been around since the 1910s and still remains one of the most popular. Ion engines are a form of electrostatic propulsion that ionizes a gas (mostly inert gases) by removing electrons hence forming a cloud of positive ions as exhaust, these thruster designs make use of a variety of plasma generation techniques for ionizing the most part of the propellant, the conventional technique is called electron bombardment and a novel technique being researched at NASA is called electron cyclotron resonance (ECR) which uses high-frequency radiation with a strong magnetic field to heat electrons in the gas letting them break away from the atoms and ions are extracted from the plasma so formed. The coulomb force along an electric field is the accelerating component. Electrons are produced by a hollow discharge cathode, at the center of the engine on the upstream end, from where they flow out of the cathode and attract towards the discharge chamber walls which are highly positively charged and have strong magnets placed so when the electrons approach the walls, they are redirected into the chamber. The propellant injected from the downstream end (which has electrodes placed to produce electric fields for acceleration) ionizes, and flows towards the upstream end, maximizing time spent in the discharge chamber for higher ionization efficiency. The downstream end has a second hollow cathode in the perimeter of the thruster for neutralization. The set of electrodes are most commonly gridded structures and

ion optics which will be discussed ahead. Between the accelerator grid and upstream ions is the thrust force, and the exhaust velocity depends upon the voltage applied across the optics, hence they are limited only by voltage across the optics unlike the chemical systems which depend on thermal resistance of the rocket nozzle. The thruster has two main units for management: the PPU, which converts the electrical power from the source into that required by each component of the thruster, and the PMS, which controls the flow of propellant from the tank to the thruster and hollow cathodes. The PPU provides voltages as per requirement of the optics and discharge chamber and currents per the hollow cathodes. These PPU and PMS systems do not have moving parts in modern designs and are managed by a central computer. The magnetic field only plays a secondary role guiding the electrons. The Ion engines provide less thrust per unit area as they work optimally in higher specific impulses of around 2000 to more than 10,000 sec but provide significantly better operating framework and plasma control. This results in very long lifespans (10,000 hours demonstrated) and less beam divergence although a 30 degree slant from solar arrays is necessary. The PPU systems is quite complex in comparison to other systems but are very technologically mature, all points to making them a preferred choice for deep space missions and other complex maneuvers like interplanetary orbit transfers. Ion thrusters have one of the highest efficiencies of up to 80% and significantly high specific impulse exceeding 10,000 sec.



[Pham Tran, Quang & Shin, Jichul. (2020). Better Prediction of the Performance of a Radio-frequency Ion Thruster. Journal of the Korean Physical Society. 76. 137-144. 10.3938/jkps.76.137. A zero-dimensional analytical model for an RF discharge ion thruster has been improved to predict the thruster performance better. Improvements were made by incorporating most physical phenomena expected in an RF ion thruster, such as secondary electron emission, double ionization, a variable Clausing factor, grid optical transparency, and an ion confinement factor affected by the electromagnetic field. Clausing factors were calculated for each flow rate by using a Monte-Carlo technique. The grid optical transparency was calculated using an ion optics simulation. The ion confinement factor was also calculated for each flow rate by using the calculated magnetic field strength obtained from magnetic field simulations. The ion confinement factor turned out to have the greatest effect on the results while minor corrections were achieved by other processes. Comparison with previously reported analytical solutions and experimental data showed improved prediction of the thruster performance for various size and power ranges.

positive are attracted toward the accelerator grid as the grid's potential is negative and are guided through the apertures resulting in ion jets across the grid, adding up to form the ion beam. This system can compare to classical chemical systems as propulsion speeds reach up to 90 km/s. the propellant is injected in the downstream end of discharge chamber and are bombarded with electrons for ionization. Electrons emitted from cathode can be accelerated by potential difference with anode, microwave heating, or be accelerated by an alternating electromagnet that induces oscillating electric field that leads to self-sustaining discharge (radio frequency ion thruster). The ions are accelerated by the potential difference between the first grid (screen) and second grid (accelerator) resulting in a final ion energy which depends on the plasma's potential. Space charge limit, which is the concepts that limits the extracted current, as electron are absent in the grid gap, to a level at which repulsion by ions would keep new ions from venturing in. a common ending for thruster lifespan is insufficient negative potential in the grid, which is a cause for failure of a system of prevention of electrons from streaming back into discharge plasma from the plasma beam outside, which is ensured by the negative voltage of the accelerator grid.

### VII. GRIDDED ION ENGINE (GID)

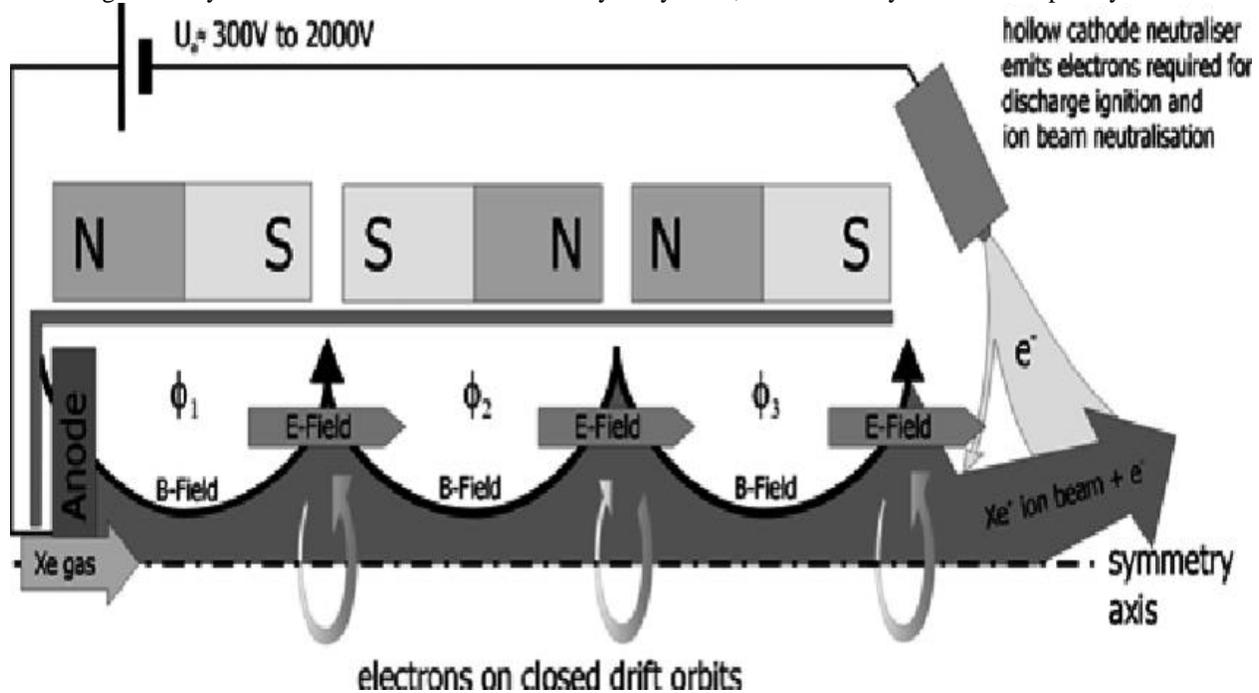
The gridded ion engines are a popular and very common design of the Ion thruster systems for use due to its high efficiency and low thrust, it is almost the same as the description given above for ion engines. On one side of the discharge chamber is a double-grid structure, with distances between each aperture of the order of 1 mm, 1-2 large across which the acceleration voltage is applied. Ions are extracted electrostatically from plasma through biased grids and are then accelerated to high velocity at voltages around 12kV the ion grid and optic electrodes comprise a large number of coaxial apertures, where each set acts as a lens that focuses ions though the grid electrically. The ions generated in regions of

### VIII. HIGH EFFICIENCY MULTISTAGE PLASMA THRUSTER (HEMPT)

This ion thruster design of EP system is a relatively new concept and a part of electromagnetic propulsions developed by Thales Deutschland GmbH in the early 2000s. An applied magnetic field by periodic permanent magnets (PPMs), is axially oriented in most channel regions, it includes a chemically inert propellant (xenon, krypton etcetera) is injected into a discharge chamber at the anode at the bottom or upstream end, the discharge chamber is made of dielectric ceramic tube that separates the plasma from the PPM system which alternates the polarity of the magnetic coils (called

cells) set across the length of the discharge tube, hence confining most electrons to the magnetic cells and reduces electron contact with the channel walls. The radial orientation of magnetic field is only at spatially confined magnetic cusps resulting in low particle fluxes towards the dielectric discharge chamber wall. A plasma source in the form of a hollow cathode placed outside the thruster emits electrons to ionize the propellant and neutralize the ion beam. The strong radial magnetic field applied holds the electrons in a drift motion as per Lorentz force ( $E \times B$ ). There have experiments to show a steep potential gradient between the first and second cells hence contributing to most of the acceleration of the ions, the second and third cells contribute to ion beam formation discharge stability. A small amount of thrust efficiency

and output are compromised due to energy transfers from collisions of the high energy particles with the walls of the chamber, these collisions can also result in wall erosions, but as the magnetic cells keep the ions well away from walls, they do not face this problem and have longer lifespans and efficiencies. The acceleration voltage ensures a high specific Impulse resulting in a significant reduction of propellant consumption, they offer a wide range of thrust making them extremely flexible. The specific impulse is usually in the range of 3000–4000 sec which can reach up to 10,000 sec and efficiency can reach to an amazing 80%. As seen, the thruster has unique features that gain attention as they have the potential to overcome most drawbacks faced by other EP systems, with relatively minimal complexity.



Matyash, Konstantin & Kalentev, Oleksandr & Schneider, Ralf & Taccogna, Francesco & Koch, N. & Schirra, M. (2009). Kinetic simulation of the stationary HEMP thruster including the near-field plume region. The Particle-in-Cell (PIC) method was used to study the High Efficiency Multistage Plasma Thrusters (HEMP), in particular the plasma properties in the discharge chamber. PIC proved itself as a powerful tool, delivering important insight into the underlying physics of the thruster. The simulations demonstrated that the new HEMP thruster concept allows for a high thermal efficiency due to both minimal energy dissipation and high acceleration efficiency. In the HEMP thruster the plasma contact to the wall is limited only to very small areas of the magnetic field cusps.

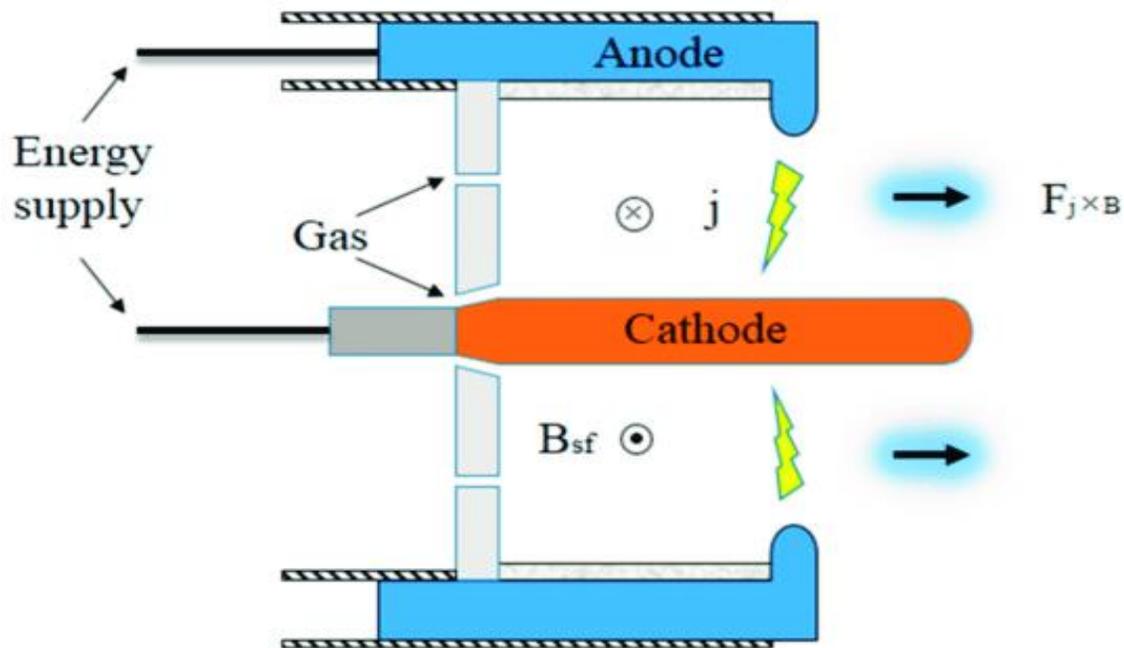
### IX. MAGNETO-PLASMA-DYNAMIC THRUSTER(MPDT)

An MPDT is an EP system which uses the Lorentz force-the force on a charged particle by an electromagnetic field-to generate thrust. The kinetic energy is gained from indirect heating and direct acceleration, there are also minor electromagnetic effects,

like a “swirl” and Hall acceleration. Generally, an acceleration chamber with magnetic and electrical fields(produced by power source) propels ionized propellant gas by the Lorentz force generated from the current flowing in the plasma and the magnetic field(either induced by current or externally applied) out as exhaust. Specific impulse and thrust are directly proportional to the power input. The current through the plasma, therefore, imparts a significant part in the creation of Lorentz force, which has an important part in the exhaust direction. This force has three components- along the thruster axis(adds to the thrust) and toward (pushes the plasma towards to the center) and perpendicular to both of these around the axis(generates a swirling effect, contributing to thrust and spreading the arc radially). The two main types of the thruster are applied-field and self-field thrusters, the central difference is in applied field the magnetic field is applied externally. The self-field thrusters have a cathode extending through the middle of the chamber, it uses a strong radial current between concentric electrodes, resulting in a magnetic pressure(directly proportional to thrust) and an azimuthal magnetic field, with a drift current. This is quite similar to PPTs except for the geometry. Applied field thrusters may use a Helmholtz coil, a solenoid around the exhaust chamber to produce

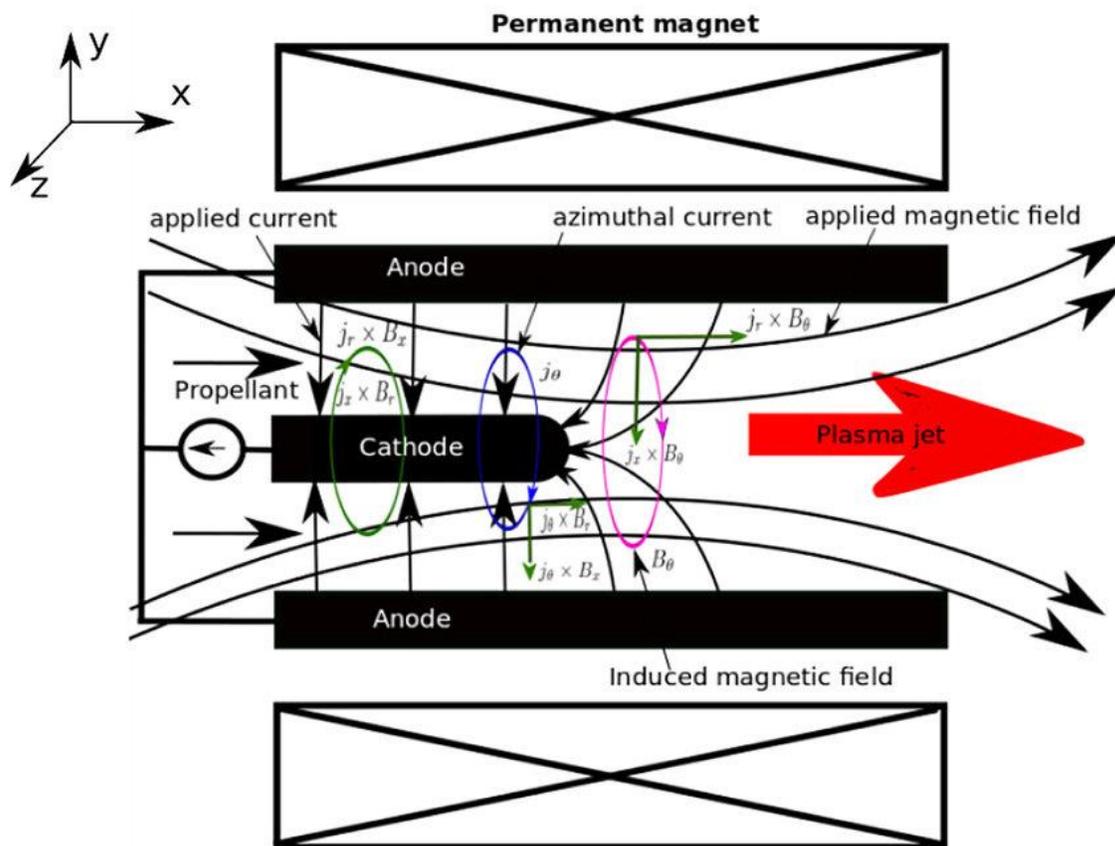
magnetic field, or a permanent magnet ring around the volume occupied by the arc, it produced meridional lines of force, arranged so as to diverge as a plume toward the exit, this force creates an azimuthal electron drift current. Many pressure, thermal and other components result in the operation being complex to understand(hence research and development is lagged), but makes it efficient in lower powers. Propellants such as xenon, neon, argon, hydrogen, hydrazine, lithium, other noble gases etcetera have been used, where lithium is usually seen to being the best performer as it reaches efficiencies of over 40%(at low power and specific impulse of 2000 sec) while noble gases have only up to 35% efficiency(at very high specific impulse of 3500 sec) and an added advantage being that it reduces erosion on central cathode significantly. Among noble gases, argon is the most important performer. Hydrogen has shown to have much higher efficiencies of over 50% and specific impulse of over 5000 sec. In applied field design, the magnetic fields can be manipulated independent of the amount of charge running through the cathode and anode resulting in a possibly extended lifespan. MPDTs have to potential of reaching exhaust velocities exceeding 110,000 m/s, about 25 times better than liquid rocket systems and extremely high specific impulses and thrust(200N), making it the highest performer

among EP systems and is regarded as a leading candidate for complicated future space missions with high payloads. The magnets however require cooling as they can heat up resulting in their properties getting degraded over time. At low power, the cooling can be done passively, at medium power, the cold gas propellant can help in cooling before being heated by the anode(this process is called regenerative cooling), the high power performing magnets which are usually the best for the thruster require a secondary cooling cycle and refrigeration system with pumps, compressors and radiators. Electromagnets do however have an advantage to change strength of the field within a range, increasing electricity and cooling if coil degrades overtime, but this isn't an option with permanent magnets, it is worth taking time for decisions with the magnetic field generation components as it is one of the lifetime limiting components of the thruster. A Helmholtz coil can theoretically tune your drive system in various ways, like pumping up the strength to constrict the plasma more if there's a lower-mass stream, but once the plasma has enough charge through it, the self-field contribution increases, which could be an advantage as at sufficient power, coil or magnets are unnecessary, resulting in a simpler, less temperature sensitive system, hence most high powered systems use self-field MPD.



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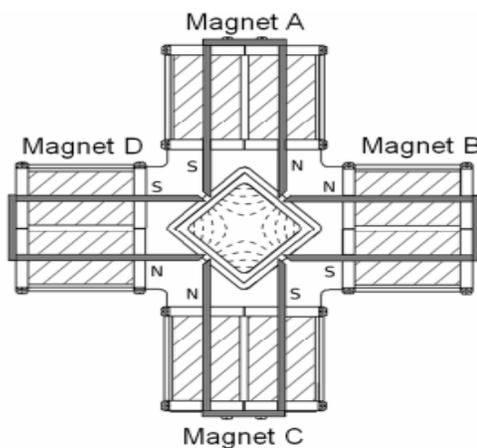


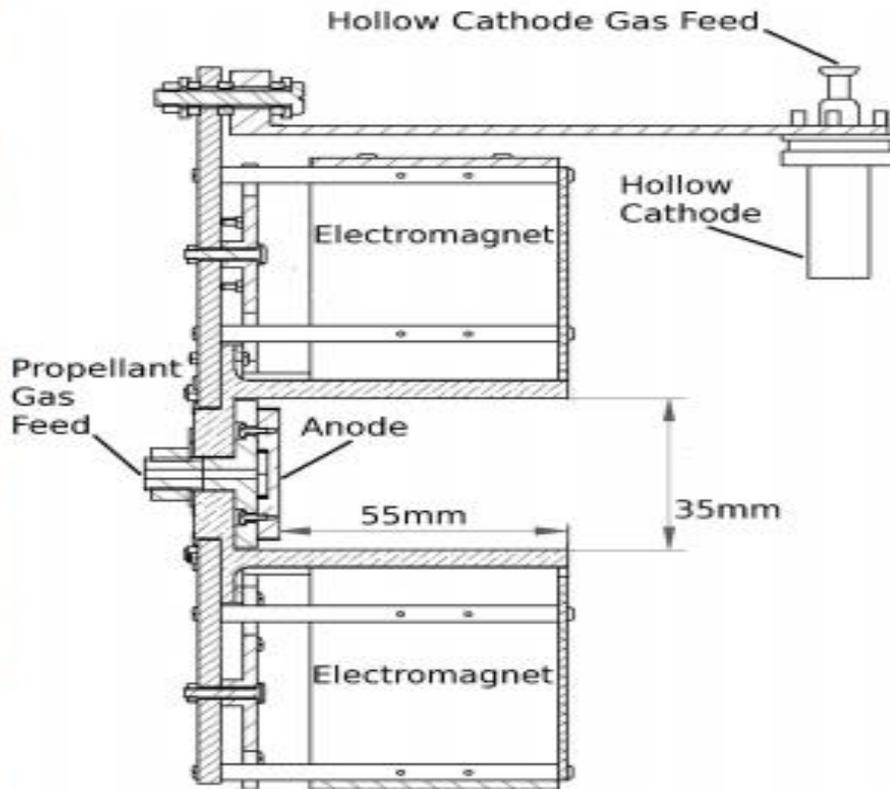
Chelem Mayigué, Charles & Groll, Rodion. (2018). Performance investigation of an argon fueled magnetoplasmadynamic thruster with applied magnetic field. *Journal of Applied Physics*. 124. 10.1063/1.5038421.

### X. QUAD CONFINEMENT THRUSTER(QCT)

The QCT developed by the Electric Propulsion Group of the Surrey Space Centre in 2009, is a new plasma propulsion design. It has a unique magnetic topology- The magnetic field contains a quadruple arrangement of eight electromagnets, four apexes at the midsections of the channel walls and a fifth apex at the center of the channel, producing an open ExB drift, this set up is for the magnetic fields to weakly confine electrons within the channel and

enhance the ionization efficiency and the ions remain unaffected by this magnetic field leading to acceleration by an axial electric field present between the cathode and anode of the thruster. The momentum of these ions leaving the thruster generates thrust. Another way of describing this system is that it consists of a perpendicular magnetic field between the external cathode neutralizer and a metallic anode. It overall resembles the HET system with a few key differences. The QCT operates at low anode voltages and it can vector thrust without the use of mechanical joints. It has very poor thrust efficiency of less than 7% and depends deeply on the magnetic field, specific impulse reaches to around 800-900 sec, more or less. The change in magnetic field causes relocation of the center of thrust and ion acceleration, providing a new ability to actively vector the direction of thrust without the need for moving parts that may prove useful to future spacecraft missions.



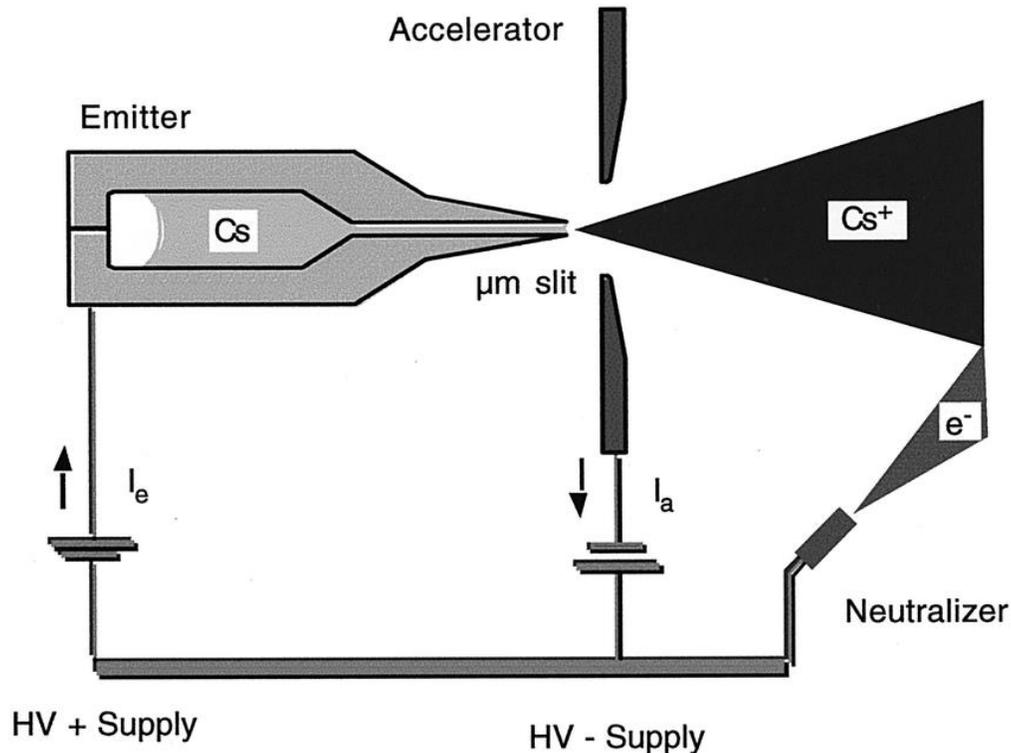


#### XI. FIELD EMISSION ELECTRIC PROPULSION THRUSTER(FEEP)

The FEEP is a complex electrostatic ion thruster EP system design that consists of an accelerator electrode, propellant, neutralizer, reservoir, an emitter and a power source. It is based on ionization of a liquid metal, and subsequent acceleration of the ions by a strong electric field. The Field Effect, which refers to generating a spray of charged ions from a strong electric field, is the main principle in use. On requirement of thrust a high potential difference is set up between the emitter and accelerator to create a high electric field, potential difference between the electrode and the free surface of the liquid metal propellant is balanced by its surface tension and it thus enters a regime of local instability from all the combined effects, and the surface deforms into protruding cusps or equilibrium cone shapes called Taylor Cones at the surface of the liquid, due to strong field intensities(110 V/m or more) in the tip of this cone, spontaneously ionized propellant jet or spray is formed and are expelled at high velocities in bulk of the liquid through a micrometric slit emitter with the help of an accelerator. Liquid metal propellant is injected through a narrow channel by capillary forces, usually the emitter is two steel halves(or any other suitable material) and a nickel layer is sprayed on one of the emitters outlining the desired channel that ends at the emitter tip. The emitter is generally positively charged and

accelerator negatively. An externally placed neutralizer like a cathode or a field effect microtip array provides electrons for overall neutrality of the ejected stream. Performance is optimized with metals or alloys, preferably alkali metals, with properties like high atomic weight, low melting points, good wettability and low ionization potentials like rubidium, cesium, indium and mercury, which ensure high mass efficiency and simplicity in overall thruster structure by discarding pressure chambers etcetera. Another design of FEEP is one based on the concept of Micro-electromechanical system, in which the thrusters, valves, and control electronics may be integrated into a single chip or a stack of chips or needle arrays. An added advantage of slit emitters compared to stacked chips array is the self-adjusting mechanism controlling the emission site formation and redistribution on the liquid metal surface, whereas the Taylor cones can only exist on the fixed tips in the stacked array, which make it consistent with one particular operating condition. Some benefits of the FEEP includes, high specific impulse(6000-12000 sec), very high, near instantaneous switch on/switch off capability, and high-resolution throttle ability (enabling accurate thrust modulation in both continuous and pulsed modes), drag free control over thrust, low noise in thrust, remarkably high thrust efficiency (close to 100%), Absence of moving parts-no valves and no pressurized gases, Self-contained propellant reservoir, high exhaust velocity of around 100,000m/sec, extremely low fuel usage. The thrust per unit power is very small (16 mN/W), which limits applicability to low-thrust precision control and the thrusters are mainly used for microradian, micronewton attitude control on spacecraft. The FEEP is one of the few EP systems that do not rely on gas-phase ionization, which is important in micro-propulsion(like for

CubeSats). Another secondary problem is the high sensitivity to surface contamination.

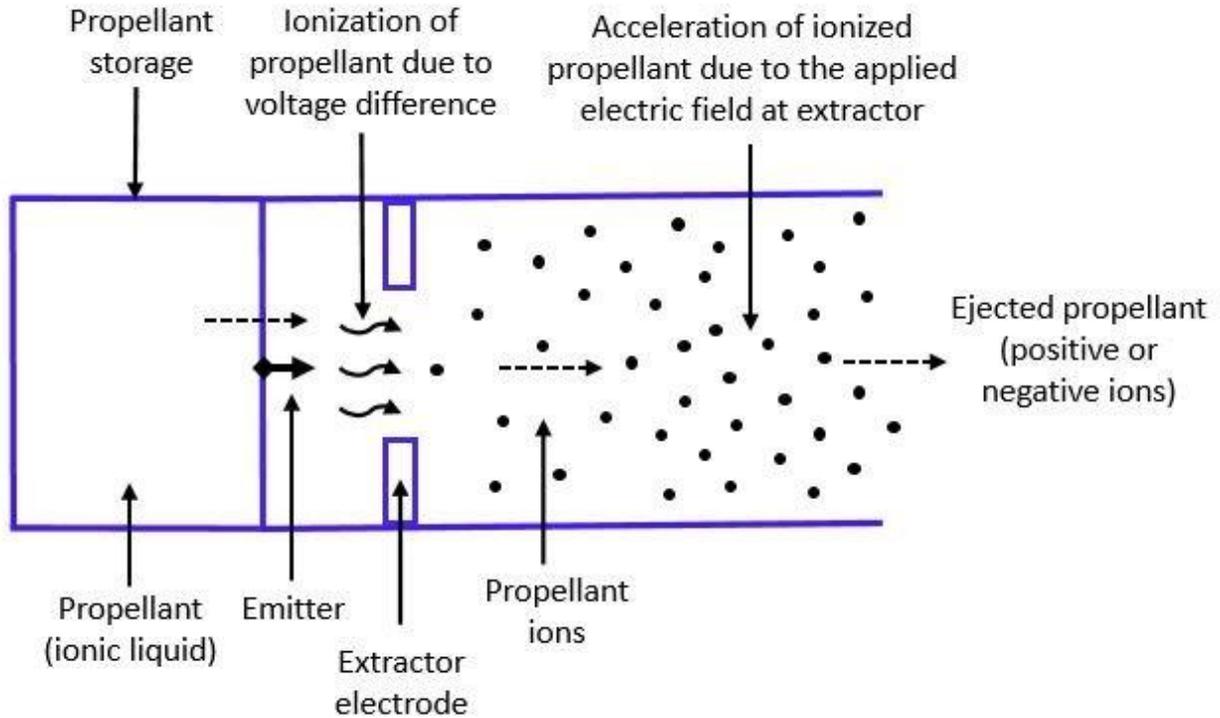


Jahn, Robert & Choueiri, Edgar. (2003). Electric Propulsion. 10.1016/B0-12-227410-5/00201-5.

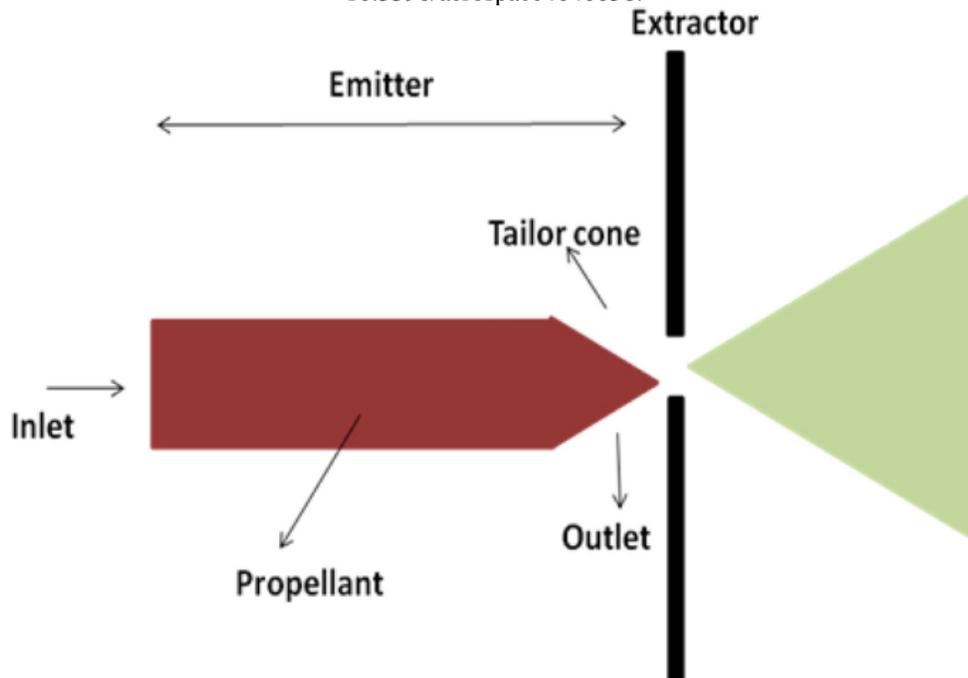
## XII. COLLOID AND ELECTROSPRAY THRUSTERS

These thrusters have been in research since the 1960s, they were developed with a goal to yield higher thrust density and would be efficient at lower specific impulse than ion engines, but this technology was put on hold for application due to the overshadow fine thrust control by the high power requirement for the very low thrust that the thruster provides. But with modernization, and interest and applications for their use in small satellites it is coming to light with developed systems to ensure significantly less power. The concept of electrospay is extraction of ions from the previously described Taylor cones for propulsion with the same creation process as above, it produces ionized aerosol droplets of liquid propellant without the complex electromechanical plumbing for pressurization and vaporization but result in nearly 100% ionization and involvement of no moving parts. It allows for

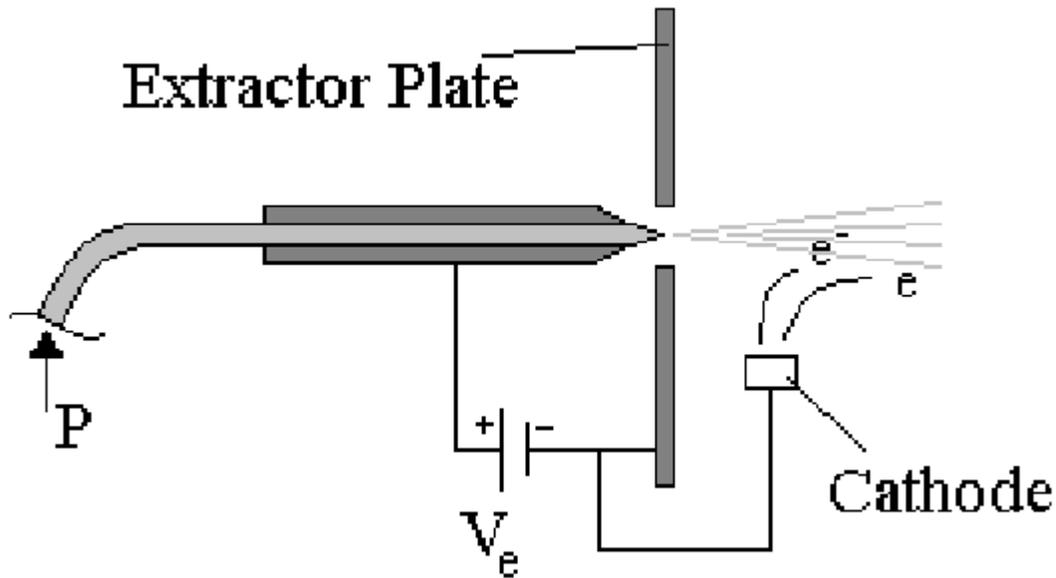
very controlled and a wide range of thrust just as described above. The colloid thruster breaks the propellant into tiny droplets instead of ions for ionization and accelerates them. The main drawback was that they required a large amount of power to produce minimal desired specific impulse. Recent work has developed colloidal engines with efficiency of 65% with specific impulse range of around 1000 sec that operate with voltages of 15– 25 kV. This system makes it perfectly suitable for micro-propulsion applications requiring high DV at good thrust/power ratios. The propellants are usually non-metallic, low-volatility ionic liquids like doped glycerol and formamide. Like other ion thrusters, its benefits include high efficiency, high thrust density, and high specific impulse, fine attitude control, efficient acceleration of small spacecraft over long periods of time. They do not use much power overall and have extremely low total thrust. They are usually not suitable for main propulsion.



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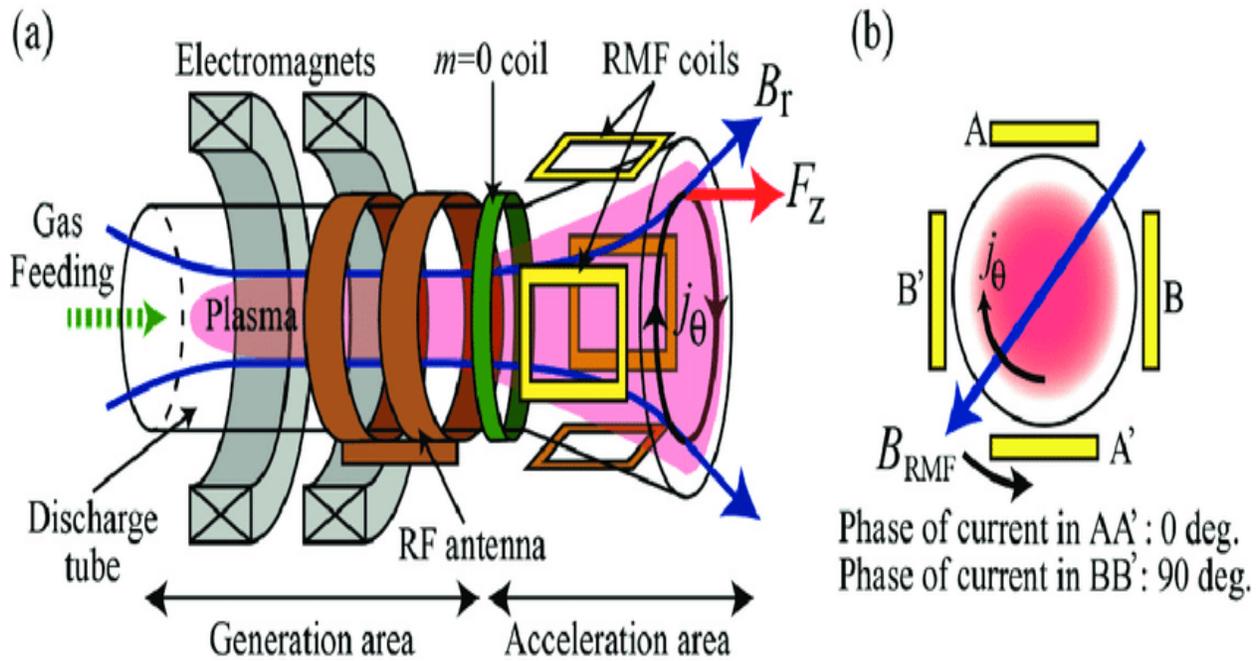


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### XIII. ELECTRODE-LESS THRUSTERS(ELT)

This thruster is a novel design with a goal to efficiently accelerate any propellant to high exhaust velocities of around 10000-40000 m/s and to operate in high power of more than 100kW, with a simple electrode-deficient, lightweight design with an almost limitless operational lifetime. It uses a rotating magnetic field drive for ionization of the propellant gas, the propellant is injected at the upstream end of thruster where it is ionized by bombarding the propellant with electrons, or by a steady electrical discharge between two electrodes or even by applying an alternating electric field via a capacitive, inductive discharge or even a helicon discharge, as the ionization is directly subjected to a magnetic field, it can utilize other ionization mechanisms such as the ion cyclotron resonance (ICR), electron cyclotron resonance (ECR) or lower hybrid oscillation. Solid propellants can be vaporized and ionized by EM waves. The ionized propellant in the plasma form is then diffused to the acceleration stage where it is accelerated by magnetized ponderomotive force in a non-uniform magnetic and electric field (high frequency) which are both applied

simultaneously. The thruster drives an azimuthal current to form a Field Reversed Configuration (FRC), which is a closed toroidal magnetic plasma set up, compressing an axial electric field against the conductive rings in the perimeter of the thruster chassis. The FRC converts the thermal energy into thrust as it expands, this is repeated in time difference the order of milliseconds, providing a seemingly constant thrust. The acceleration process is not limited by grid electrical screening or the Hall effect parameter of plasma density hence providing large thrust density. One noticeable feature of the thruster is the absence of an external neutralizer due to all plasma species being accelerated in the same direction, it is also inherently multi-staged and is optimized at all stages manually, independently. The thruster can be controlled at constant power as per requirement of higher thrust or specific impulse. The thruster also eradicates contamination and erosion issues as it has no contact between the plasma and the electrodes, making them significantly more durable than most other thrusters that use electrodes. They have low fuel mass usage than the chemical thrusters at the same thrust levels, the large thrust density allows faster missions.

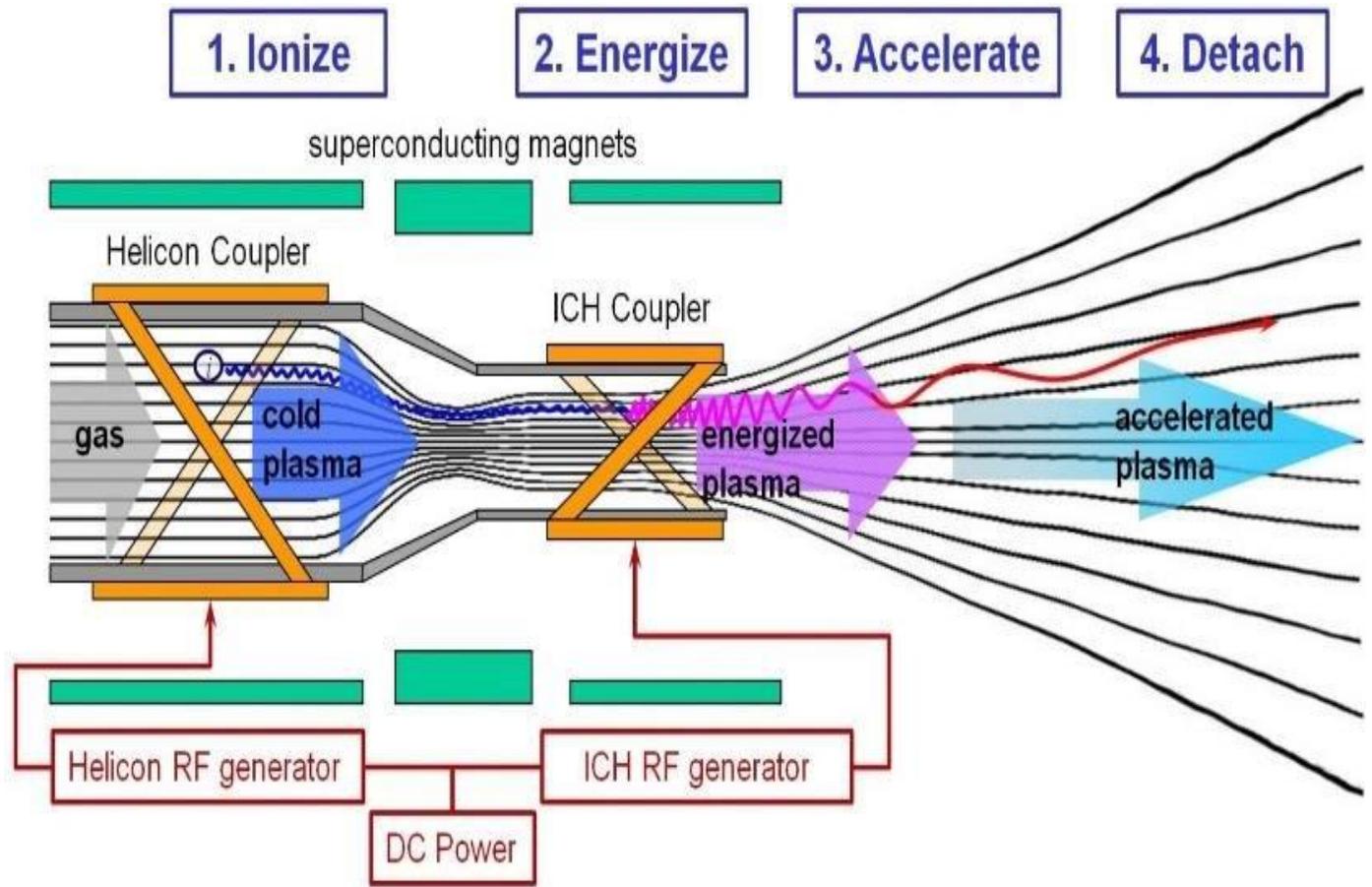


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#### XIV. VARIABLE SPECIFIC IMPULSE MAGNETO-PLASMA ROCKET (VASIMR)

The VASIMR engine is a very novel design of plasma-based propulsion systems with extremely promising applications and features, it is a type of electrothermal propulsion, it works by ionizing and heating a neutral, inert propellant using radio waves. A propellant is injected into a hollow channel surrounded by electro-magnets and an electric power source is used to heat and ionize fuel into plasma, a series of two radio wave (RF) couplers (mostly Helicon couplers which ionize gas by launching helical waves), which turn the propellant gas into superheated plasma, which is then accelerated by the electric fields. The plasma is called cold plasma though it's temperature can be as high or little more than the Sun's surface. The Ion Cyclotron Heater, the second coupler, emits electro-magnetic waves in resonance phase ions as they travel through the engine slowing down orbital speed the plasma particles, this heats the plasma to temperatures around 173 times the sun's surface. The magnetic fields direct the plasma

in towards the exhaust consisting of a magnetic rocket nozzle that converts the plasma thermal motion into a focused jet, creating thrust for the spacecraft, which can be varied allowing it to vary its acceleration. This exhaust can reach extreme velocities of the order of 180,000 km/hr. The cyclotron waves push only on the ions as they orbit in the magnetic field lines. The ions are immediately ejected from the nozzle before they achieve thermalized distribution. The ions leave the nozzle with a very narrow energy distribution as the energy of the ion cyclotron wave is uniformly transferred to the plasma in a single-pass cyclotron absorption process. It also may sport a special mode to sacrifice fuel efficiency and provide additional speed if required, hence it can either have low thrust and high specific impulse or high thrust and low specific impulse. Some propellants that can be used are hydrogen, helium and deuterium, argon, neon, krypton ammonia, iodine, potassium, rubidium, xenon and can be adapted to other solid or liquid propellants that do not pose a risk for the spacecraft. It has efficiency exceeding 70% and specific impulse of about 2000-5000 sec and scales to power of the order of megawatts of. The entire engine is magnetically shielded from the plasma, is also electrode-less and has almost no moving parts hence increasing durability and decreasing erosion. Some major drawbacks are that the strong magnetic fields and electromagnets may cause interference with other devices on board and cause unwanted torque from magnetosphere interactions. This effect can be counteracted making a net zero-torque magnetic quadrupole, by placing two thruster units packaged with magnetic fields oriented in opposite direction. This engine provides the power density needed for sustainable human exploration.



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	resistoj et	arcjet	GID/R F ion	HET	Colloid	FEEP	VASIMR	QCT	ELT	MPDT	PPT	HEMPT
type	electrothermal	electrothermal	electrostatic	electrostatic	electrostatic	electrostatic	hybrid	electromagnetic	electromagnetic	electromagnetic	electromagnetic	electrostatic
efficiency	65-85%	35%-50%	30-90%	45-55%	50-65%	95-100%	70-87%	5-7%	50-55%	35-65%	8-30%	70-80%
thrust	0.5-60	50-68	0.01-75	0.25-12	30-50	1.6-10	36-40	8.6-10	1.2-15	2.5-25	0.05-10	0.01-2000
specific impulse	150-850 sec	130-2200 sec	1500-18000 sec	1000-8000 sec	900-3000 sec	6000-12000 sec	2000-5000sec	800-900sec	1000-6000sec	5000-6000sec	1400-2700 sec	3000-10000 sec
power	450-700W	150-600W	20-250W	200W-2kW	15-25kW	90-150W	200-300kW	20-200W	100kW	100-300kW	50-200W	150-300W
exhaust velocity	3500 m/s	20000m/s	90000 m/s	50000 m/s	12000 m/s	100000m/s	180000m/s	10000m/s	10000-40000m/s	110000 m/s	14000m/s	28000 m/s

**XV. FUTURE?**

Everyone is familiar with the sight of blazing fire and smoke when a rocket is launched into space, but as great as the thrust it produces may be, it's certainly not efficient. The hopefully not-so-far future may even hold EP systems with thrust as good as or greater than conventional chemical propulsion systems. The costs for EP systems is predicted to cut down largely in about 10-20 years. Some major challenges to be addressed are facility effects, lifetime extension challenges, prototyping or making simulations and predictive models for incompletely understood systems, power and propellant improvements, etcetera. Currently, most EP systems derive power from solar systems, but if the field must develop, there have to be developments in nuclear reactor systems, NASA'S kilopower project already seems to be letting go of the limits solar EP brings by harnessing in-space fission reactors. But even without unpredictable fission reactors, solar EP systems can produce an amazing amount of energy that is the stuff of science fiction, with huge cargo, efficiencies, and speeds. There is no doubt electric propulsion systems will be the dawn of many

**XVII. APPENDIX**

This table provides a concluding condensed comparison for the electric propulsion systems described in this paper, other information that the reader may want to acquire can be referenced from the links to all references provided below.

futuristic systems with major applications in all fields but most importantly space exploration and research. New age satellites are preferred to be small and cost effective, the most popular being CubeSats, which are an affordable means to perform scientific and technological studies in space, hence have been studied diversely. CubeSats

**XVI. CONCLUSION**

This paper hopes to have provided a condensed overview of electric propulsion systems, which a very novel propulsion system but has undergone rapid development for applications in the real world which is predicted to continue undeniably breaking stereotypes and bringing fiction to reality. The descriptions and points made here will become obsolete with future development in possibly a short enough time.

The author apologizes in advance for any points that may have been missed.

**XVIII. PEER REVIEWS**

**IMPROVEMENT AS PER REVIEWER COMMENTS**

## ACKNOWLEDGMENT

I would like to show my gratitude to Brahmastra aerospace systems for sharing their pearls of wisdom with me during the course of this research, and I thank the reviewers in advance for their so-called insights, although any errors are my own and should not tarnish the reputations of these esteemed persons. Lastly, I'd like to thank myself for managing time for this paper, the first of my research, to be possible.

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# Comparison of Willingness to Process Fresh Mango into Processed Mango Products between Mango Farmers In Majalengka and Kuningan Regency, West Java

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**Abstract-** The processing of fresh mangoes into processed mango products is very important to bring added value so that it has the potential to increase family income. This study aims to identify, compare and analyze the differences of willingness to process fresh mangoes into processed mango products between mango farmers in Majalengka Regency and Kuningan Regency. The research design used a quantitative research design with survey methods through interviews with 121 mango farmers in Majalengka Regency and 110 mango farmers in Kuningan Regency who were determined by stratified random sampling technique. Data were analyzed using descriptive statistical analysis and the Mann-Whitney U-Test. The results showed that the majority of mango farmers in Majalengka Regency have the willingness to process fresh mangoes into processed mango products (60.3%). Meanwhile, the majority of mango farmers in Kuningan Regency not have the willingness to process fresh mango into mango processed products (79.1%) and those who have the willingness to process fresh mango into processed mango products are only around 20%. The age factor is the main reason for those who are interested and the factor of increasing income is the main reason for those who are interested in processing mangoes. Meanwhile, the results of the Mann-Whitney U-Test analysis showed a significant difference in the term of willingness to process fresh mango into mango processed products between mango farmers in Majalengka Regency and Kuningan Regency at the population level.

**Index Terms-** willingness to process, processing mango, fresh mango, processed mango products, mann-whitney u-test

## I. INTRODUCTION

One of the leading commodities of Indonesian horticulture is mango commodity (*Mangifera indica L*). The physical characteristics of mangoes are distinctive and their fresh taste makes them in demand by consumers in both the domestic and export markets. In Indonesia itself there are several provinces that become the center of national mango production. Based on Table 1, in Indonesia there are three provinces with the largest mango producers, namely East Java, Central Java and West Java provinces with contributions to national mango production of 40.36 percent or 1,059,325 tons from East Java Province, 16.90 percent or 443,487 tons from Central Java and 15.41 percent or 404,543 tons from West Java. However, in terms of mango productivity, West Java Province has the highest productivity among other mango producing provinces in Indonesia. West Java has mango productivity of 14.31 tons per hectare while in East Java as the largest mango producer in Indonesia only produces 12.71 tons per hectare in 2018. This shows that mango production in West Java is very productive because the harvest area is not so high but can produce maximum mango production.

Table 1. Mango Harvest Area, Production and Productivity for 2017-2018 Based on Leading Provinces in Indonesia

Province	Harvest Area (Ha)		Production (Ton)		Productivity (Ton/Ha)	
	2017	2018	2017	2018	2017	2018
East Java	88.847	83.353	898.595	1.059.325	10,11	12,71
Central Java	35.801	36.763	389.019	443.487	10,87	12,06
West Java	23.959	28.273	325.457	404.543	13,58	14,31
West Nusa Tenggara	10.819	11.265	165.25	151.354	15,27	13,44
South Sulawesi	9.083	10.386	97.026	120.968	10,68	11,65

Source: Central Statistics Agency and Director General of Horticulture, 2018

West Java as one of the largest mango producing provinces in Indonesia has five mango production centers, including Indramayu, Sumedang, Cirebon, Majalengka and Kuningan Regency so that mango production contributes to the increase of mango production at

the provincial level. For the amount of production produced by the five districts of the production center is not always high and the results vary because it does not close the possibility of behavior in different farming. Based on Table 2, Majalengka and Kuningan Regency are the two mango production centers with the lowest production in West Java. Agribusiness activities in both Regency are still at low to moderate levels. According to [1], the performance of agroindustry sub-system in Panyingkiran district, Majalengka Regency has the least performance value compared to other sub systems. This is because mango farmers do not wash mangoes, they also do not do mango sorting activities. Mango farmers also do not do grading activities because mango farmers feel they still do not understand to do these activities [2]. [3] stated that based on marketing margin, profit, farmer's share, marketing efficiency, all mango marketing channels in Majalengka are categorized as efficient. Whereas, farmers' farming behavior in Kuningan Regency has not been intensive in controlling pest attacks and this is suspected to have an effect on low farmer production [4]. So that when viewed from this, the agribusiness behavior of mango farmers in Kuningan Regency is still not efficient.

Table 2. Mango Commodity Production in West Java Province by District in 2018

Kabupaten	Total Produksi (Ton)
Indramayu	94.114,7
Sumedang	73.582,1
Cirebon	55.476,7
Majalengka	44.756,7
Kuningan	34.850,6

Source: Jawa Barat dalam Angka, 2018

The low production of mango farmers in Majalengka and Kuningan Regency is also related to their low income from mango farming. In addition, most of the mango farmers are farmers with narrow land tenure for mangoes [5]. Big farmers produce mangoes with good grades while small farmers produce bad grades [6]. Farmers can actually increase the added value of mango commodities into processed products such as fruit juice, dried mango, jam, chili sauce, yogurt, mocha, ice cream, pudding, mango powder and other types of mango preparations so that mangoes can continue to be consumed by the public and drive the selling price which can also increase so that production results are not wasted and the shelf life becomes longer. Referring to [7] and [8], even mango waste can be processed into processed mango products such as mango peel chips or other products. This processing activity brings added value so that it has the potential to increase his family's income. Especially when the mango harvest season comes, causing an over supplies of mangoes. This situation causes the price of mangoes to be cheap, and even farmers often cannot market their mango crops.

Farmers usually sell their products to *bandar* or collectors directly in fresh form. Based on the results of research by [9], it is found that farmers who carry out the mango processing process are still very low. This is in line with the results of research by [10] which states that farmers in cultivating agriculture and technology absorption are still low. This is partly due to the limited knowledge of farmers about the added value that will be generated by processing mangoes to increase their family income so that the interest of mango farmers to process mangoes is still lacking.

In terms of mango production and agribusiness potential, Majalengka Regency is relatively better than Kuningan Regency. Then the question that arises is whether mango farmers in Majalengka Regency are also more interested in processing fresh mangoes into processed products than mango farmers in Kuningan Regency. Thus, the study aims to identify, compare and analyze differences in the willingness to process fresh mangoes into processed mango products between mango farmers in Majalengka and Kuningan Regency.

## II. RESEARCH METHOD

### A. Research Object and Location

The object of this research is the farmers' willingness to process fresh mango into processed mango products. The location of this research is in Majalengka Regency and Kuningan Regency, West Java Province. The location of this research was chosen with the consideration that these two areas are regencies centers of mango production in West Java Province with relatively low mango production compared to other mango production centers in West Java.

### B. Research Design and Methods

The design in this research uses a quantitative research design using numerical methods to define an observation or variable that becomes the object of research. The research method used in this research is a survey method through interviews with respondents.

### C. Research Population and Sample

The number of population of this research is 2, namely the population of mango farmers in Majalengka Regency and the population of mango farmers in Kuningan Regency. The sampling technique used to determine the sample was stratified random sampling technique,

so that a sample of 121 respondents was obtained for the sample of farmers in Majalengka Regency and 110 respondents for the sample of farmers in Kuningan Regency.

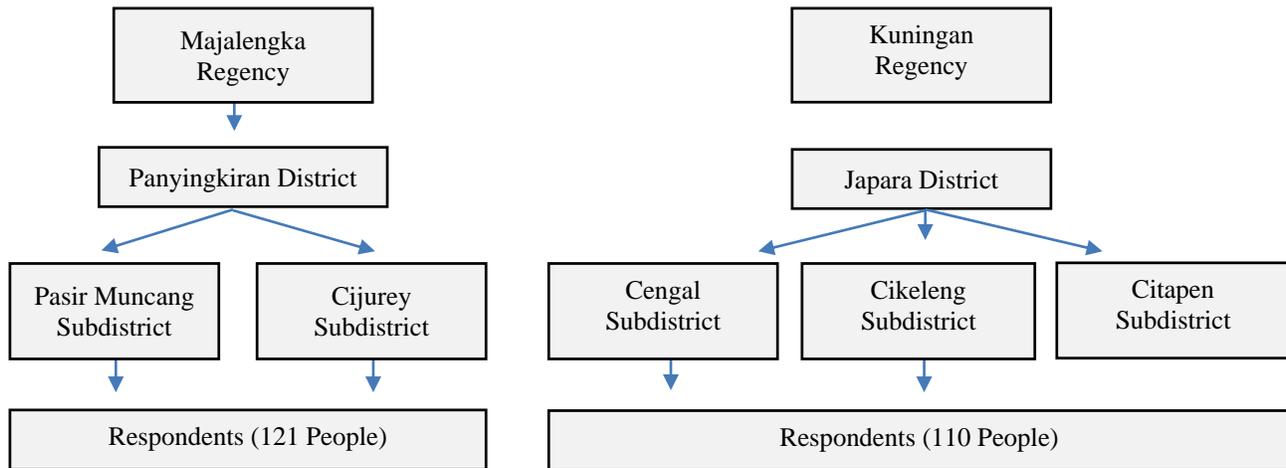


Figure 1. Sampling Techniques for Mango Farmers in Majalengka and Kuningan Regencies

*D. Data analysis*

Data analyze technique used in the research are descriptive statistics analysis and Mann-Whitney U-Test. Descriptive statistics analysis used in this study is a frequency distribution table of the variable of willingness to process fresh mango into processed mango products from sample of farmers in Majalengka and Kuningan Regencies and any other types of descriptive statistics. Meanwhile, the Mann-Whitney U-Test was used to test the differences in willingness to process fresh mango into processed mango products on populations from sample of farmers in Majalengka and Kuningan Regencies. The Mann-Whitney U-Test is a hypothesis testing for 2 independent samples with non-parametric methods for qualitative variables with an ordinal measurement scale. The steps for hypothesis test about the differences of willingness to process fresh mango into processed mango products between mango farmers in Majalengka Regency and Kuningan Regency using the Mann-Whitney U-Test as follows:

a. Hypotheses

$H_0$ : There is no difference in term of willingness to process fresh mango into processed mango products between mango farmers in Majalengka Regency and Kuningan Regency in the population level.

$H_a$ : Willingness to process fresh mango into processed mango products between mango farmers in Majalengka Regency and Kuningan Regency is different in the population level.

b. Test Statistics

The distribution form of Mann-Whitney U-Test is approximately normal distribution ( $z$ ) for large case ( $n_1, n_2 \geq 7$ ) with test statistics as follows:

$$z = \frac{U - \mu_U}{\sigma_U}$$

where

$$\mu_U = \frac{n_1 n_2}{2}$$

and

$$\sigma_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$$

Note:

$n_1$  = The size of the sample of farmers in Majalengka Regency

$n_2$  = The size of the sample of farmers in Kuningan Regency

$U$  = Number of ranks of willingness to process fresh mango into processed mango products mango of farmers in Majalengka Regency (or Kuningan Regency)

$\mu_U$  = Mean of sampling distribution of  $U$

$\sigma_U$  = Standard deviation of sampling distribution of  $U$

c. Rejection Rule

Reject  $H_0$  if  $p\text{-value} \leq \alpha$

The data analysis process is carried out using SPSS 22 software statistics tools.

### III. RESULT AND DISCUSSION

#### A. Description of Willingness to Process Fresh Mango into Processed Mango Products between Mango Farmers In Majalengka and Kuningan Regency

The results showed that the majority of mango farmers in Majalengka Regency who have a willingness to process fresh mangoes into processed mango products are as much as 60.3%, while those who are not interested in processing fresh mangoes into processed mango products are 39.7%. Meanwhile, there were 79.1% of mango farmers in Kuningan Regency who did not have the willingness to process fresh mango into processed mango products and those who had the willingness to process fresh mango into mango processed products only around 20% (Table 3). This shows that mango farmers in Majalengka Regency are more interested in developing their business more. According to [11], [12] and [13], mango farmers in Majalengka Regency have often attended counseling and training on mango development and are supported by local government policies.

Table 3. Frequency Distribution of Willingness to Process Fresh Mango into Processed Mango Products between Mango Farmers In Majalengka Regency and Kuningan Regency

Regency	Willingness to Process Mango	Frequency (Person)	Percent (%)	Cumulative Percent
Majalengka	No	48	39.7	39.7
	Yes	73	60.3	100.0
	Total	121	100.0	
Kuningan	No	87	79.1	79.1
	Yes	23	20.9	100.0
	Total	110	100.0	

Source: Primary data, processed (2020)

#### B. The Reason of Farmers about Their Willingness to Process Fresh Mango into Processed Mango Products

There are many reasons why mango farmers both in Majalengka Regency and Kuningan Regency do not have the willingness to process fresh mangoes into processed mango products. These reasons are summarized in Table 3. Mango farmers in Majalengka Regency stated more reasons than mango farmers in Kuningan Regency. However, from all the reasons put forward directly by the respondents, the old age factor was the reason most frequently cited by mango farmers in Majalengka Regency and Kuningan Regency. Mango farmers in Majalengka Regency and Kuningan Regency have an average age of over 50 years old. In addition, based on Table 4, it can be seen that the median age of mango farmers in both Majalengka Regency and Kuningan Regency is more than 50 years, meaning that more than half of the number of mango farmers in these two areas are over 50 years old with the oldest age of the respondents is 87 years old. This age factor certainly affects farm productivity. According to [14], the development of agribusiness businesses that were traditional in nature, are now more modern and global in nature, this requires young farmers to be willing to be involved in developing agribusiness in Indonesia.

Table 4. Reasons of Mango Farmers Not Interested in Mango Processing Based on Regency

Reason	Regency		Total
	Majalengka (Person)	Kuningan (Person)	
- Selling Results of fresh mango harvest is enough	2	5	7
- I'm lazy	0	1	1
- High risk	1	4	5
- Complicated, troublesome, complicated	0	7	7
- Being sick	0	1	1
- Busy	2	1	3
- Already exhausted	0	2	2
- Already old	3	20	23

Reason	Regency		Total
	Majalengka (Person)	Kuningan (Person)	
- There is no capital	2	6	8
- Nothing helps	0	1	1
- There's nothing to distribute	0	1	1
- No answer	38	38	76
<b>Total</b>	<b>48</b>	<b>87</b>	<b>135</b>

Source: Primary data, processed (2020)

Based on Table 4, it can also be seen that the average age of mango farmers in Kuningan Regency is older than mango farmers in Majalengka Regency. This shows that not many young farmers are willing to enter the world of agriculture, especially mango farming. As information from several respondents, it is known that their children prefer to work in offices and in urban areas than in the agricultural sector, especially in mango farming. This is because working in an office is more perceived as having a higher prestige than being a mango farmer. Regeneration of mango farmers, especially in Kuningan Regency by young farmers who have an agribusiness spirit is very important to be able to increase mango production and farmers' interest in not only selling fresh mangoes but also processing them into processed mango products so that it will increase farmers' income from the added value generated from processed products mango. In addition, mango farming is indeed a risky type of business [15], but young farmers will be more willing to face the risk of something new [16].

Table 5. Description of Age of Mango Farmers Based on Regency

Farmer Age	Regency	
	Majalengka	Kuningan
N	121	110
Mean	50.80	57.59
Median	50.00	57.00
Std. Deviation	13.353	11.836
Minimum	23	27
Maximum	87	87

Source: Primary data, processed (2020)

Meanwhile, mango farmers who are interested in processing fresh mangoes into processed mango products have the most reason to increase their income. There are also those who have reasons to be more successful, increase knowledge, seek experience and want to be independent. These reasons may be cited by young mango farmers. Meanwhile, old mango farmers have another more visionary reason, namely that the mango processing business can be passed on to their offspring.

Table 6. Reasons of Mango Farmers Interested in Mango Processing Based on Regency

Reason	Regency		Total
	Majalengka (Person)	Kuningan (Person)	
- In order to be passed on to offspring	2	0	2
- To be more successful	7	0	7
- Increase knowledge	4	0	4
- Increasing income	29	14	43
- Looking for experience and want to be independent	2	0	2
- No answer	29	9	38
<b>Total</b>	<b>73</b>	<b>23</b>	<b>96</b>

Source: Primary data, processed (2020)

### C. The Differences of Willingness to Process Fresh Mango into Processed Mango Products between Mango Farmers In Majalengka and Kuningan Regency

The results of the Mann-Whitney U-Test analysis regarding the differences of willingness to process fresh mango into processed mango products between mango farmers in Majalengka Regency and Kuningan Regency show the value of Asymp. Sig. equal to  $0.000 < 0.01$

=  $\alpha$ . This means that there is a significant difference in the willingness to process fresh mango into processed mango products between mango farmers in Majalengka and Kuningan districts at the population level (Table 7).

Table 7. Results of the Mann-Whitney U-Test Analysis

Regency	Willingness to Process Mango		
	N	Mean Rank	Sum of Ranks
Majalengka	121	137.68	16659.50
Kuningan	110	92.15	10136.50
Total	231		
Test Statistics <sup>a</sup>			
Mann-Whitney U		4031.500	
Wilcoxon W		10136.500	
Z		-6.059	
Asymp. Sig. (2-tailed)		.000	

a. Grouping Variable: Regency

With this significant difference, it can be concluded that one of the group has a greater willingness to process fresh mango into processed mango products than other group by comparing the mean rank value of the willingness to process mango between Majalengka Regency and Kuningan Regency. Based on Table 7, the mean rank value of willingness to process mango in Majalengka Regency is 137.68 which is greater than Kuningan Regency with a mean rank value of 92.15. Thus, it can be concluded that at the population level with a confidence level of 99%, that the willingness to process fresh mango into processed mango products by mango farmers in Majalengka Regency is greater than the mango farmers in Kuningan Regency.

#### IV. CONCLUSION

The majority of mango farmers in Majalengka Regency who have a willingness to process fresh mangoes into processed mango products are as much as 60.3%, while those who are not interested in processing fresh mangoes into processed mango products are 39.7%. Meanwhile, there were 79.1% of mango farmers in Kuningan Regency who did not have the willingness to process fresh mango into processed mango products and those who had the willingness to process fresh mango into mango processed products only around 20%. The old age factor was the reason most frequently cited by mango farmers in Majalengka Regency and Kuningan Regency so that they do not have the willingness to process fresh mangoes into processed mango products. Meanwhile, mango farmers who are interested in processing fresh mangoes into processed mango products have the most reason to increase their income. Then, based on the results of the Mann-Whitney U-Test analysis can be concluded that with a confidence level of 99%, that the willingness to process fresh mango into processed mango products by mango farmers in Majalengka Regency is greater than the mango farmers in Kuningan Regency at the population level.

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# The Influence Of Information, Education And Communication On The Success Of Human Rights Education School Programmes In Kenya

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**Abstract-** The aim of this paper is to establish the influence of information, education and communication on the success of human rights education school programmes in Kenya. Human rights education has been upheld as one of the key measures set to enhance the human rights among the communities. Through Human Rights Education, awareness on human rights is created as well as ensuring every individual is at the forefront of observing, respecting, and advocating for the human rights. In the past two to three decades, there has been an emergence of human rights organizations at both international and local contexts. These organizations have come up with varied strategies of promoting the effectiveness of human rights education. One of these strategies is the use of Information Education and Communication in HRE school programmes. A sample survey research design was adopted. A sample size of 369 respondents was drawn from a population comprising of students, teachers and key informants from the human rights organizations in Kenya. A structured questionnaire and interview schedule was used to collect data for the study. Data was analysed using mixed method analysis. The findings revealed that some of the IEC strategies preferred included drama, videos, discussions and case studies. These methods were found to significantly influence the success of human rights education programmes in Kenyan secondary schools.

**Index Terms-** Information, Education and Communication, Human Rights Education.

## I. INTRODUCTION

Protecting the Human Rights has been at the forefront of many international and local intergovernmental and non-governmental organizations for the past two decades (Lee & McLoughlin, 2010). The main motive has been to ensure that human rights are upheld and any violators of the latter are brought to book. Locally, such bodies include Human Rights Commission (KHRC), Legal Resources Foundation (LRF), Community Based Development Services (COBADES) and Centre for Law and Research International (CLARION).

As a way of making their efforts fruitful, most of the human rights crusaders have majorly focused on promoting education and creating awareness on the human rights. This is the first step towards making the goals of the Human rights crusade successful

(Wheeler, Yeomans, & Wheeler, 2008). For citizens to claim and defend their rights, they have to know them. This appeared to have been the principle that propelled NGOs into initiating activities among the Kenyan citizens. Thus HRE became necessary for citizens to learn and value their Human Rights. Educated citizens, it was expected, would take responsibility in respecting, defending and promoting their rights as well as the rights for others. To enhance the effectiveness of the human rights observance, the institutions came up with Schools' Outreach Programmes (SOP). This was initiated with one principal and immediate goal- to instill a culture of awareness, respect for and acknowledgement of human rights and democratic principles among students. Another goal was to raise a culture of resistance to human rights violations. At LRF, for example, the Schools' Outreach programme was born. The three-year programme, covering year 2000-2003, was conducted in 45 secondary schools in Nairobi, Thika, Maragua, Makueni and Kiambu districts. The main objectives of these programmes have been to create general HRE (Human Rights Education); to equip teachers with the knowledge and skills for passing the same to the students, to establish a network of teachers who could advocate for democracy and HRE for their inclusion in the school curriculum, to empower students to think critically on HRE issues, and to promote tolerance among the citizenry (via schools) (Greenhow, 2011).

As NGOs dealing with HRE in secondary schools fast mushroomed, there arose a need to coordinate their work in schools to not only reduce duplication but also to enhance effective delivery of non- formal HRE. As a result, in 1999, various Human Rights NGOs came together to discuss ways of cooperating to enhance their collective effectiveness in the teaching of HRE in schools. This cooperation would grow into the fully-fledged network dubbed the Forum for Legal and Human Rights Education in Kenyan schools – FLEHURE.

FLEHURE members have continued to work with students through non – formal and co- curricular avenues such as law clubs, debating, child rights, history and government clubs, pastoral sessions and whole school lectures. As a result, schools offering Human Rights Education through non- formal and co- curricular avenues have grown in number from a handful in 1998 to almost 500 secondary schools today – one seventh of all secondary schools in Kenya. For several years now, NGOs have directed their IEC efforts in the activities of the Schools Outreach Projects. Through activities such as essay – writing competitions, establishment of students' magazines, training of teachers as

trainers, formation of law – related clubs, debates/ talks/lectures in schools, mock trials, conducting inter and intra – schools debates and so on, HRE has been taken to schools (Webb, 2009).

It was hoped that cultivation of a culture to respect human rights could reduce Human Rights violations that is so rampant in schools and improve communication between students and administrators /teachers. Unfortunately, there is still a wide gap between Human Rights awareness and behavioural change in matters of Human Rights among secondary school students.

### **Problem Statement**

Despite the various efforts put in HRE in secondary schools, human rights violations continue unabated even in schools where HRE is being carried out. The IEC strategies used neither seem to bring about a “greater sense of justice, tolerance and fairness” nor “developing a willingness and ability to resolve disputes through informal and where necessary, formal mechanisms”. A good example is the circumcision of 12,000 school- going girls in December 2003. Out of the 12,000 girls circumcised, 5,000 later dropped out of school. In 2019, the prevalence of FGM in Kenya still stands at 21% despite the increased awareness creation and focus on human rights school programmes (UNICEF, 2019).

A report by the Kenya Human Rights Commission (2018) revealed that human rights in Kenya are yet to gain any improvement with cases of GBV increasing by 39% and cases of child abuse increasing by more than 31%. This is an indication of low uptake of HRE. Empirical literature has revealed IEC to be a key driver in civic education. This however is yet to be proved in a local extent especially as far as HRE is concerned. It is against this background that the study seeks to assess the influence of Information Education and Communication on the success of human rights education school programme in Kenya.

### **Objectives**

The main aim of this paper was to establish the influence of Information, Education and Communication on the Success of Human Rights Education School Programmes in Kenya Specifically, the paper sought to:

1. Establish the IEC strategies were used to administer HRE in secondary schools
2. Establish the relationship between the quality of IEC strategies used and performance of HRE

## **II. LITERATURE REVIEW**

### ***The Group Dynamic Theory***

Initially developed by Kurt Lewin, the main assumption of the Group Dynamics approach is that the individual is a social being with an intimate dependency on others for knowledge and decisions on his attitudes and actions. In sharing beliefs, attitudes and behaviour, the group one belongs to or identifies with are important.

According to Zimbardo and others (1977), the main factor that changes people’s attitudes, beliefs and perceptions is the discrepancy between the individual’s attitudes or behaviour and the group norm. Other people do not have to persuade you by arguments, they need merely to hold a position that is different from yours, and you have to be aware of that discrepancy

(Mbindyo). If you really need to gain their acceptance, approval and recognition, that can cause you to change.

This theory acknowledges the importance of developing strategies around group norms (read law clubs). IEC strategies for HRE must identify the positive norms of groups of students and teachers and strengthen them by motivating members.

### ***The social Learning Theory***

The Social Learning theory argues that most human behaviour is learnt observationally through the informative function of modelling. The theory looks at behaviour and the situation. The theory argues that there is a continuous reciprocal interaction between a person’s behaviour, events going on within a person and the environmental consequences of that behaviour. Thus most human behaviour leads to consequences that feedback on behaviour, either maintaining or changing the probability of similar behaviour in the future. The theory assumes that the mechanism by which a person’s behaviour is changed is a form of learning (Barbour & Plough, 2009).

The important dimensions in the Social Learning theory are that people can directly experience the consequences of their own behaviour; people can learn by observation (also known as observational or vicarious learning) and through media exposure. Planners of human rights education should therefore use a combination of media channels to change the students’ behaviors and attitudes.

The theory also emphasizes vicarious reinforcement or incentives. This is indicated when observers increase behaviour which they have seen others reward. Since both direct and vicarious reinforcement inevitably occur together in everyday life, it is their interactive effect, rather than their independent ones that should be of primary interest to HR information campaigns.

### **Information Education and Communication (IEC) and Human Rights Education (HRE)**

IEC as a process of interventions used through the mass media, interpersonal communication, traditional media or group communication to create awareness and attitude change, motivate or change behaviour of an individual or groups of people (Naveh, Tubin, & Pliskin, 2010). The goal of IEC, according to this report, is to increase awareness or change attitudes, beliefs, values and behaviour within individuals or groups of individuals. Thus the outcome of an IEC intervention is increased awareness as well as a change in individual or community’s, attitudes, values and behaviour (Schroeder, 2011).

Abdu-Raheem (2012) defines communication by categorizing it into two: planned or unplanned processes. Through these communication processes, one person may influence the behavior of another person. Thus communication is generally a science of interactions between individuals that have behavioural consequences and not one of communication gadgets or hardware. What others called IEC (Delgado, 2006). Abdu-Raheem (2012) calls planned communication. Planned communication includes all those deliberate interventions that are aimed at achieving predetermined changes in the covert and overt behavior of the communicate.

Abdu-Raheem (2012) likens the process of planning and implementing an intervention to the steps involved in the process

of clinical treatment in which a physician begins with a diagnosis of the illness before he administers effective treatment.

Successful IEC campaigns should combine informational, educational and motivational processes. It aims at achieving measurable behaviour and attitude changes within specific audiences, based on a study of their needs and perceptions (Nsega, 2010). IEC has to be well articulated with the provision of relevant products and /or services. It requires multi-disciplinary skills and may borrow techniques from various disciplines. Designing an IEC strategy is a cyclical, trial – and – error process (Paechter, 2009). It involves proposing options and making informed decisions in a systematic and step- wise manner.

Communication is a planned process aimed at motivating students and teachers and the entire school community to adopt new attitudes or behaviour, or to utilize existing services (Brady, Holcomb, & Smith, 2010). It is based on the target audiences’ concerns, perceived needs, beliefs and current practices. It promotes dialogue (two – way communication), feedback and increased understanding among teachers, students, parents, school administrators and all other actors in a school environment. It is thus an integral component of all services and outreach activities. This process is most effective when it involves a strategic combination of mass media, and interpersonal (or face – to – face) communication supported by print media and other audio – visual aids (Halil, 2012). Education on the other hand refers to the process of facilitating learning to enable teachers and students to make rational and informed decisions, and to influence their behaviour over the long-term. (UNFPA, 1992).

### III. METHODOLOGY

A sample survey design was used. This is an essential survey design that helps to capture original data and describing a population too large to observe directly. The target population comprised of secondary schools in Kenya that had implemented the HRE and human rights organizations in Kenya. A total of 369 respondents were surveyed. These were purposively sampled. Primary data was obtained through focused group interviews and a structured questionnaire. Both qualitative and quantitative data was therefore captured. The collected data was analysed through mixed method (descriptive and content analysis).

### IV. FINDINGS

#### *Information, Education and Communication Strategies*

The research sought to find out the communication channels preferred or not preferred by learners in the teaching-learning process of HRE. Asked to cite the teaching methods they preferred during learning of HRE, learners gave the following response: Least preferred and not at all preferred were compressed into not preferred. Most preferred and more preferred were compressed into preferred. Debates were the most preferred methods of learning HRE, with 81 percent preferring it, followed by discussion groups with 76 percent. These findings were expected. This is because these two most preferred methods require active participation of learners as opposed to, say, lectures where learners are more passive. On the other hand, the two methods demand for more time for preparation and implementation by teachers.

**Table 1: Teaching Methods Preferred by Learners of HRE**

Teaching methods	Total		Preferred		Not preferred		No response	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<b>Debates</b>	180	81	27	11	15	7	222	100
<b>Discussion groups</b>	170	76	29	13	23	10	222	100
<b>Research</b>	140	63	57	26	25	11	222	100
<b>Lectures</b>	124	56	70	32	28	13	222	100
<b>Class Discussion</b>	116	51	65	29	41	18	222	100
<b>Panel discussions</b>	91	41	92	41	39	18	222	100

#### **Effectiveness of IEC Strategies**

Asked about strategies they preferred during learning of human rights, learners gave the following responses: Majority of respondents, 84 percent, preferred the use of drama while learning HRE. This was followed by videos, with 67 percent while role playing and games scored 64 percent each. Even though poems are involving, most learners in secondary schools do not like them.

Most students complain that poems are difficult and boring. In this study, poems were rated sixth, with 58 percent. The same applies to songs and dance, which scored 56 percent. The three least preferred strategies were posters with 83 percent of learners not preferring them and flip-charts and talk and chalk, each with 37 percent saying they did not prefer them.

**Table 2: IEC Strategies Preferred by Learners During Teaching of Human Rights**

Strategies	Preferred		Not preferred		No response		Total	
	No	%	No	%	No	%	No	%
<b>Drama</b>	187	84	10	4	25	11	222	100

<b>Videos</b>	171	67	27	12	24	56	222	100
<b>Role playing</b>	143	64	37	17	42	19	222	100
<b>Games</b>	141	64	44	20	37	16	222	100
<b>Case studies</b>	133	60	42	19	47	21	222	100
<b>Poems</b>	129	58	54	24	39	18	222	100
<b>Songs &amp; dance</b>	126	56	41	19	55	25	222	100
<b>Talk and chalk</b>	119	53	93	37	21	9	222	100
<b>Posters</b>	96	43	183	83	40	18	222	100
<b>Flip- charts</b>	83	37	82	37	57	26	222	100

Interpersonal communication is an appropriate strategy among teachers in the teaching of HRE in secondary schools in Kenya. Majority of teachers (86 percent) used it to share information with other law club patrons. However, 14 percent of teachers never shared any information with patrons of law clubs from another school. This percentage, though small, demonstrates that more efforts are needed in mobilizing teachers in the teaching of HRE among secondary school students in Kenya.

It was also found out that majority of teachers in the study had played a great role in starting a law club in another secondary school. This was done through convincing a teacher from another school to start a club at that school. 57 percent of the teachers' sample had convinced a teacher from another school to start law club. Nevertheless, the big minority of 43 percent who have never convinced another teacher to start up a law club in another school is a matter for concern. This is expected, as only a satisfied acceptor can actively convince another to accept a new innovation for instance HRE.

Concerning the sharing of information with fellow teachers in the school, the study found that 14.3 percent of the teachers of HRE do so all the time while a big majority of 71.4 percent do so sometimes. A small minority, 14.3 percent, indeed those that felt that Human Rights NGOs have abandoned them, share with fellow teachers rarely.

## V. CONCLUSION AND RECOMMENDATIONS

The study concluded that drama, videos, role playing, games and case studies were the main preferred Information, Education and Communication strategies preferred by earners in teaching and learning the Human rights Education. These strategies played a critical role in ensuring that the learners benefited from the educational programmes on human rights. The teachers on the other hand preferred school interchange programmes as a way of enhancing the success of Human Rights Education.

The study concluded that the human rights education is more effective through use of IEC. By sharing the preferred information in the right manner and promoting the access of information among the learners, HRE learning achieved better results. In this regard, the success of HRE would require more emphasis on information sharing and more interactive sessions between the learners and the teachers.

Continued focus, follow-up, clear goals and objectives, appropriate exposure and use of clear concepts and experts should be embraced as a way of making learning more effective and

impactful. Valuation of learners and training of teachers and patrons of school clubs should also be emphasised as a strategy towards ensuring effective learning process and the success of HRE.

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# Comparative Study Of Uyghur Manuscripts Of The Epos “Kholdorkhan”

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**Abstract-** This article deals with the Uyghur manuscript of the epic "Kholdorkhan". The focus is on the work of world scholars who have studied the epic scientifically. The Uyghur version of the epic "Kholdorkhan" is subjected to a comparative analysis of the manuscript with oral versions, and the peculiarities of the manuscript are revealed. The article also compares the Uyghur manuscript and oral versions with the manuscript and oral versions of the Uzbek epic Gorogly. It should be noted that the Uzbek epics "Gorogly" played a special role in the formation of oral and manuscript copies of Uyghur epics "Gorogly". The role of the epic in the work of folk singers is highlighted. The analysis will also focus on the Caucasian and Central Asian versions and other versions of the Turkic peoples.

**Index Terms-** “Kholdorkhan”, Uyghur manuscripts exzempyles, Turkish epos, history and development of study of the epos “Gorogly”, version, Caucasus, Central Asia.

## I. INTRODUCTION

A lot of research has been done on the “Gorogly” epics, and a fundamental scientific research on the Uzbek versions of the epic was initiated by V.M.Zhirmunsky and the great folklorist H.Zarifov and continues to this day. The study of the epic in world folklore began in the middle of the XIX century by A.Khodzko, and in the process hundreds of scholars conducted research. The epic has also been studied with interest by European folklorists, in particular, Carl Reichl conducted extensive research on the subject.

The epic "Gorogly" is one of the epics loved by the Uzbek people, along with many other Turkic peoples. The epic has been preserved in the repertoire of bakhshis and has been recorded in oral versions as well as in manuscripts.

One of the manuscripts of the epic is the epic "Kholdorkhan", the manuscript of which is stored in the Manuscripts Fund of the Institute of Oriental Studies of the Academy of Sciences of the Republic of Uzbekistan under inv. 8042. There is also another manuscript version of the epic among the Uyghur manuscripts, and the value of these manuscripts is evident when they are compared with oral versions or with other manuscripts.

In the Uyghur manuscript, the events begin with the first plots related to the birth of Gorogly. The manuscript contains the plot of "Invasion of Ahmad Sardor", in which the daughter of the Karakhan king Zaynabshah is married to Avazkhan, and the birth of her son Elikhan and daughter Nurkhan is described.

In the manuscript, the events begin with a direct walk. The name of the country in the manuscript is "Shahdorshah city", in the oral Uzbek version it is "Crimea". In the publication version, Ahmad Sardar returns to Chambil with ten thousand citizens, and forty young men in the manuscript.

Uncle Yunus asks the fairy and Zaynabshah to open the castle gate. As soon as Ahmad Sardor entered the fort, he declared himself king, "Whose time is the time of Ahmad Khan?" He plunders the treasures. He recruits soldiers from sixteen to twenty years of age. He gives them weapons.

The plot of the wedding: In the oral version, Kholdorkhan tells Gorogly to the wedding in the Crimea. Avaz, Hasan kolbar Shodmon comes and wants to laugh at them. Gorogly walks over Hasankhan. In the manuscript, a herdsman named Kholdorkhan tells Karakhan about the wedding, and when Karakhan sees that his daughter has been humiliated by Ahmad sardor, he walks to Chambil over Ahmad sardor.

In the Uyghur manuscript, great attention is paid to Kholdorkhan Pahlavon. Since the Eastern Uzbek version mentions both the Crimean king Kholdorkhan and Gorogly's hero Kholdorkhan, the reader is confused about the Kholdorkhans. For example 8042-inv. the manuscript mentions Kholdorkhan, the king of Chinoron, and the plot ends with a victory over him. The Uyghur manuscript mentions only the hero Kholdorkhan, not King Kholdorkhan. Hence, the branch describing the invasion of the Crimean khan Kholdorkhan is not given in the Uyghur manuscript.

In both the Uyghur manuscript and the oral version, the hero Kholdorkhan Ahmad demonstrates heroism in exposing the sardor's deceptions. The epic of the Crimean king "On the war with Kholdorkhan" and one of the sons of Gorogly's epic "On the hero of Kholdorkhan" were a separate branch. We can see this in the Uyghur manuscript. Because the plots dedicated to them are given as separate epics. In the Uzbek edition, Ergash Jumanbulbul oglu sang along with these songs. In addition, they sang to the extent that they did not affect the content of each other in the slightest. The plots are intertwined.

The epics of the Crimean king Kholdorkhan and the hero Kholdorkhan were formerly separate epics and were added by the *bakhshis* based on their names. As a result, the size of the oral version has expanded slightly. If we take into account the fact that the manuscripts pay more attention to brevity and detail, we can be sure that the oral versions of these epics also had a much wider range of branches.

In the Uyghur manuscript, Zaynabshah's father, Karakhan, Kholdorkhan, and Kholdor Bekzoda, accompanied by an army of forty, invaded Ahmad Sardar. He was in a good mood. When he

heard the news of the army, he went out with an army of twelve thousand.

They returned with the army to Kholdorkhan's tent. Gorogly was amazed to see Aga Yunus pari, Zaynabshah and her grandchildren here. They returned to Chambil, saying, "Well done, thank you". Ahmad chased Chambil away after insulting the captain. Thus, Hayvazkhan again ruled the country with justice.

He ruled for fourteen years in this way. Gorogly was one hundred and twenty years old. When he said, "What will you cry for when I die?", Aga Yunus, Misqal and Gulnor cried. In the Uyghur manuscript, the poem "My childless sultan from the world" is given:

*Бухоронинг бир тумани Регистони,  
Тоza мато кийган экан аристонни,  
Фарзандли уйни кўрсам гулистони,  
Ўзинг, сен, Чамбилбелни бек-султонни,  
Дунёдан фарзандсиз ўтган султоним [1].*

*Бухорони бир тумани Туркистон,  
Тоza мино (майно) келар экан ўристон,  
Уйингда фарзандинг йўқ (са) Гўристон,  
Ўзинг ўлгач Чамбилбелнинг Чўлистон,  
Дунёдин бефарзанд ўтган, султоним [4].*

It seems that in both manuscripts the poems are written in a peculiar style. But in the process of comparing the poems in the manuscripts, we can see that the Uzbek version is more artistically and stylistically perfect than the Uyghur version. "Hasan and Avaz wept bitterly, saying, 'It is true that a man should be a sultan in his own country until he becomes a sultan in his own country'" [2]. The toponym "Hudak Lake" is given in the Uyghur manuscript as "Ovdak Lake":

The Uzbek version was published in 2010 under the editorship of folklorist Tora Mirzaev under the title "Hikoyati Gorogli sultan". This edition includes a selection of artistically more mature poems.

In the Uyghur manuscript, although some poems in the lithographs of the Uzbek epic "Gorogly" are similar, it is possible to see that some of the abbreviations and omissions have been omitted. In the Uyghur manuscript:

*Юракимда бордир ажаб бир армон,  
Иш бўлмас қудратли ҳақдин бефармон,  
Меҳмон йигит, хуш келибсиз бу ерга,  
Қулоқ солиб англанд буни, бегижон [1].*

*Юракимда бордир ҳар турли армон,  
Иш бўлмас қудратли ҳақдин бефармон,  
Меҳмон йигит, хуш келибсиз бу ерга,  
Қулоқ солиб тингла муни, бегижон [5].*

The narration of Avazkhan and Botakoz consists of twenty-four verses in both manuscripts. The question and answer of Gorogly and Avaz are also eight points in both manuscripts. Gorogly had an elder named *Yortiboy* (Boqiboy aksakal in Uyghur manuscript): *Мурти шондай, оғзи эски қондай, бир кўзи тилдадай.* (Murti was like a shop, his mouth was like an old bag, and one eye was like a bowl).

The ethnonym "Uzbek" is found mainly in the manuscripts of the eastern Uzbek versions. In the Baku stone of 1927, the compound "*Ozina bek*" was used. This combination also explains and expresses the qualities of "*Ozina bek*" as a famous name.

The poem in the Uyghur manuscript "*Avazning arazi*" ("The Story of Avaz Oglon") is copied from the Uzbek version in its entirety. It is noteworthy that at the same time, the branches of "*Hikoyati Gorogli sultan*" ("The Bringing Avaz") were completely copied from the stone. This poem, which is called "Appeal to the gatekeepers", is one of the traditional ready-made poetic texts and is found in the epics "*Kuntugmish*", "*Hasankhan*".

The poem "*Armonim qolmadi*" given in the manuscript number 953 was omitted in the Uyghur manuscript. "*Autobiographical Veteran*", consisting of eighteen verses, is one of the poems that form the ideological basis of Gorogly's epics. This poem is given at the end of the manuscript in seventeen verses.

Ahmad sardor did not like the fact that Gorogly raised Avaz as khan in his place. After a few days of exile from the country, he traveled to the city of Zanggi. His king had an army of ten lakhs. Ahmad Khan urges the King of Zanggi to march on Gorogly. The king of bells writes a letter telling Gorog to submit and sends an envoy. In a fit of rage, Gorogly cut off the ambassadors' ears and noses and hung them around their necks.

Filling a golden glass with wine, he asks if anyone is willing to walk on this wine, the King of Zanggi. At this point, Avazkhan makes a demand. In folk epics there are the words "talab", "savash". These words mean struggle and battle. Alone, he goes to the "savash" or fights and fights. Goes to "fight" with an army or guys.

The practice of drinking wine in folk epics is a test of heroes, a test in general. Keeping wine in the folk epic is an invitation to a test, a journey. The person who takes it must pass a test, or perform a difficult task. You can't just drink a glass. Jam is the symbolic meaning of the call to perform any test. The hero who drank the wine in the cup had to go to "demand". Either he would take any girl back, or he would get ready for battle and ride.

In the Uyghur version, Gorogly asks for a candidate to "bring Avazkhan" and "fight with the king of Zanggi." In one of them Hasankhan and in the other Avazkhan take the cup. Gorogly tells Avaz: "The life of a fish is with water, and my life is with numbers". This analogy is found in many of the "Stories of Gorogly Sultan" and the eastern Uzbek epic "Gorogly". On this basis, we can say that the East Uzbek epic "Gorogly" was the basis for the formation of manuscripts of Uyghur epics.

Gorogly sent Avazkhan with a blessing. Avazkhan marched into the innumerable armies of the Zanggi. They wrapped their heads in red ribbon (ribbon). Hence the term "Redheads". According to some reports, they were representatives of the Shiite sect, wearing twelve ribbons of red ribbon on their heads. During this march, Avazkhan came to the tent of the daughter of the king of Zanggi. He will be asleep with forty maids. Entering the girl's tent, he took out the precious ring and scarf in the girl's hand and rode off. He fled, saying, "Be careful, Amir Gorogly's army has arrived." In the morning the girls were amazed.

This motif is similar to the plot of folk tales in which three brothers take the queen's ring from the royal palace.

According to the next scene, the daughter of the King of Zanggi angrily drove away her maids and was left alone in the tent.

Avazkhan decided to kidnap him. He grabbed the girl's hand as he entered the girl's tent. The girl woke up and drew her sword, saying, "I caught the thief." Avazkhan smiled. The girl stared at his radiant face and fell in love. He went to Chambilbel with Avaz with his consent.

The plot of this station is significant in that it is based entirely on fairy-tale motifs. But it has already been formed as an epic.

According to the legend, the next day the maids reported this to the King of Zanggi. He summoned the Kurandazs and sent ninety thousand troops in the footsteps of Avaz. They grabbed Avaz and the girl. They imprisoned Avaz. Layla Kir escaped and went to Gorogly's country. Gorogly arrived, preparing his ten young men for battle. They hung the voice on a pole two hundred cubits from his hand. Seeing this, Gorogly did not rest and went into battle. He fought 21 nights.

Here again mythological elements, motives are visible. At the behest of the king of the bells, a ninety-year-old witch turned Avazkhan and his daughter into pigeons and drove them into the city of the bells. Gorogly finds out about this. As soon as Gorogly informed Aga Yunus, Aga Yunus became a horse, flew after them and chased them away.

The witch took them to the ground and read a spell and turned them into a deer. He chased himself up the mountain like an eagle. Yunus *oga* also turned into an eagle and chased. At this time the deer and the eagle came across a well. The witch turned them into fish and she herself fell into the well in the form of a snake. The trio became a black bird with the magic of a witch, and Aga Jonah attacked the pair. Yunus *oga* was helpless because he was alone. At that moment he smoked the fur his uncle had given him. His uncle, who was standing on the 7th of Kuhikof mountain, immediately arrived and cast a spell to restore the girl and Avazkhan, the Aga Yunus couple, to their original appearance. They hugged. At that moment, the voice of the "*devil, the devil, the devil*", was heard, and the world was filled with darkness. It was the sound that came when a witch died.

Yunus aga sent Avazkhan to Gorogly and returned to Chambil with his daughter. The phrase "Kuch nurgun" (strong) is used here. This is the same as the term "Nuyurgun botir" in rubies. It is not surprising that the origin of this was "Nur Kun", which was the basis for the formation of the name Nurali and this branch.

Yunus aga brings the wrestler from Arabia with the permission of Gorogly. The Gol wrestler pulled out a maple tree by its roots and swept away the Zanggi army. They were defeated and wished "well". Gorogly reconciled with them, gave them peace, and brought Ahmad Sardor back and they watched the wedding for forty days and nights.

Here, at the end of the manuscript of the manuscript, is a poem of seventeen verses, "I have no hope."

They took the daughter of Ahmad Sardor and the king of Zanggi to Avaz, achieved their goal, and in turn drank the wine of death (Uyghur manuscript).

In the final part of the final, at the battle with the King of Zanggi, we see that the events of the final part of the epic "Princess Ayyor", which is part of the Uzbek "Gorogly" epics, were taken in full, without any changes. We also witness a wonderful example of mythological motifs, evolution. For example, giants and fairies are mythological epic plots, while witches, lizards, pigeons, and falcons form epic plots typical of fairy tales. And the witch is one

of the first appearances of the licking old woman. It can be said that this last branch was formed from the beginning to the end on the basis of fairy tales and legends, the motives of myths.

Academician T.Mirzaev in his article "Four Hasan of Gorogly" states his more definite conclusions about the epic "Kholdorkhan". The teacher notes that the part of "Kholdorkhan"'s epic "Ahmad Sardor's Attack on Chambil" was published by the great folklorist Hodi Zarif in 1945 under the name "Chambil's Defense" in the journal "Almanakh".

There is another episode in the epic where the wrestlers of the two sides tried their best before the war, and in some cases it decided the fate of the battle. This tradition has been incorporated into epics by bakhshis as an epic plot. Gorothli's Kholdorkhan wrestler goes out to fight the enemy wrestler and defeats him.

In the epic "Kholdorkhan" through the activities of two heroes of the same name (Kholdorkhan Pahlavon and the Crimean khan Kholdorkhan) it is necessary to work in the world. The fact that one Kholdorkhan lived for the celebration of goodness and the other for the realization of his evil intentions encourages the reader to draw vital conclusions without being indifferent.

In the Uyghur manuscript, Gorogly is given in the style of Amir Gorogly, and in the Eastern Uzbek version in the style of Gorogly Sultan. In Tajiks, Kazakhs and Karakalpaks it is called Goroglykhan. In fact, the epics "Gorogly". The epic "Gorogly" itself is a lyro-epic legacy formed since the creation of world civilization, and it is a great epic plot. However, to this day, regardless of the number of Gorogly epics, he has combined a number of epic, lyrical and dramatic plots, re-improvised. For example, if we look at the manuscript of the epic "Birth of Gorogly" (inv. 9590) [6], on the basis of epic plots dedicated to the birth of the protagonist, a number of lyrical and dramatic plots are combined. The events of "The death of Gorogly's mother, his birth and discovery in the grave, his naming". There are many lyrical and dramatic moments in these events.

The manuscripts of Uzbek folk epics also show the issues of re-incorporating some of the ancient plots into the structure of epics, their use in the creative process, ie poetic interpretation. For example, in prose texts: In the Uyghur manuscript, Avazkhan takes away a precious ring and a scarf from the daughter of the king of Zanggi. This plot is influenced by the plot of the fairy tale "Three Brothers". Or the giants, fairies, the underworld in the epic "Princess Ayyar" – the city of Torikistan, the transformation of the Queen into a dove, Gorogly into a ring - all this is the result of the interpretation of ancient mythological plots.

Images and events related to Islam, including the four quarters, twelve imams, and forty chiltans, came and fought for Gorogly, giving him 120 years of strength, high state and prestige, Girat, when Gorogly was in a difficult situation, especially in the eastern Uzbek versions Oshik Aydin Pir, a historical figure whose real name was Shahobaddin, lived about fifty years before the Mongol invasion and was given an interpretation in the epics, and even a special branch of the "Gorogly" epic. It should be noted that a special epic is dedicated to folk epics.

Hence, these epic plots played an important role in the formation and spread of folk epics, including manuscript epics. Apparently, some epic plots have undergone a process of interpretation and improvisation and have become ingrained in the epic.

Kidnapping of a girl still exists in some Turkic peoples, including Karakalpak customs. This custom is extremely ancient, and after the advent of Islam, most peoples abandoned this custom because it was not in accordance with the laws of Islamic law.

One of the heroic deeds he performed to show the true heroism of a hero in folk art was to bring a girl or kidnap a boy. The kidnapping of a boy and his abduction or the kidnapping of a girl and marrying him are among the epic plots that show the heroism of the protagonist.

When religion Islam came, many such customs were condemned by Islam as the customs of ignorance and put an end to them. These customs and their manifestations are embedded in folk tales, legends, as well as in epics and their manuscripts, and are preserved in this way.

Of course, it seems that at the heart of every epic plot lies a real or vital basis, a reality, and manuscript epics have played a worthy role in the survival of this epic plot.

The fact that the king of bells sent a letter to Gorogly calling for war is also an epic plot. Prayers are lyrical plots. Battles to enhance the drama, the seven-syllable poetic texts cited to describe the protagonist's horse-riding movements, and the descriptive texts that formed the basis of the dramatic plots in the epics.

War, heroism, romance, historical epics focus mainly on epic and dramatic, while romantic-adventure epics focus on lyrical and dramatic plots. We will talk about this again.

Uzbek folk epics "Gorogly", unlike the epics of some Turkic peoples, were formed and spread only in the genre of "epic". In

this process, it is worth noting the unparalleled services of the people's *bakhshis*. How many epochs, creative processes does each plot go through to reach the level of an epic. Our *bakhshis* have done a lot of creative work here.

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# Brand Equity And Brand Loyalty: The Mediating Effect Of Customer Satisfaction

## A Comparative Study On Companies With Brand Change

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**Abstract:** The study investigates the impact of brand equity on brand loyalty with the mediation of customer satisfaction in X Company and Y Company in Batticaloa city branch. The study uses five dimension of brand equity, which include perceived quality, perceived value of cost, brand identification, trust and lifestyle congruence. Questionnaire has been used to collect the data from the customers in using X Company and Y Company in Batticaloa city branch. The data has been collected from 267 respondents and analyzed through SPSS.

The existing level of the independent variable brand equity and customer satisfaction indicated that there is a high level of brand equity and customer satisfaction. Further the finding of this study shows that there is a high level of brand loyalty in the selected customer in X Company and Y Company in Batticaloa city branch.

The study shows a positive significant impact of brand equity on brand loyalty. All hypotheses have been supported to the study and the customer satisfaction partially mediates the relationship between brand equity and brand loyalty. The study will enable the managers to change policies and to train the staff so they can satisfy the customers which in turn would make customers loyal with the organization. The study is limited only to the selected two finance sector in Batticaloa city only. Future studies can be conducted across different type of businesses and cultures.

This paper provides a basis to study the effect of trust on brand loyalty with mediation of customer satisfaction and offers practical help for managers to train employees which could enhance customer satisfaction and loyalty.

**Keywords:** Brand Equity, Customer Satisfaction and Brand Loyalty

### 1.1 INTRODUCTION

The brand is considered as a highly distinguished and valuable asset for a Company. The brand is a strategic tool for marketers, and it diminishes the effect of price sensitivity in market competition (Helmig, Huber, and Leeflang, 2007). Customers are inclined to spend additional money for a preferred brand because they believe that no competitor can deliver the value provided by the preferred brand. The premium price paid by the customer is partially justified by brand loyalty. Hence, brand loyalty is considered as a requisite for an organization's profitability and sustainability (Chaudhuri & Holbrook, 2001), "The chain of effects from brand trust and brand affect

to brand performance: the role of brand loyalty". With reducing product differentiation and the short maturity period and increasing unpredictability of the product market, the conservation and growth of brand loyalty is the focal interest of marketers (Kataria and Saini, 2019).

Brands are one of the vital assets of a firm (Keller & Lehmann, 2003; Lehmann & Srinivasan, 2014). Brand equity has been one of the most important marketing concepts in both academia and practice (Srinivasan, Park, & Chang, 2005). By the 1980s, marketing researchers discovered brand equity had an influence on customer satisfaction (Lanza, 2008). For many years, customer satisfaction has been a major goal of business organizations (Hansemark and Albinsson, 2004). Brand loyalty describes marketing phenomena, and is typically associated with customer satisfaction (Bennett, 2001). Although scholars often study brand equity, brand loyalty and consumer satisfaction issues, only a few of them have focused on the relationship of brand equity, consumer satisfaction and brand loyalty in recent years. Using partial least squares structural equation modeling approach (PLS-SEM) statistical methods and taking advantage of first-hand data from 1840 Chinese sports brands customers, the aims of this study are: confirming the significant dimensions of brand equity and main factors influencing brand loyalty, investigating the relationship between brand equity, consumer satisfaction and brand loyalty.

## 1.2 Research Problem

Limited attention has been devoted to the inter-relations among loyalty, brand equity and customer satisfaction. Although the literature suggests that brand loyalty is directly influenced by brand equity, the mediating role of customer satisfaction in the relationship between loyalty and equity has not been analyzed by researchers for the low-involvement product category. Despite the significance of the topic and the numerous studies published on loyalty, brand equity and customer satisfaction; there exists a scarcity of studies on the relationship among these three variables.

Previous studies have not been able to reach a common consensus regarding the relationship of brand loyalty with customer-based brand equity. Researchers Aaker, Aaker, and Biel, (1993) suggested that loyalty is one of the principal elements for brand equity, whereas Keller (1993) believes that loyalty is the outcome of brand equity rather than a determinant of it (Aaker, 2009; Keller, 1993; Lei & Chu, 2015). In his study, Nam, Ekinici, and Whyatt, (2011) supported Keller's viewpoint by mentioning that loyalty is not one of the element of equity but rather a consequence of it because brand equity is a perception, whereas loyalty is a behavioral construct related to the intentions of repurchase. Expanding on the perspective of Nam et al. (2011), the current study considers loyalty as an outcome of brand equity. Hence, brand loyalty is observed as a dependent variable for brand equity rather than its component.

According to the interview conducted by the researcher with the manager of the selected financial company in Batticaloa, stated that their company loose certain amount of brand name and switched to competitive companies in recent time.

Based on the conversation with the manager, it is possible to realize that the brand equity plays a crucial role in determining customer satisfaction which paves the way to brand loyalty. Finally to the best knowledge of the researcher, this study has provided support for the mediating impact of customer satisfaction on the relationship between brand equity and brand loyalty.

## 1.3 Research Questions

The following research questions have developed to carry out this research,

1. What is the level of brand equity, brand loyalty and customer satisfaction in X Company and Y Company?
2. What is the relationship of brand equity, brand loyalty and customer satisfaction in X Company and Y Company?

3. Whether the customer satisfaction will mediate the relationship between brand equity and brand loyalty in X Company and Y Company?

#### **1.4 Research Objectives**

The objectives of the study were,

1. To identify the level of brand equity, brand loyalty and customer satisfaction in X Company and Y Company.
2. To identify the relationship between brand equity and brand loyalty in X Company and Y Company.
3. To investigate whether the customer satisfaction will mediate the relationship between brand equity and brand loyalty in X Company and Y Company.

### **LITERATURE REVIEW**

#### **2.1 Brand Equity**

Various researchers have provided different perspectives on brand equity, with most of them being similar to the definition provided by Farquhar (1989), Park and Srinivasan (1994), Baldinger and Rubinson (1996) and Aaker (1996) that “brand equity is the value addition done by a brand through customers association and perception towards a particular product”. Brand equity is generated from the higher faith that consumers have in a particular brand compared with others. This built-in trust translates into brand loyalty and premium pricing for the brand. The Brand Equity that influencing on Purchase Intention (Devendra 2017). Brand equity is the overall utility, including both functional and symbolic utility, associated by the customer with purchase of the brand (Lopez-Vazquez et al., 2002).

#### **Dimensions of Brand Equity**

##### **2.1.1. Perceived Quality**

Netemeyer et al. (2004) defined perceived quality as the customer’s assessment of the overall supremacy of the brand compared with that of alternative available brands. This measure is subjective in nature due to it being based on customer’s perception regarding quality, product benefits and need fulfillment. Attributes attached to a brand, such as the cost, physical appearance, features, advertisements and brand name, also influence a purchaser’s perception of quality. Perceived quality forms a selective brand image in consumers mind and hence leads to product differentiation (Aaker, 1991). Keller (1993) differentiated quality from perceived quality. He defined quality as actual superiority or excellence over competitor’s brands and perceived quality as consumer’s intangible perceptions of superiority of a product.

##### **2.1.2. Perceived Value of Cost**

According to Tzeng and Huang (2011), perceived value as the outcome of assessing the relative value of benefits received and amount sacrificed in relation with purchase. Due to its simple approach, this definition was highly criticized by other researchers for not being multidimensional. Netemeyer et al. (2004) provided a more holistic approach and described perceived cost as customer evaluation of rewards obtained from the brand based on the perception of benefits secured and sacrifices incurred. Consumer behavior can be better analyzed through the perceived value approach because perceived value is a basis for all marketing strategies, like: market segmentation, policy positioning and product differentiation.

### **2.1.3. Brand Identification**

Consumers indicate their social identity by connecting to or consuming a particular brand. This leads to integration or dissociation of consumers with a particular class of individuals, who form a social circle. Schiffman, Christianson, Jacobsen, Hirsch, and Reis (2000) indicated that the consumption of a brand is influenced by customer social identity. The relationship of brand identification and brand loyalty was empirically supported by Bhattacharya and Sen (2003). Nam et al. (2011) indicated that customer satisfaction partially mediates the relationship between brand identification and brand loyalty. They stated that strong brand identification leads to high satisfaction.

### **2.1.4. Brand Trust**

Trust is logically and experientially an important factor in the relationship between a buyer and seller (Komund and Osarenkhoe, 2012). Customers who lack trust are unlikely to be brand-loyal and switch from one brand to another, whereas a trusted brand enjoys increased market share and sales revenue, premium price, increased purchasing power. A few studies have suggested trust to be an intention (Gefen & Straub, 2003), whereas others have suggested it to be a belief (Ganesan, 1994). In their study on the mediating role of values in the relationship between trust and loyalty, Sirdeshmukh et al. (2002) concluded that organizations should primarily focus on competence, benevolence and the problem solving attitude for building trust with consumers.

### **2.1.5. Lifestyle Congruence**

The lifestyle concept reveals consumer's daily needs and wants. It also indicates how particular brands help consumers in their pursuit of a particular lifestyle. Moreover, consumers develop a preference for and repurchase a particular brand when its consumption helps them express their uniqueness by pursuing their desired lifestyle (Quintal, Thomas, and Phau, 2015). In a wider sense, lifestyle indicates demographic characteristics, attitudes towards life, beliefs, and aspirations and is an integral component of consumer's daily life (Brassington and Pettitt, 2003). However, no such widely accepted definition of lifestyle is available in literature.

## **2.2 Customer Satisfaction**

Customer satisfaction has been characterized from numerous viewpoints (Dimitriades, 2006). However, the most broadly acknowledged definition of customer satisfaction in the literature is provided by the expectancy disconfirmation theory (McQuitty, Finn, and Wiley, 2000), where satisfaction level is defined as a consequence of the difference between the expected and perceived performance (Oliver, 1999). Customer satisfaction may directly and indirectly influence business sustainability, competitiveness and profitability (Ratcliff, Thapar, Gomez, and McKoon, 2004; Luo and Homburg, 2007).

## **2.3 Brand Loyalty**

Brand loyalty is a major topic in consumer behavior literature. The significance of brand loyalty can be estimated by the fact that this factor is a measure of the business performance which influences the financial performance of an organization.

It brings numerous uncountable benefits, such as substantial entry barriers for competitors, increased market share and sales revenue, increased company's capacity to react to competitive threats and low sensitivity of customers towards the marketing efforts of a competitor having the potential to cause switching behavior (Elena & Jose, 2001).

## **2.4 Hypotheses Development**

In this section, there are four hypotheses to be presented based on each relationship established developed through conceptual framework.

H1: There is a positive relationship between brand equity and brand loyalty.

H2: There is a positive relationship between brand equity and customer satisfaction.

H3: There is a positive relationship between customer satisfaction and brand loyalty.

H4: Customer satisfaction mediates the relationship between brand equity and brand loyalty.

#### **2.4.1 Relationship between Brand Equity and Brand Loyalty**

Brand loyalty is seen in product brand equity discussions as an element of brand equity referring to the loyalty of stakeholders for the organization and its brand. In other words, traditionally loyalty is seen as a component of brand equity (Aaker, 1991) and some of recent studies (Rios and Riquelme, 2008; Rauyruen, Miller, and Groth, 2009) support this view. However, researchers are now saying that loyalty is an outcome of brand equity (Berens, Van Riel, and Van Bruggen, 2005). It is argued that brand equity has a strong impact on customer's loyalty intentions and it is likely to influence a customer's willingness to stay, repurchase, and recommend the brand.

Research shows that when a museum's brand is evaluated positively, customer loyalty toward the museum is greater (Garanti and Kissi, 2019). Therefore, the study proposes the following hypothesis:

*H1: There is a positive relationship between brand equity and brand loyalty.*

#### **2.4.2 Relationship between Brand Equity and Customer Satisfaction**

Ali and Muqadas (2015) have comprised brand loyalty has the relationship with customer satisfaction. Brand equity plays a key role in the customer satisfaction (Lei and Chu, 2015).

Aaker (1991) was the first to establish the relationship between perceived quality and brand equity. Darsono and Junaedi (2006) supported the view that perceived quality is an antecedent for customer satisfaction and shares a direct and positive relationship with satisfaction. As the perception of value increases in consumer mind, satisfaction also increases (Dorai and Varshney, 2012). There exists a high possibility that customer satisfaction can be an antecedent or a result of perceived value; however, the literature supports the view that satisfaction is a result of perceived value, that is, perceived value significantly influences satisfaction.

Therefore, the following hypothesis is proposed:

*H2: There is a positive relationship between brand equity and customer satisfaction.*

#### **2.4.3 Relationship between Customer Satisfaction and Brand Loyalty**

Relationship between satisfaction and loyalty is documented in previous researches within the context of services (Back and Parks, 2003). Kim et al. (2008) have established the relationship among these constructs with in restaurants industry. Satisfaction is also studied as the predictor to loyalty (Faullant, Matzler, and Fuller, 2008). Furthermore, evidence to support the positive relationship between customer satisfaction and loyalty formed in the study of Yoon and Uysal (2005).

Therefore, the following hypothesis is proposed:

*H3: There is a positive relationship between customer satisfaction and brand loyalty.*

### 2.4.4 Customer Satisfaction Mediates the Relationship between Brand Equity and Brand Loyalty

The study aims at examining the mediating role of customer satisfaction on the relationship between customers based brand equity and brand loyalty. Bloemer, Ruyter, and Peeters (1998) revealed that customer satisfaction mediates the effect of service quality on brand loyalty. Caruana (2002) confirmed the mediating role of satisfaction on service quality and service loyalty in the retail banking sector. Moreover, Karatepe (2011) also confirmed that there is a mediating role of satisfaction on the relationship between the two constructs. Moreover, Ekinci, Dawes, and Massey (2008) have also confirmed that the effect of service quality and ideal self-congruence on brand loyalty, intention to return is mediated by the customer satisfaction.

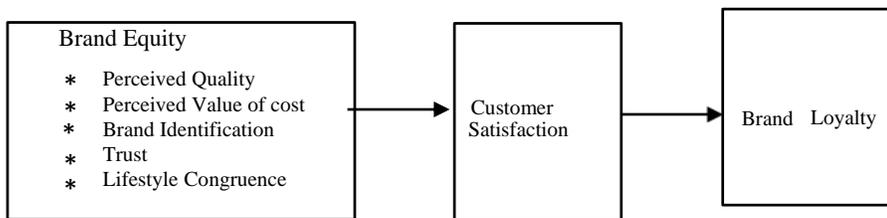
Therefore, the following hypothesis is proposed:

*H4: Customer satisfaction mediates the relationship between brand equity and brand loyalty.*

## CONCEPTUALIZATION AND OPERATIONALIZATION

### 3.1 Conceptual Framework

A conceptual framework represents the researcher's synthesis of literature on how to explain phenomenon. The conceptual framework is the researcher understands of how the particular variables in the study connect with each other. Conceptual framework use to illustrate the relationship between the variables. The research conceptual framework developed by Katarina and Saini (2019). This conceptual framework link among brand equity, customer satisfaction and brand loyalty



( Source; Katarina and Saini 2019)

### 3.2 Operationalization

Operationalization is the process of taking a conceptual definition and making it more precise by linking it to one or more specific, concrete indicators or operational definitions. These are usually things with numbers in them that reflect empirical or observable reality. The process of operationalization is specifying the procedure that will be employed to measure that concept. Operationalization always encompasses measurement.

The outcome of operationalization will be indicators that represent that concept. There are four important steps in the process of operationalization, such as: firstly formulate concepts into variables, then formulate variables into dimensions, formulate dimensions into indicators and source.

**Table 01 Summary of Operationalization**

Variables	Indicators	Statements	Measurement
<b>Brand Loyalty</b>	Repeat Purchase	Q1	<b>Five Point Likert's scale</b>
	Continue Purchase	Q2	
	Brand Superiority	Q3	
	Word of mouth	Q4	
	Word association	Q5	
<b>Customer Satisfaction</b>	Goodness	Q6	
	Need	Q7	
	Expectation	Q8	
<b>Brand Trust</b>	Trustworthy	Q9	
	Consuming interest	Q10	
	Honesty	Q11	
	Safety	Q12	
<b>Perceived value of cost</b>	Attractive cost	Q13	
	Price	Q14	
	Value	Q15	
<b>Perceived Quality</b>	Quality	Q16	
	Features	Q17	
	Functionality	Q18	
	Reliability	Q19	
	Good Quality	Q20	
	Brand Appearance	Q21	
<b>Brand Identification</b>	Familiarity	Q22	
	Embarrassment	Q23	
	Emotional	Q24	
<b>Lifestyle Congruence</b>	Brand Reflected	Q25	
	Brand Congruence	Q26	
	Well Being	Q27	

(Source: Kataria and Saini, 2019)

**4. Methodology of Study**

According to Hanson, Creswell, Clark, Petska and Creswell (2005), the term population is defined as a group of persons having a common characteristic. Study population for this research identified as customers who are customers in X Company and Y Company in Batticaloa branch. A population is considered to be any group of people, event, or things that are of interest to the researchers and that they wish to investigate (Sekaran, 2000). Researcher mentioned that a sample is a subset of the population in question and consist of a selection of members from the particular population (Sekaran, 2000). Population of this study is known by the researcher.

Probability sampling is used in this study. When, elements in the population have a known chance of being chosen as subject in the sample, researcher resort to probability sampling design (Sekaran, 2000). In this study, Simple random sampling method is used to choose the sample size in X Company and Y Company. Because it's mutually exclusive both organization.

Simple random sampling, each element in the population has a known and probability of selection. Furthermore, each possible sample of a given size (n) has a known and probability of being the sample actually selected. The sample is drawn by the random procedure from the sampling frame (Malhotra, 2004). Only 300 customers were selected as sample based on simple random sampling method will proportionate method. The sample will be selected as random basis on stipulated time.

The sample size is 300 customers in X Company and Y Company in Batticaloa branch. Each single internet user is considering as a respondent of this study. The following equation was used to calculate the sample size,

$$\text{Sample amount} = \frac{\text{Each company population}}{\text{Total population}} \times \text{Total sample (300)}$$

$$\begin{aligned} \text{X Company sample} &= \frac{\text{Each company population}}{\text{Total population}} \times \text{Total sample (300)} \\ &= \frac{2000}{5000} \times 300 \\ &= 120 \text{ samples} \end{aligned}$$

$$\begin{aligned} \text{Y Company sample} &= \frac{\text{Each company population}}{\text{Total population}} \times \text{Total sample (300)} \\ &= \frac{3000}{5000} \times 300 \\ &= 180 \text{ samples} \end{aligned}$$

Liker's five points rating scale is used to require respondents to order their answers. The Likers scale is widely used to measure individual attitudes. A five point Likert's scale is used to measure the variables and this scale consist of five boxes ranging from strongly disagree to strongly agree. Further the respondents administrated to mark (X) their options regarding the statement in the questionnaire.

## DISCUSSION OF FINDINGS

### 5.1 Discussion -Objective One

**To identify the level of brand equity, brand loyalty and customer satisfaction in X Company and Y Company**

#### Level of Brand Loyalty

Brand loyalty is the dependent variable of this study which measured with five indicators. The overall mean value of brand loyalty is 4.21 and it is deviated from 0.625. It shows that the brand loyalty is in higher level in the selected customers. In Y Company, The overall mean value of brand loyalty is 3.88 and it is deviated from 0.637. It shows that the brand loyalty is in higher level in the selected customers.

### 5.2 Discussion – Objective Two

*Objective Two: To identify the relationship between brand equity and brand loyalty X Company and Y Company.*

#### Coefficient Correlations between Brand equity and Brand Loyalty

The results of Pearson correlation between brand equity and brand loyalty in X Company. The correlation coefficient (r) value is 0.746 between brand equity and brand loyalty. In Y Company, The correlation coefficient (r) value is 0.687.

***H1: There is a strong positive and significant relationship between brand equity and brand loyalty in both X Company and Y Company.***

### **Correlation Analysis between Brand Equity and Customer Satisfaction**

The results of Pearson correlation between brand equity and customer satisfaction in X Company. The correlation coefficient (r) value is 0.672 between brand equity and customer satisfaction in Y Company. The correlation coefficient (r) value is 0.446 at the 0.01 significance level (2-tailed) is 0.000.

***H2: There is a strong positive and significant relationship between brand equity and customer satisfaction in X Company and there is a medium positive and significant relationship between brand equity and customer satisfaction Y Company.***

### **Correlation Analysis between Customer Satisfaction and Brand Loyalty**

The results of Pearson correlation between brand loyalty and customer satisfaction in X Company. The correlation coefficient (r) value is 0.495 at the 0.01 significance level (2-tailed) is 0.000.

***H3: There is a medium positive and significant relationship between customer satisfaction and brand loyalty in X Company and there is a strong positive and significant relationship customer satisfaction and brand loyalty Y Company.***

## **5.3 Multivariate Analysis – Mediation Analysis**

***Objective Three: To investigate whether the customer satisfaction will mediate the relationship between brand equity and brand loyalty in X Company and Y Company.***

### **5.3.1 Simple regression of Brand Equity and Brand loyalty**

The indicates that R Square statistic value is 0.557 which means 55.70% of the variation in dependent variable of brand loyalty can be is explained by the independent variable of brand equity in X Company. And The indicates that R Square statistic value is 0.472 which means 47.20% of the variation in dependent variable of brand loyalty can be is explained by the independent variable of brand equity in Y Company.

### **5.3.2 Simple regression of Brand Equity and Customer Satisfaction**

The indicates that R Square statistic value is 0.245 which means 24.50% of the variation in dependent variable of customer satisfaction can be is explained by the independent variable of brand equity in X Company And The indicates that R Square statistic value is 0.199 which means 19.90% of the variation in dependent variable of customer satisfaction can be is explained by the independent variable of brand equity in Y Company.

## **5.4 Multiple regression of Brand loyalty on both Brand equity and Customer Satisfaction**

### **5.4.1 Multiple Regression Analysis in Y Company**

The illustrates that R Square statistic value is 0.579 which means 57.90% of the variation in brand loyalty is explained by brand equity and customer satisfaction in X Company. And The illustrates that R Square statistic value is 0.618 which means 61.80% of the variation in brand loyalty is explained by brand equity and customer satisfaction in Y Company.

***H4: Customer satisfaction mediates the relationship between Brand equity and brand loyalty in X Company and Y Company***

**Mediation Effect**

**5.4.2 Mediation Effect in X Company**

In summaries for testing mediation using SPSS, for partial, the direct effect from brand equity to brand loyalty with customer satisfaction as mediating variable is 0.539 and significant at 95% confident level too. The results of this study show that brand loyalty partially mediates the relationship between brand equity and brand loyalty.

**Mediation Effect in Y Company**

In summaries for testing mediation using SPSS, for partial, the direct effect from brand equity to brand loyalty with customer satisfaction as mediating variable is 0.404 and significant at 95% confident level too. The results of this study show that brand loyalty partially mediates the relationship between brand equity and brand loyalty.

**5.5 Hypothesis Testing**

**Table 2 Summary of Hypotheses Testing**

<b>Hypothesis</b>		<b>Decision</b>
H1	There is a strong positive and significant relationship between brand equity and brand loyalty	Accepted
H2	There is a strong positive and significant relationship between brand equity and customer satisfaction	Accepted
H3	There is a medium positive and significant relationship between brand equity and customer satisfaction	Accepted
H4	Brand Loyalty mediates the relationship between Brand equity and Customer satisfaction	Accepted

(Source: Developed for study purpose)

**CONCLUSION AND RECOMMENDATION**

**6.1 Conclusion**

The first objective of this study is to identify the levels of brand equity, customer satisfaction and brand loyalty of selected customer in X Company and Y Company in Batticaloa city branch. The existing level of the independent variable brand equity and customer satisfaction indicated that there is a high level of brand equity and customer satisfaction. Further the finding of this study shows that there is a high level of brand loyalty in the selected customer in X Company and Y Company in Batticaloa city branch.

The second objective of this study is related with to examine the relationships among brand equity, customer satisfaction and brand loyalty in selected customer. To find the relationship between brand equity and brand loyalty in the selected customer the Pearson correlation technique was applied. It indicated that there is a strong positive relationship between the two variables, brand equity and

brand loyalty. When assessing the relationship between brand equity and customer satisfaction. The findings from the Pearson correlation technique indicated a strong positive relationship between the brand equity and customer satisfaction. As well as the relationship between customer satisfaction and brand loyalty selected customer, express Pearson correlation as an evidence for a strong positive correlation between customer satisfaction and brand loyalty.

The final and third objective of this study is identifying whether the relationship between brand equity and brand loyalty mediated by customer satisfaction. The study shows a positive significant impact of brand equity on brand loyalty. The result of the multiple regression analysis indicated that, customer satisfaction partially mediates the relationship between brand equity and brand loyalty.

## **6.2 Limitations of the Study**

The study consists with several limitations. The first limitation is that the survey was limited to one geographic city Batticaloa branch of a single country that is selected customer X Company and Y Company which prevents generalization of the findings.

This study surveyed only 267 respondents. Selected sample respondents have been relatively small if any study consist more than this sample size the findings would be further confirmed. From the overall collected samples, 267 respondents are insufficient to represent the overall Sri Lankan consumer's population. The sample representation did not fairly represent the overall Sri Lanka's demographics.

The male and female ratio did not represent a fair comparison among the gender group and it was difficult to distinguish which gender group is highly active on social media platforms, and more brand consciousness when purchasing a product or service.

And the other limitation of this study is that the data was collected through a single measurement tool it is survey-based questionnaires of the quantitative approach, using qualitative research approach such as interviews and observation will be effective to get more explanation.

The scale used to measure the research questions were five-point likert's scale. Instead, if a seven-point scale were used, measurement that is more accurate would have been taken for each variable. Due to analyses complexity it was avoided.

## **6.3 Direction for Future Studies**

Future research could be done to collect data from the whole country in order to enhance generalizability of the data. Furthermore, no cross gender, cross group, and cross culture comparisons were made, future research studies can be conducted to have comparison among different groups, cultures, age ranges, etc. Lastly the study has been conducted in one service sector future study can be conducted in other service sectors to check the behavior of customers in those sectors.

This research provides some preliminary exploration into the relationships between consumer-based brand equity, consumer satisfaction, and brand loyalty. Future research may seek to replicate these findings with a border brand categories study and provide further insights into the nature of these relationships between different regions or countries.

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# Coal Pit Mapping with Random Forest-Based Ensemble Machine Learning at Lower Benue Trough

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**Abstract-** This work entails identifying areas of all coal pits in and around a part of Lower Benue trough where coal exploitation had taken place in the past, using random forest machine learning technique with out-of-bag (OOB) estimate of generalization error. Training sites were selected from the Landsat image covering the area of interest using QGIS image processing software. Two well-known exploited sites were selected as coal training sites while few other ones also identified were reserved for validation. Some other areas known to be different than coal sites were selected and classed as non-coal areas. The two sets of data were trained for binary classification using random forest ensemble supervised classification. Scikit-learn library run by python API was adopted for the machine learning. Open-source library, GDAL was employed to treat image raster and shape file within the python API. Accuracy of result was estimated to be equal to approximately 99.957%. A map showing location of all exploited sites was produced. Validation was carried out with known reserved coal pits observed during ground truth. The result accurately identified the validation sites and other areas properly.

**Index Terms-** Coal pit, Machine Learning, Random Forest, 'OOB', Scikit-learn

## I. INTRODUCTION

Coal exploitation activity was known to be common within and around Benue trough. Official exploitation commenced in 1909 in Nigeria (Famuboni, 1996; Minjng, 2006) after discovery of coal, in the course of search for crude oil. Locally, activities of artisans were also common and many people did take advantage of abandonment of further formal exploration and exploitation for the resource after oil was struck and attention of the government was diverted to use of oil for powering railway activities and power generation, the then two major users of the product. The need for alternative source for powering electricity turbines as gas supplies dwindle and recent attention of the government to resuscitate the state's moribund iron and steel rolling company at Ajaokuta with attendant need for coal as raw material re-awaken the need to source for more coal. This work embraces inventory taking of coal exploitation sites hitherto opened for coal activities through mapping using ensemble machine learning technique.

## II. BACKGROUND

Machine learning is regarded as a field of study which engages implementation of algorithms in computer to transform data into intelligent action (Abellera et al., 2018).

Ensemble learning is a machine learning which aggregates several models to produce an estimator with performance metrics better than each single component. They include but not limited to Bagging (also called Bootstrap Aggregating), Bayes Optical Classifier, Boosting, Bayesian Model Averaging, Bucket of Models, Stacking and Random Forest.

Random forest combines several decision trees. A decision tree is a non-parametric supervised learning which is applied to both classification and regression (Albon, 2016). These trees are generated to strengthen the most popular class. Hence, a random forest classifier consists of "a collection of tree-structured classifiers  $\{f(x, \Theta_k), k=1, \dots\}$  where the  $\{\Theta_k\}$  are iid random vectors and each tree gives a vote for the most likely class at input  $x$ " (Breimen, L, 2001). With the ensemble of classifiers  $f_1(x), f_2(x), f_3(x) \dots f_k(x)$ , the margin function is defined as

$$mg(\mathbf{X}, Y) = \text{avg}I(h_k(\mathbf{X})=Y) - \max_{j \neq Y} \text{avg}I(h_k(\mathbf{X})=j) \dots \dots (1)$$

The margin function indicates the confidence in the classification by measuring the differences between the average number of votes at  $X, Y$  for the correct class and that for any other class. The generalization error is also defined as

$$PE^* = P_{X,Y}(mg(\mathbf{X}, Y) < 0) \dots \dots (2)$$

where  $P_{X,Y}$  is the probability is over the  $X, Y$  region.

where  $f_k(X) = f(X, \Theta_k)$ , (Breimen, L, 2001) suggests that as the number of trees start increasing with strong correlation with the law of large numbers, certainly all sequences  $\Theta_1, \dots, PE^*$  will converge to

$$P_{X,Y}(P_{\Theta}(h(X, \Theta)=Y) - \max_{j \neq Y} P_{\Theta}(h(X, \Theta)=j) < 0) \dots \dots (3)$$

The prediction system of random forest estimates the mean or mode of individual decision tree, with decision rules to estimate the result. Decision tree learning merits usages by many due to ease of interpretation of the process. Pavlov (2019) and Mitchell,

(2011) observed that random forest accuracy was as good and sometimes better than Adaboost; it is robust to outliers and noise; it is faster than bagging or boosting; it provides meaningful internal estimate of errors, correlation and variable importance and; it is simple and easy for parallel computing. Random forest ensemble classification has been applied in many fields with good results, ranging from health-care such as in the diagnose of alcohol use disorder (Ogretmen, 2019) with higher accurate result when some features with no apparent contribution to the accuracy are carefully eliminated than when all features were used. Fecal source identification was conducted by Roguet et al. (2018) with rapid and accurate solution using random forest. Long et al. (2019) applied random forest to analysis and prediction of travel mode choices by applying 2013 travel diary data from Nanjing, China. The method achieved high accuracy and also less computation cost. Random forest (RF), boosting and support vector machine (SVM) predictive accuracies have been compared by Ogotu et al (2011) for genomic selection. Random forest accuracy came second behind boosting. It surpassed the SVM and others with empirical evidence. Out-of-Bag (OOB) samples are samples not included in the training samples which are used for error check and accuracy assessment in random forest classifier. It is equally used for selection of appropriate values for tuning parameters with reduced bias, resulting in good estimation when stratified subsampling is applied (Janitza & Hornung, 2018) The algorithm is computationally cheaper than, and serves as alternative to cross-validation error metric (Park & Ho, 2018)

### III. METHODOLOGY

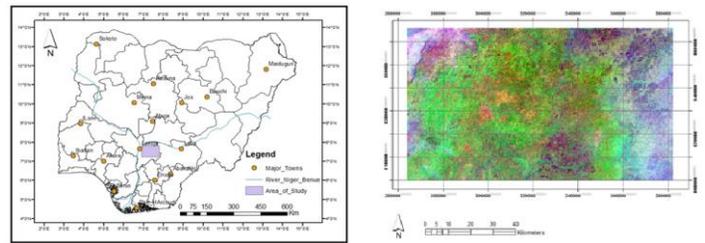
Landsat satellite image data covering the area of interest (Aoi) with scene IDs as LC81880552017006LGN01 and LC81890552017045LGN00 were downloaded from the host, USGS website. The images were corrected for radiometric and atmospheric corrections through the use of ENVI image processing software. The two images were mosaicked and the Aoi was culled. The image bands were stacked. The stacked image contains seven bands: one to seven, excluding the band 8. Each image band is characterized with 30m-by-30m spatial resolution. The image was loaded as raster data by QGIS software and the training areas were selected. These areas were already known through visitation to site at earlier dates. They were saved as ESRI shapefile for later usage. The entire Aoi image was also saved with .img extension.

#### A. Study Area

The study area is a part of lower Benue trough located in Kogi state, Nigeria (Figure 1). The area can be defined by the following geographic coordinates framework.

Lower Left: 7.225164°N, 6.865464°E

Upper Right: 7.837803°N, 7.841064°E



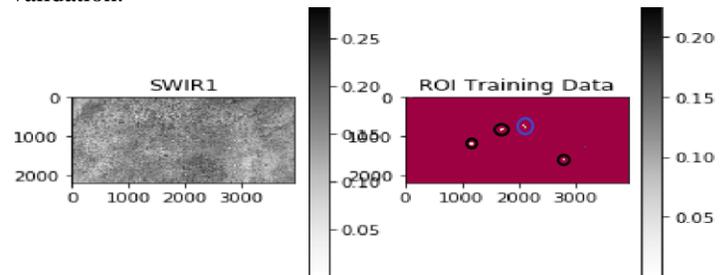
**Figure 1. Left: Map of Nigeria Depicting Area of Study, Right: Processed Image of the Study Area.**

#### B. Machine Learning procedure

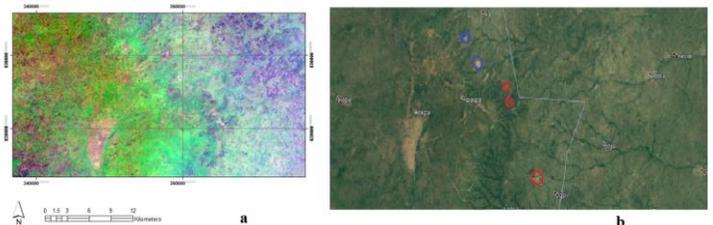
The training data and the entire Aoi data were loaded using the ogr and the gdal of the osgeo package respectively. The training data were rasterized and classed into coal and non-coal areas. The array was observed to have conformity. The Aoi image was masked for cloud coverage and one of the bands was later excluded out of the seven. the entire bands were found to contain 8682030 pixels. While the Class 1 which represents the non-coal pixels in the training data has 15718 pixels, the coal area training data contains 510 pixels and classed as 2. The model was conducted with 500 decision trees with OOB score set as 'True', and the training data was fitted. Accuracy of prediction and confusion matrix were produced to verify the reliability of the model. The model was adopted to predict the entire Aoi image pixels. Visualization was conducted to see the results. Results were exported to file for further treatment with ArcMap. In ArcMap, overlay of the result was done on the bands 751 false colour RGB image of the Aoi in order to effectively compare the predicted areas with reserved validation areas.

### IV. RESULTS

Figure 2 depicts plotted short-wave infrared 1, SWIR1 band of the image and the region of interest training data. Areas encircled in black represent the non-coal area training sites while the areas encircled in blue are the areas earlier exploited for coal as identified on ground and google earth image (figure 3b). Areas encircled in red in figure 3b are other identified areas on ground where coal had been exploited but serve as reserved areas for validation.

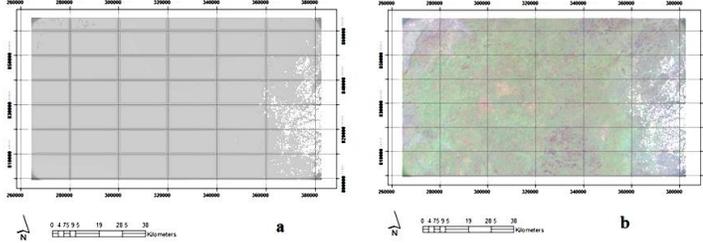


**Figure 2. Left: SWIR1 Band and, Right: Training Data.**



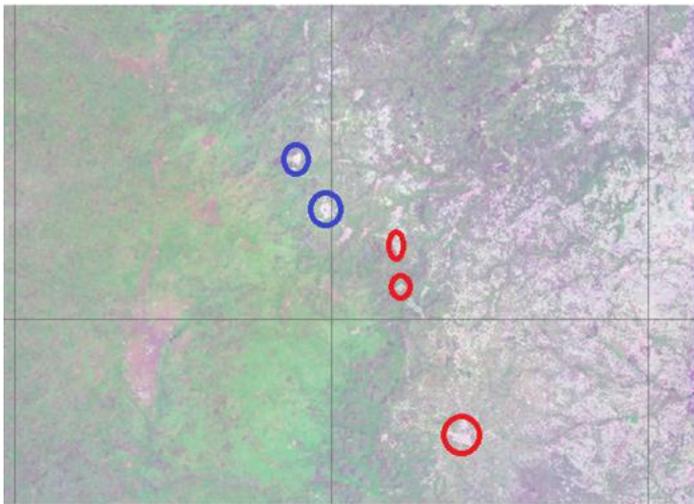
**Figure 3. a: Landsat RGB 751 False Colour Composite of the entire Aoi. b: Google earth image of the AoI showing Coal Pits. Blue marker represents site used for training while red markers are validation pits.**

Figure 4a shows the classified map. Bright areas represent the exploited areas for coal (coal pits) while other areas in dark hue are non-coal areas. Accuracy of prediction was 99.957%.



**Figure 4. a: coal pit map. The Pits are Shown in Bright Pixels. b: Aoi Image Super-imposed on the Pit Map.**

Figure 4b is the super-imposed 4a on the Aoi image at 65 percent transparency of the latter. Figure 4c is the zoomed-in image of the portion of figure 4b which contained both the train data and the validation pit for better verification. The spatial coordinates of validation pits were further checked and found to correspond.



**Figure 5. Zoomed-in Image of the Eastern Flank of Figure 4b for Verifying How well the Classified Pit and the Validation Pits Match.**

## V. CONCLUSION

The objective of this work was to map coal pits in part of Benue trough using random forest ensemble machine technique. This objective was achieved with very good accuracy of result. Checks made against reserved areas as used showed consistency. The method was able to detect other available pits on the eastern flank of the AoI.

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# Promotion of Sanskrit and Sanskritic Culture in India

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**Abstract-** This paper is oriented to study the efforts made for promotion of Sanskrit language and Sanskritic culture in India in its post independent and post- liberal period. Sanskrit language, which had a glory in ancient time has gradually come to a status of medium of chanting mantras and worshiping language in India. There are initiatives by governmental and non-governmental organisations, and even some people who work independently for reviving the past glory of Sanskrit. It needs to gauge the extent of such initiative and its success. This paper tries to see the different initiatives taken by people and government to promote Sanskrit culture and education.

**Index Terms-** Sanskrit, promotion, education, culture, India.

## I. INTRODUCTION

Sanskritic culture and Sanskrit education is the matter of concern for Indian scholars now a days due to its gradual deterioration. The western aggression to Indian culture due to colonial rule and its continuous impact on Indian society is a major reason behind the loss of glory of Sanskrit. The Sanskrit knowledge base and Sanskritic culture which became the dominant pattern of culture in Ancient India and the later periods down to pre-colonial period is the only written repository of knowledge at large in Indian subcontinent. It occupies a dominant space in Indological sources of literature. The growth of vernacular languages has led to the reduction of its popularity and usage. Due to its propagation of Brahmanical knowledge in one hand, the gradual deterioration of Sanskritic values and improper interpretation and usage of Sanskritic knowledge on the other has created inner contradiction within Indian society. It is because Sanskrit is regarded to be the mere representative of Aryan knowledge and worldview and has created its gradual deterioration. Besides, the Muslim invasion from Middle East and later aggression by the British imperialistic forces has reduced this language into a language for religious chanting of mantras and taking oath in auspicious moments. Besides, the globalisation in post-colonial period which is high in last decade of twentieth century and present twenty first century, has brought a number of changes to Indian culture and society.

Again, the Sanskritic culture that is inherited through ages by Indian society is also under continuous attack by foreign culture. While there is a degradation of Sanskritic culture, there is a rising consciousness in the society to preserve and revive many of these traditions and culture too. This is reflected in the steps taken by many sections of society in different places and time. The scholars of Sanskrit studies and social sciences reiterated it in many of their write ups, yet a systemic effort has not taken to study

the steps taken for promotion of Sanskritic culture and Sanskritic education. This paper makes a modest attempt to accumulate information on that line and assess the extent of initiatives at different level to promote Sanskrit education and culture.

## II. PROMOTING SANSKRITIC EDUCATION AND INITIATIVES

After the growth of vernacular languages, Sanskrit did not remain as living language and is mostly used for certain specific purposes, mostly as medium of instruction and publication or writing literary piece. Sanskrit is one of the 22 official languages in India. It is the second official language of two of the states in India viz. Uttarakhand and Himachal Pradesh. According to 2011 census, there are 2360821 Sanskrit speakers in India.

The use of Sanskrit in India is confined to the religious rituals as hymns and mantras chanted by the priests during the ritual. Sanskrit has been being written in Devanagari alphabet for nineteenth century, though many other regional languages are also used to write Sanskrit. in India. After Devanagari, Roman alphabets are also used for Sanskrit. Many vernacular languages of India are also used as script in writing Sanskritic contents.

As a language, it was a part of modern course curricula in primary, secondary, higher secondary, graduation and post-graduation level from the beginning of modern education system introduced during Colonial period and continued in post-colonial India till date. In case of lower level, Sanskrit was compulsory subject and even now also many central and state government - schools continue it to be the compulsory subject. There are also privately funded schools which included Sanskrit as a compulsory subject of study in primary and secondary level. It is an elective paper in post-high school level courses. and colleges.

There are many central and state Universities imparting knowledge on Sanskrit. Besides there are Sanskrit Universities too which are specifically established for Sanskrit education. Three major Sanskrit institutes which are given special attention and selected for promotion of different activities are; Rashtriya Sanskrit Sansthan (RSS) Delhi, Sri Lal Bahadur Shastri Rashtriya Sanskrit Vidyapeetha (LBSRSV) New Delhi, and Rashtriya Sanskrit Vidyapeetha (RSV) Tirupati. Besides these three premiere Institutes, there are a number of institutes that impart Sanskrit education as Uttarakhand Sanskrit University, Sampurnanand Sanskrit University (Banaras), Sanskrit College and University (Kolkata), Kameshwar Singh Darbhanga Sanskrit University (Bihar), Shri Sankaracharya University of Sanskrit, Jagadguru Ramanandacharya Sanskrit University (Rajasthan) and many more. While there is a good number of Sanskrit Universities that impart Sanskrit education, the demand for such education has come down to the extent that these have become centre for

research. There are very few enrolments in those universities for Sanskrit education.

Rastriya Sanskrit Sansthan was established in 15th October, 1970 as an autonomous organisation registered under the Societies Registration Act, 1860 (Act XXI of 1860) for the development and promotion of Sanskrit all over the country. It is fully funded by Government of India. It works as an apex body for propagation of Sanskrit and assists the Ministry of Human Resource Development in formulating and implementing various plans and schemes for the development of Sanskrit studies. It plays the role of a nodal body for proper implementation of various recommendations made by the Sanskrit Commission, which was set up by the Government of India, Ministry of Education in 1956 for the propagation and development of Sanskrit language. The institute has now been declared as Deemed by the Ministry of Human Resource Development. It is declared as Central Sanskrit University. This Sansthan has adopted five villages. These are; Jubatara (Mohanpur), Tripura, Masot (Pragpur), Himachal Pradesh. Chittembai (Shimoga), Karnataka Adat (Puzhakkal), Kerala and Barai (Huzoor), Madhya Pradesh to promote Sanskrit. Sri Lal Bahadur Shastri Rashtriya Sanskrit Vidyapeetha (SLBSRSV) was established on 8th October 1962 in New Delhi and it got the status of Deemed university in 1987. It has been providing Sanskrit education for a long time.

The Art, Culture and Language Department is a newly Department of Government of National Capital Territory (NCT) of Delhi with the aim to preserve cultural heritage. Propagation, promotion and development of languages, literature, art and culture as an integral part of composite culture of Union Territory of Delhi. These activities are carried out through Sahitya Kala Parishad and Language Academies: Punjabi, Hindi, Urdu, Sanskrit and Sindhi, which are autonomous bodies.

The Sanskrit Academy is engaged in the promotion, propagation and development of Sanskrit language and literature in Delhi. With a view to promote Sanskrit lingual culture and encourage exchange of ideas and experiences, it organises poets meets, competitions of different natures in Sanskrit language, distributes ABCDs of Government Centre for Civil Society 59 awards for original writing in Sanskrit. It organises centres for Sanskrit teaching, yoga, ayurveda, jyotish and karmakanda.

Different state governments have also given priority to promote Sanskrit. While it is the second official language in Uttarakhand and Himachal Pradesh, many state governments have taken interest in promoting Sanskrit.

The government of India has taken many steps to promote Sanskrit language. It has devised a provision of financial assistance to Adarsh Sanskrit Mahavidyalayas / Shodha Sansthans and instituted the award of merit scholarships to students of Sanskrit Pathasala to College level. It also provides financial assistance to NGOs / Higher Educational Institutions of Sanskrit for various Research Projects / Programmes. The retired eminent Sanskrit scholars are engaged under the Shastra Chudamani scheme for teaching. Sanskrit is also taught through Non-formal Sanskrit Education (NFSE) programme, by setting up Non-Formal Sanskrit learning centres, in reputed institutions like Indian Institute of Technology, Ayurveda Institutions, modern colleges and Universities. The government has also provided presidential awards for Sanskrit Language to senior and young

scholars. Storing the knowledge base are very much the need of the hour as many Sanskrit texts are disappearing day by day.

It has provided financial assistance for the publication and reprint of rare Sanskrit books. The government has also implemented Astadashi projects containing eighteen projects to sustain the growth of Sanskrit. The Ministry of Human Resource Development (MHRD) had established the Rashtriya Sanskrit Sansthan – and allocated Rs 643.84 crore to it in the last three years – in Delhi as a nodal authority to promote Sanskrit. In 2019-20, the Sansthan was allocated Rs 231.15 crore, Rs 214.38 crore in 2018-19, and Rs 198.31 crore in 2017-18 (16 Feb., Hindustan Times, 18 Feb., 2020; Deccan Herald).

The non-governmental organisations which are engaged in promoting Sanskrit culture at all India level are Sanskrita Bharati, Viswa Hindu Parishad, Rastriya Swayam Sevak Sangha, Sanskrit Promotion Foundation, etc. Out of these, the International Association of Sanskrit Studies (IASS), Sanskrit Bharati, Viswa Hindu Parishad, are the international organisations involved in promoting Sanskrit education and Sanskrit culture at a larger scale. The need to establish International Association of Sanskrit Studies ([www.sanskritassociation.org/](http://www.sanskritassociation.org/)) emerged in 1972 in International Sanskrit Conference (Visva Sanskrita Sammelana) held in New Delhi under auspices of Ministry of Education and Rastriya Sanskrit Sansthan. It was realised that the International Congress of Orientalists and international Congress of Asian and African Studies did not allow sufficient discussion on Sanskrit and allied subjects. As a result, in 1973 international congress of Orientalists held in Paris, Sanskritists from various countries endorsed this need for an International Association of Sanskrit Studies.

### III. ONLINE INITIATIVES

There are a number of online initiatives to impart Sanskrit education in recent decades. The times of India report, Jan, 23, 2004 says that the glory of Sanskrit revived online. A number of initiatives are taken both with profit and non-profit motive to impart Sanskrit education and Sanskrit knowledge. A number of websites, online journals, magazines, translators are available in Sanskrit. Vyoma-Samskrta-Pāṭhaśālā, Shri Timli Sanskrit Pathashala, Many Sanskrit tools and software are also developed in Sanskrit in IITs. Many spoken Sanskrit lessons, Sanskrit pages are available online.

Government of India has started a portal dedicated to Sanskrit itself known as Sanskrit Portal. It provides access to various links related to Sanskrit education and activity related to that. It is a repository of vast Sanskrit knowledge and various developments taking place in promoting Sanskrit. A number of published and archaic materials are uploaded in this portal.

### IV. HINDUTVA POLITICS AND SANSKRIT PROMOTION

Sanskrit as propagator of Hindutva ideology and Brahmanical text has been raised by the anti- Sanskrit and anti-Brahmanical organisations in India, the DMK movement and all India DMK is a political organisation which criticising the promotion of Aryan language and the Brahmanical ideology. The anti- Brahmanical movement started by JP Narayan, Jotiba Phule

and B.R. Ambedkar are some of the major movements that have been working as a strong force against the propagation of Sanskrit culture and language. These organisations focus on non-Aryan base of Indian civilisation and consider Sanskrit as the creator and propagator of social inequality, the dominant system of caste hierarchy in India. The pluralistic political philosophy along with parliamentary democracy which gives equal weightage to all cultural groups and representation in parliament allows these diverse movements and ideological coexistence. Hence there is a divide between different linguistic and cultural communities to accept the language as the only language to propagate.

Besides this linguistic difference Sanskrit also has got rejection by the larger Muslim community as the language to propagate Hinduism and Hindu ideology. RSS and Viswa Hindu Parishad are considered as the organisations which work for promotion of Hinduism. The present Prime Minister and the government ruled by the political party Bharatiya Janata Party is considered by opposing forces and political party to propagate Hindutwa ideology and has given a special focus on promotion of Sanskrit. Many newspapers bring forth this kind of claims made by politicians of different parties.

It is reported that there is unhappiness by the politicians who pointed out that the present BJP led government has spent around Rs. 643.84 crore to promote Sanskrit in last three years span. This is 22 times of the total amount (Rs 29 crore) spent on the other five classical Indian languages – Tamil, Telugu, Kannada, Malayalam and Odia according to the information of Union Ministry of Culture (The National Herald). The DMK leader Dayanidhi Maran questioned the relevance of Sanskrit in the face of a subordination of other languages led to heated criticism. Recently the move to rewrite the names of railway station in Sanskrit which were written in Urdu (19 Jan, www.livemint.com.), also raised a lot of criticism.

## V. CONCLUSION

Sanskrit as the oldest known Indo-Aryan language, not only stores knowledge base of people existed till that time, but also

contains the existing knowledge of non-Aryan people of that time. A language and mainly classical language need to be preserved and Sanskrit is the oldest classical language known so far. It needs promotion not only for resource base in general, but also the very rich resources of that time for which the language got internal reputation too. Besides the religious contents, it has a vast stock of scientific knowledge reiterated by scholars of different disciplines. Hence promotion of Sanskrit and preservation of Sanskrit language is very much necessary. There is no doubt that with BJP government it has got more importance due to the ideological base of being oriented to Indian culture, but the preservation of it being very old language is the prime need of the hour. Hence being the generator of many vernacular languages, Sanskrit has got its merit to be preserved than any other vernacular language.

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# Relationship between Internet dependency and mental health of adolescents: The psychology of internet use

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## *Conflict of interest*

We declare that we have no significant competing professional, financial or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

## *Author's contributions*

Both the author's contributed equally to the theoretical development and writing of the manuscript.

First author: First author contributed in the planning of the whole study and analyses, interpretation of the data and manuscript writing.

Second author: Second author contributed in theoretical development, review of literature and data collection.

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**Abstract-** The use of internet is very common and has become an interesting behavioral addiction type among young people is assumed to have an influence on psychological well-being. This study was carried out to examine the relationship between different dimension of mental health and internet dependency. Present study has a significant contribution in the planning and implementation of preventive psychological counseling services and sustains the psychological well-being of adolescents. 200 adolescents studying in various colleges of Raebareli and Lucknow completed the Young's Internet addiction test and mental health questionnaire (MH38). The correlation and regression analyses were employed for the analysis and interpretation of data. The results of correlation analysis showed that internet addiction was significantly negatively related to the negative dimensions of mental health (anxiety, depression and LBEC) and negatively related to positive dimensions of mental health. Further the results of hierarchical regression analyses indicated that internet dependency was significantly positively predicted anxiety, depression and LBEC and significantly negatively predicted general positive affect. In conclusion, adolescents with high Internet use will have high level of anxiety, depression, less emotional and behavioural control and low positive affect. Implication, limitations and some areas of future research related to mental health and internet dependency were also discussed.

**Index Terms-** internet dependency, mental health, anxiety, depression, positive affect.

## I. INTRODUCTION

The development of Internet came through many stages and presently this system is widely used all over the world and most of the people could not imagine their life without it. It becomes an integral part of our lives (Nalwa & Anand, 2003). It has many advantages like as easy communication, easy accessibility to information (Kaplan & Haenlein, 2010), low cost and minimal location constraints, due to these qualities there is an increment in the number of users of the internet (Panicker & Sachdev, 2014; Czincz & Hechanova, 2009).

Well-being is one of the most important goals which individuals strive for. The general well-being of adolescents has been the topic of considerable debate in recent years. Although the concept of well-being is important in all stages of life, it is most important in young adults, because, this stage is a critical phase of transition where the individual changes physically and psychologically from a child to an adult. It is a built-in, necessary transition period for ego development. Cognitive, emotional and attitudinal changes which are characteristic of adolescence often take place during this period. Adolescence is the most vulnerable age for development, when the child once entering in this stage requires intensive readjustment to school, social and family life. While many adolescents experience anxiety, unpleasant or strange feelings Therefore, it is necessary to focus on the psychological well-being of university students.

The Internet is widely used by adolescents and young adults, in daily life in various countries. Among the Internet-using population, the fastest growing group is ranging from 13-34 and 91% of this age group will be online. Substantial part of this growth has been seen in the adolescents in particular. Individuals with an Internet dependency experience excessive uncontrolled internet use and spend a great deal of time online, in spite of negative outcomes in their lives. Also, Internet dependency negatively affects psychological well-being (Winther, 2014). Moreover, people can become addicted to the Internet if they become increasingly dependent on the Internet and they seek to be online to escape real life issues or a dysphoric mood. The result of frequent Internet use, particularly among adolescents, has become a highly controversial issue. Still, there remains a paucity of research on the subject, including the use and their consequences. Due to the rapid growth of the internet dependency, this issue should be must recognize by both professionals and researchers particularly with respect to the college students.

Therefore by taking into account these issues of internet use the present investigation mainly focused on the comprehensive examination of the relationship between internet dependency and positive and negative mental health.

Internet dependency is any online-related, compulsive behaviour which interferes with normal living and causes severe stress on family, friends, loved ones, and one's work environment (Young, 1998). Internet addicts make the Internet a priority more important than family, friends and work (Sarao & Sharma, 2017).

Most research studies have suggested that internet plays an integral part of daily life for people of today, particularly in the age of adolescence (Young, 1999; Thorsteinsson & Davey, 2014; Wallace, 2014; Tzavela, Karakitsou, et.al., 2017). Many research scholars identifies one of the worst affect of internet addiction is anxiety, (Nima & Nazanin, 2012), depression (Morgan & Cotton, 2003), loneliness, depressive mood (Kraut, Patterson & Lundermark, 1998), and compulsiveness (Griffiths & Pontes, 2014).

Exaggerate and inappropriate use of internet creates many problems for young people. Internet addiction has changed the human behaviour pattern and affects their relationship in all way. Several studies (Ko et al, 2008; Yen et al, 2008), have reported that depression is much prevalence among internet users than normal person, while Namazee et al (2005) have reported no relationship between Internet use and depressive symptoms. On a sample of Turkish students Akini and Iskender, (2011) have reported that depression and anxiety are significant predicted the Internet addiction.

Finally it has been found Internet addiction is just like an impulse control disorder. In the Diagnostic and Statistical Manual for Mental Disorders (DSM), internet dependency has been conceptualized as an addictive behaviours like as substance abuse or pathological gambling. Therefore internet dependency is frequently considered as a "behavioural addiction" or an "impulse control disorder," as it shares most features (e.g., craving, tolerance, loss of control, relapse, and withdrawal) with other addictive disorders.

### **H1: Internet dependency would be positively related to anxiety, depression and loss of behavioural and emotional control among adolescents.**

Only a few studies have examined the relationship between internet dependency and positive mental health (Koc, 2017). Positive mental health is a combination of feeling good and functioning effectively (Huppert, Baylis & Keverne, 2005). There are several aspects of positive mental health one of them is life satisfaction. Regarding the relationship between internet addiction and life satisfaction in a study Koc (2017) has found that high-level internet addiction is positively related low-level life satisfaction and positive emotions, and high-level negative feelings among the students. This finding is also supported by other research findings (Baruch, 2004; Cardaks, 2013; Engelberg & Sjoberg, 2009; Morahan- Martin & Schumacher, 2000; Shahnaz and Karim, 2014).

Concerning the relationship between internet addiction and emotional ties, studies have reported that excessive internet use is highly related to the interpersonal relationship problems (Li & Chung, 2006; Shuhail & Bergees, 2006). A rapid increase has been reported in the relationships between excessive Internet usage and interpersonal problem. Li and Chung (2006) stated that it is very important to know how Internet users formed their relationship with their friends through online or normal social life. According to them it is also necessary to check whether the people are missing their social engagement, whether they more comfortable with online friend and reduce the contact with the people in reality or not.

### **H2: Internet dependency would be negatively relate to positive affect, emotional ties and life satisfaction among adolescents.**

## II. METHOD

### **Participants**

The sample consists of 200 students from different institutions and colleges in Raebareli (U.P) and Lucknow. The sample further divided into male and female. The age of participants ranged from 13 to 17 years. The current study specifically assessed adolescents and, therefore, the purposive sampling method was used to choose a sample. Data were obtained on the basis of response by means of structured questionnaires.

### **Measures**

#### **Internet Addiction Test (IAT)**

The Internet Addiction Test (IAT) was developed by Young in 1998. The Internet Addiction Test (IAT) is a 20-item scale, rated on a six-point likert-scale, where 0= 'does not apply' and 5='always'. The internet addiction scale was found to have good reliability ( $\alpha = 0.90$ , Keser et al, 2013).

**Mental health inventory 38**

To assess the well-being of participants, Mental Health Inventory (MHI- 38), was used which was developed by Veit and Ware (1983). It consists of 38 items that measure different aspect of psychological well-being including the following: anxiety, depression, loss of behavioural/emotional control, general positive effect, emotional ties, and life satisfaction. It is a 6 point Likert style scale, with responses ranging from 1(high) to 6(low). Cronbach’s alpha rating of this scale is 0.93.

**Personal data sheet**

Demographic variables included: age, gender, class, stream, area and overall health.

**Procedure**

All the measures along with the personal data sheet were administrated to the participants and they were asked to read the instructions carefully given in the questionnaire. Every participant was explained about the nature and purpose of the study. Participants were also assured about the confidentiality of the data. Participants were allowed to take their own time to complete questionnaire. There was no time limit to complete the questionnaires.

All the scoring of the obtained data was done according to their manual. The data was analyzed using the SPSS. Firstly, the correlation coefficients were computed to examine the pattern of relationship between predictor and criterion variables. Finally, Hierarchical regression analyses were performed to test the hypotheses.

**III. RESULTS**

Present investigation examined the relationship between internet dependency and mental health. This chapter will point out the detailed statistical analysis of the research data. The data were analyzed using the statistical program for social science.

**Results of correlation between Internet dependency and outcome variables**

Table 1 recorded the relationship between health, internet dependency, anxiety, depression, LBEC, GPA, ET, LS, Psychological Distress, psychological well-being and global mental health. Findings of the table 1 indicated that the internet dependency was significantly positively correlated with anxiety ( $r = .277, p < 0.01$ ), depression ( $r = .316, p < 0.01$ ), LBEC ( $r = .289, p < 0.01$ ) and Psychological Distress ( $r = 0.337, p < 0.001$ ). Result further indicated that internet dependency was significantly negatively correlated with GPE ( $r = -.265, p < 0.01$ ), psychological wellbeing ( $r = -.194, p < 0.01$ ) and global mental health ( $r = -0.322, p < 0.01$ ). Results finally indicated that internet dependency was not found to be significantly correlated with ET and LS.

**TABLE 1**  
**Correlation between internet dependency and outcome variables**

	Internet dependency	Anxiety	Depression	LBEC	GPE	ET	LS
Internet dependency							
Anxiety	.277**						
Depression	.316**	.426**					
LBEC	.289**	.471**	.474**				
GPE	-.265**	-.273**	-.227**	-.364**			
ET	-.057	.081	-.063	-1.48*	.286**		
LS	-.079	-.111	-.152*	-.231**	.291**	.110	

\* $p < 0.05$  \*\* $p < 0.01$

**Results of hierarchical regression analysis predicting anxiety, depression and LBEC from internet dependency**

We have predicted significant positive relationship between internet dependency and anxiety, depression, LBEC. Findings of the regression analyses regarding the relationship between internet dependency and these variables are reported in the table 2.

Findings of the table 2 revealed that the overall model predicting of anxiety was significant ( $F_{7, 192} = 15.34, P < 0.001$ ) and explained 8.8 % of variance (internet dependency added 7.3 % above the control variables,  $p < 0.001$ ). Similarly, the overall model predicting of depression was significant ( $F_{7, 192} = 19.46, P < 0.001$ ) and explained 12.5 % of variance (Internet dependency added 8.9 % above the control variables,  $p < 0.001$ ). Finally, the model predicting LBEC was also significant ( $F_{7, 192} = 17.65, p < 0.001$ ) and explained 13.1 % of variance (internet dependency added 8.0 % above the control variables,  $p < 0.001$ ).

As can be seen in the Table 2, results indicated that, that individuals who experienced high level of internet dependency reported higher level of anxiety ( $\beta = 0.281, p < 0.001$ ) depression ( $\beta = 0.310, p < 0.001$ ) and LBEC ( $\beta = 0.294, p < 0.001$ ). Overall the results indicated that internet dependency has strong predictive power in regards to anxiety, depression and LBEC.

**TABLE 2: Results of hierarchical regression analysis predicting anxiety, depression and LBEC from internet dependency**

Predictor variables	Criterion variables					
	Anxiety		Depression		LBEC	
Control variables	Step1	Step2	Step1	Step2	Step1	Step2
Age	.042	.013	.001	-.032	.025	-.006
Gender	.003	.026	.095	.131*	-.015	.009
Class	-.092	-.094	.037	.036	-.156	-.157*
Stream	-.095	-.064	-.076	-.042	.028	.059
Area	-.029	-.010	-.090	-.069	-.134*	-.114
Health	.004	.046	-.108	-.062	-.103	-.059
Independent Variable						
Internet Dependency		.281***		.310***		.294***
R <sup>2</sup>	.016	.088	.036	.125	.052	.131
Adjusted R	-.015	.055	.006	.093	.022	.100
R Change	.016	.73	.036	.089	.052	.080
F Change	.512	15.34***	1.215	19.46***	1.75	17.65***

\* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$  df step1=6, 193, df step2=7,192

**Results of hierarchical regression analysis predicting General positive effect, Emotional Ties and Life satisfaction from internet dependency**

Findings of the regression analyses regarding the relationship between internet dependency and positive effect, emotional ties and life satisfaction are reported in the table 3. Consistent with this prediction, findings of table 3 indicated the overall model predicting of GPE was significant ( $F_{7, 192} = 12.96, P < 0.001$ ) and explained 8.5% of variance ( internet dependency added 6.2 % above the control variables,  $p < 0.001$ ). It can be clear from the Results of Table 4 indicated that, individuals who experienced high level of internet dependency reported low level of GPE ( $\beta = -0.259, p < 0.001$ ). Findings further indicated that internet dependency was not found to be significantly predicted emotional ties and life satisfaction.

**TABLE 3: Result of hierarchical regression analysis predicting GPE, ET and LS from internet dependency**

Predictor variables	Criterion variables					
	GPE		ET		LS	
Control variables	Step1	Step2	Step1	Step2	Step1	Step2
Age	-.047	-.020	.107	.114	-.053	-.046

Gender	-.002	-.024	-.063	-.069	.059	.054
Class	-.053	-.051	-.110	-.109	-.032	-.031
Stream	.106	.078	-.010	-.018	.110	.104
Area	-.034	-.052	.030	.025	-.075	-.080
Health	-.003	-.042	.063	.053	-.058	-.067
Independent Variable						
Internet Dependency		-.259***		-.068		-.063
R <sup>2</sup>	.023	.085	.018	.022	.031	.034
Adjusted R	-.007	.051	-.013	-.013	.001	.000
R Change	.023	.062	.018	.004	.031	.004
F Change	.760	12.96***	.588	.842	1.024	.721

\*p<0.05 \*\*p<0.01 \*\*\*p<0.001 df step1=6,193, df step2=7,192

#### IV. DISCUSSION

It was hypothesized in the present study that internet dependency would be positively related to anxiety, depression and LBEC and negatively related to positive effect, emotional ties and life satisfaction.

The finding of the study shows that there is a significant positive correlation between anxiety, depression and LBEC with Internet addiction. It can be said that Internet itself has no harm but addiction of internet caused many psychological issues such as shyness, loneliness, anxiety, depression, and interpersonal relations. This finding is consistent with that of earlier studies of the same area (Alavi et al, 2010; Ko et al, 2007; Ha et al, 2007; Barak & King, 2000; Jafari & Fathizade, 2012).

In determining the relationship between anxiety and Internet addiction, we can stated that the high anxiety and stress may have existed before the Internet use, that is, the anxious individuals may use Internet as an escaping way. Similarly, anxiety and stress may occur due to addiction to the Internet, that is, when the individual becomes addicted to the Internet, s/he becomes restless, worried and anxious, and uses Internet to reduce her/his anxiety and stress (Mirzaeian et al, 2011).

In explaining the relationship between depression and Internet addiction it can be said that depression may therefore acts as a trauma that predisposes individuals to develop Internet addiction. Some people use the Internet to reduce their depression so that the Internet may provide an alternative to the joyless life. Similarly, depression may occur due to addiction to the Internet, that is, the individuals who become addicted to the Internet experience the negative consequences resulting from it such as depression; therefore, according to the present study, we cannot give any idea about the precise reason of the relationship between Internet addiction and depression and this issue requires further study (Petrie & Gunn, 1998, Widyanto, & Griffi, 2005).

Finally regarding the relationship between internet dependency and LBEC the finding of hierarchical regression analyses supports our hypothesis. The consequences of focusing more on the quality of the virtual world have various impacts on the spirits and the temperament of the people. Therefore, overusing internet causes physical laziness and developing hypoergasia, and reduces having relationship with others in the real world and as a result causes social isolation In other words, the use of Internet as a means for escaping from the problems, reducing the frustration feeling, anxiety and depression or spending a lot of time in the Internet to find virtual friends to reach imaginary affairs that are not possible in the real world by some of individuals addicted to the Internet is a factor for dependence to the Internet (Brenner, 1997; Kubey et al. 2001; Scherer, 1997; Shuhail & Bergees, 2006).

#### Hence, hypothesis 1 of the present study was completely supported.

Only a few studies have conducted on the relationship between internet dependency and positive aspects of mental health i.e. on positive effect, emotional ties and life satisfaction. Therefore by taking into consideration this existing gap of literature we predicted that internet dependency would be negatively related to the positive effect, emotional ties and life satisfaction. Consistent with this prediction significant negative correlations were found between internet dependency and positive affect while internet dependency was not found to be significant with emotional ties and life satisfaction.

On the basis of this finding it can be said that feelings play an important role on the thoughts and behaviors of the individual (Arslan, 2017). Therefore, it can be said that feeling is a concept which is related to internet addiction. In a study Koc (2017) have reported that students with high-level internet addiction have low-level life satisfaction and positive emotions, and high-level negative feelings. Further, results of this study showed that as individuals with higher levels of subjective well-being have lower levels of Internet addiction compared to those who have lower. Consistent with the findings of this research, studies have shown that people with internet addiction have negative feelings and people with positive feelings are less connected to the internet (Baş, Soysal and Aysan, 2016; Derin, 2013).

## V. CONCLUSION

On the basis of findings of present study we concluded that individual with high level of Internet dependency have high level of anxiety, depression, and have loss of behavioural and emotional control and psychological distress. Further it has been found that higher level of Internet dependency is negatively related to general positive effect, psychological wellbeing, mental health, stream and health.

Findings of the study indicate that internet addict students have greater mental health problems than the students who are not internet addicts. So the findings of the study may have counseling implications for the students who are internet addicts. Certain intervention programmes can be made for the youths in order to help them control the excessive usage of internet and increase their mental health status.

In the present investigation self-reported questionnaires were used for data collection. Future studies should includes individual interviews along with filling up of the questionnaires would significantly contribute towards improving future research studies conducted in the field of internet research. This would aid in gathering more information regarding participant's internet use, state of mind while online, and the experiences of the user after his/her time online.

Another research study should discuss more about Internet dependency in children. Also, a good topic for research would be the effect of specific personality traits that may make the person more vulnerable to Internet addiction.

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# Corporate Social Responsibility by Small and Medium Enterprises in India

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## Abstract:

This paper is an exploratory study on Corporate Social Responsibility (CSR) by Small and Medium Enterprises (SMEs) in India in terms of the nature of their CSR-related practices and disclosures. For analysis, the SME sample was taken to be the SMEs listed on the BSE SME and NSE EMERGE. The official website and annual report 2018-19 of the listed SMEs were searched for mentions of CSR-related information. The findings indicate that despite the majority of SMEs stating that they were not mandated to perform CSR, a number of SMEs have considered CSR-related aspects in some form, however their disclosure practices for CSR-related information vary. In addition, a number of SMEs mandated to perform CSR have in some cases followed more stringent CSR practices and disclosures than required by law. In overall, there is an indication that a number of SMEs have a favourable perception towards the importance and need of CSR by businesses, despite CSR not being commonly associated with SMEs. The CSR practices by SMEs in India have not often been in the focus. However, cumulatively SMEs comprise a significant part of the Indian economy and hence the nature of their CSR activities is important for consideration.

**Keywords:** Corporate Social Responsibility, CSR, Small and Medium Enterprises, CSR Practices, CSR Disclosures

## Introduction:

### Corporate Social Responsibility (CSR) in India:

CSR has been a practiced by some Indian businesses since a long period of time. The motivations of firms in India to practice CSR include both moral and economic factors (Dhanesh, 2014).

CSR activities are now an aspect of many businesses in India as there is both a growing awareness of their responsibility towards the society and a legal mandate to engage in CSR activities for a prescribed class of businesses. The number of companies engaging in CSR activities in India has seen a consistent rise in the period from 2014 to 2018 as indicated by Table 1.

**Table 1:** The number of companies engaging in CSR in India and their percentage growth for the corresponding period

Period	Number of companies engaging in CSR	Percentage Growth
2014-15	16548	-
2015-16	18290	10.53%
2016-17	19539	6.83%
2017-18	21937	12.27%

**Source:** Data of number of companies engaging in CSR from the National CSR Data Portal (Ministry of Corporate Affairs, Government of India)

In general, CSR activities can be undertaken by a wide variety of companies in terms of their size, but the CSR activities by the Small and Medium Enterprises (SMEs) are not often in the limelight as it is considered that the CSR efforts by them will usually be relatively constrained by their smaller size and thus resources individually as compared to the larger corporations (Smith,

2013). However, when considered together, the SMEs often comprise a significant size of the global economy (Mousiolis et al., 2014) and even the Indian economy (Jain, 2014).

SME's play a vital role in the economy of many nations and play a significant role in providing employment opportunities. In addition, individual SMEs may be dispersed in areas that otherwise lack the presence of big businesses (Jain, 2014) and in some cases even have more local-level connect with their area of operation as compared to the larger corporations which may accordingly influence their CSR activities (Mousiolis et al., 2014).

Hence, given their importance and their large prevalence in economies, the nature of CSR activities by SMEs is significant for consideration. SMEs may be defined in a variety of ways on the basis of various parameters such as on the basis of their turnover, capital investment or paid-up capital, etc., and in terms of the commonly used definitions, SMEs constitute a significant part of the Indian economy.

The Government of India defines Micro, Small and Medium Enterprises (MSMEs) by the Micro, Small and Medium Enterprise Development (MSMED) Act, 2006 and by it broadly, till July 2020 (PTI, 2020), MSMEs included manufacturing enterprises with an investment in plant and machinery less than 10 *crore* Indian Rupees (100 million Indian Rupees) and for service enterprises with investment in equipment lesser than 5 *crore* Indian Rupees (50 million Indian Rupees). (Ministry of MSME, n.d)

It is mentioned in a journal of the Ministry of MSME, Government of India that there are an overall 63 million MSMEs in India that constitute 45% of the industrial production and 30.5% of the service sector in the Indian economy (Arora, 2019). The large presence of SMEs in the Indian economy is indicative that the CSR practices that are undertaken by them are worth consideration.

According to a report in 2018, smaller companies, which here include those having a net turnover lesser than 500 *crore* Indian Rupees (5 billion Indian Rupees), comprised of 47% of the total number of companies engaging in CSR and 15.9% of the total CSR expenditure. (CRISIL Foundation, 2019)

Some SMEs in India have engaged in CSR voluntarily over the years, and the activities of some have even been recognized by awards such as the Federation of Indian Chambers of Commerce and Industry (FICCI) CSR awards for Small and Medium Enterprises (SMEs). The FICCI CSR awards for SMEs considered all companies having an annual turnover lesser than 200 *crore* Indian Rupees (2 billion Indian Rupees) and the list of winners of FICCI CSR awards (FICCI, n.d) for SMEs indicates that SMEs have been awarded for their CSR activities even in years before CSR was mandated for some class of companies in 2014.

In recent years, some SMEs have been mandated to follow the CSR rules due to some of them falling under the class of companies specified by Section 135 of the Companies Act, 2013. According to Section 135, any company in India, that satisfies one of the conditions of having a turnover greater than 1000 *crore* Indian Rupees (10 billion Indian Rupees), net worth greater than 500 *crore* Indian Rupees (5 billion Indian Rupees) or profits greater than 5 *crore* Indian Rupees (0.5 million Indian Rupees) have to follow certain CSR practices. (Ministry of Corporate Affairs, n.d)

The companies mandated to practice CSR by Section 135 have to follow certain procedures such as constituting a CSR Committee to formulate and monitor a CSR Policy and also make a minimum amount of expenditure on CSR. This framework has also been voluntarily practiced by some SMEs performing CSR.

In contemporary times, there has been a growing realization that CSR is needed not just due to the moral and ethical obligation of firms, but is a need for the long-term sustenance of the firm. SMEs and large businesses are not identical in a general sense, however they both still have incentives to engage in CSR activities. (Smith, 2013)

## Literature Review:

Mousiolis et al. (2014) have noted that a lot of research has focused on CSR by large corporations instead of Small and Medium Enterprises (SMEs) despite their significant role in the economy of both developed and developing countries. They note that motives and strategies concerning CSR are different for larger corporations such as multinational corporations (MNCs) as compared to the SMEs. They concluded that while SMEs are limited by factors such as resources when compared to MNCs, they also have unique aspects which favour them when compared to the larger organizations. The favourable aspects include the possibility of faster and less rigid decision-making which often are more focused on issues in the immediate environment of the SME in comparison to MNCs global perspective of decision-making. (Mousiolis et al., 2014)

Nair and Sodhi (2012) have noted that SMEs have a wide variety of incentives to practice CSR that also includes the consciousness of the smaller SMEs on their moral obligations. They analysed CSR by SMEs in India with the analysis of the business case studies of 5 SMEs in India. They noted that the majority of these SMEs implemented CSR directly through a foundation and financed their CSR expenditure through both their operating profits and external funds such as donations. The major hindrance in pursuing CSR was cited to be the non-availability of projects that can be continued sustainably in the long-run after initially commencing the project due to various reasons including financial constraints and the lack of the government's focus on CSR by SMEs in India. They noted that there is a lack of disclosure of CSR activities by SMEs in India due to factors such as the lack of awareness of internationally recognised reporting forums and frameworks. (Nair and Sodhi, 2012)

Sanjanwala et al. (2019) noted that the CSR provisions of the Companies Act, 2013 could be applicable on certain SMEs in India that meet the specified conditions. It is also noted that due to their limited resources some SMEs have tried to comply with the provisions to perform CSR by collaborating with other SMEs to jointly use their combined resources for their CSR activities within an area. It also noted that SMEs could also use a permitted external non-profit organization to handle their CSR activities so that they can focus on their primary business activities. (Sanjanwala et al., 2019)

Ziek (2009) analysed CSR communication by firms in the United States. The study looked at various ways the firms disseminated information related to CSR through the internet including the Annual Report. The study noted that CSR communication was largely seen in the larger organizations by revenue. The CSR related information was largely disseminated as philanthropy information by firms. They also noted that CSR communication practices are largely overlooked and can be researched further.

Parker et al (2015) noted that literature on CSR by SMEs has not often focused on the manner that the CSR-related information is communicated by the SMEs through the various available mediums including through their own webpage and hence studied a particular aspect of it pertaining to the disclosure of the SMEs perceived association of CSR with various stakeholders on their website. The nature and depth of detail of CSR-related information disclosures on the websites was found to be highly diverse.

Dincer and Dincer(2010) analysed the CSR disclosures of SMEs in Turkey thorough the internet. The sample was taken to be the SMEs with an official website that were listed as a member of a certain web-portal. It was found that a very few SMEs had made a dedicated page on their website to disclose their CSR-related information.

### **Research Objectives:**

The large prevalence of SMEs in the Indian economy is indicative that their CSR practices are relevant for consideration. The objective of this paper is an exploratory study on CSR by SMEs in India in terms of their various CSR practices along with analysing the overall practices of their CSR-related information disclosures. This paper will also attempt by this to infer the perception of the SMEs towards CSR by businesses.

### **Research Methodology:**

To analyse the nature of CSR by Small and Medium Enterprises (SME), the SMEs listed in the BSE SME and National Stock Exchange (NSE) SME EMERGE as on November 2019, were considered. The BSE SME and NSE EMERGE requirements for listing include various regulatory requirements for the SMEs including the condition to be an incorporated company and to have a post-issue paid-up capital equal or lesser than 25 crore Indian Rupees (250 million Indian Rupees) in terms of their face value. (BSE SME, n.d; NSE EMERGE, n.d) These sample of SMEs were chosen for analysis as there are some public disclosure requirements for these SMEs due to being listed publicly. For example, a SME listed on the BSE SME has to maintain an official website and make reports periodically. (BSE SME, n.d) This enhances the possibility of obtaining the relevant data relating to CSR. The total sample size of SMEs for consideration by this was 495 listed SMEs.

The sample of SMEs were searched for any mentions of CSR, including both voluntary CSR or CSR mandated by Section 135 of the Companies Act, 2013 on the SME's official website and their Annual Report. For further detailed analysis, only the data given through the company's Annual Report 2018-19 was considered. The type of disclosures relating to CSR made in the Annual Report was also studied to analyse how SMEs reported their CSR-related information.

### **Findings:**

The majority of the sample of SMEs had stated in their Annual Report 2018-19 that they were not covered by Section 135 of the Companies Act, 2013 and hence were not mandated to perform CSR activities. Despite this statement in their Annual Report with regards to CSR, some of these SMEs had still uploaded a CSR policy or else had some mention of CSR activities on their official company website. The CSR activities mentioned on the website included a wide variety of activities such as the organizing of health-care camps and conducting activities related to environment protection. Such SMEs amounted to roughly 10% of the sample of SMEs, however the feasibility of any further detailed analysis is limited due to a lack of additional data and non-standard disclosure practices. There was a lack of disclosure of the actual CSR activities conducted by many SMEs that had only uploaded a CSR Policy and also a lack of disclosure of other relevant information such as the amount of CSR expenditure made by SMEs that had mentioned the CSR activities performed by them on their website.

Nevertheless, this is still indicative that CSR is perceived to be important by a significant number of SMEs that it has still been considered in some form by these SMEs despite not being compulsorily required by the law.

In addition, at least 12.32% of the SMEs had made some disclosures relating to CSR in their latest Annual Report with regard to either mandatory or voluntary compliance.

In the case of companies declaring to perform CSR activities voluntarily, a few SMEs had also made detailed or partial disclosures in their Annual Report as would have been required in the case for companies mandated to perform CSR activities. They amounted to 2.42% of the SMEs and a majority of such disclosures in the Annual Report were only regarding the constitution of the CSR Committee by the SME.

The format prescribed for the reporting of the CSR activities of the companies mandated to perform CSR was notified by the Ministry of Corporate Affairs, Government of India in 2014. It includes various required disclosures including some such as the CSR Committee member composition, prescribed and actual amount of CSR expenditure, and various other details about the expenditure made including the sector, mode of implementation etc. (Ministry of Corporate Affairs, 2014)

Table 2 summarises the nature of some disclosures made by the SMEs in their Annual Report 2018-19 concerning their CSR initiatives for that period. As shown in the table the common disclosures made by those SMEs include aspects prescribed by the framework for SMEs mandated to perform CSR, along with additional disclosures of some aspects that are not specifically prescribed by that framework.

**Table 2:** The nature of common disclosures made by SMEs declaring to perform CSR activities in the Annual Report 2018-19:

The CSR Disclosure made in the Annual Report	Constitution of CSR Committee	Amount of CSR Expenditure	Number of CSR Committee meetings	Attendance of CSR Committee members in its meetings	The sector towards which CSR expenditure is directed	Mode of implementation of CSR activities
Percentage of total sample of SMEs <sup>a</sup>	12.12%	9.90%	7.07%	4.65%	7.47%	8.48%

<sup>a</sup> = Including both the SMEs performing CSR voluntary and SMEs mandated to perform CSR.

**Source:** Compilation of the nature of the various disclosures made by the listed SMEs in their Annual Report 2018-19

The amount of CSR expenditure was reported by 9.90% of the sample of SMEs. Amongst the companies disclosing the relevant details, the SMEs had an average CSR expenditure equal to 2% of their past three-year profits on CSR activities. This is the same percentage as prescribed by Section 135 of the Companies Act, 2013 indicating it is used as a benchmark for CSR expenditure by many SMEs. However, a few had spent lesser than their desired or prescribed CSR expenditure and had mostly cited that they were unable to identify suitable projects or else had suffered a loss in the year CSR activities were to be undertaken.

An overall 12.12% companies had disclosed in their latest Annual Report that they have a CSR Committee that comprised of on an average 3 directors of which on average 1 member was an Independent Director. This is the same as the mandated CSR Committee composition as per Section 135 of the Companies Act, 2013. In addition, 5.86% of the sample of SMEs had gone a step ahead and had made an independent director as the chairperson of the CSR Committee.

A few SME had also made further disclosures regarding the number of meetings and attendance of the committee members. An overall 7.07% of the sample of SMEs disclosed the number of meetings held by their CSR Committee and 4.65% further disclosed the attendance of the CSR Committee members in the meetings held by the committee. On average, the SMEs that made the disclosures regarding the number of meetings had held a CSR Committee meeting twice a year.

The areas of spending that were disclosed by the SMEs were relating to a wide range of areas including rural development, social development, animal welfare, etc. This information was disclosed by 7.47% of the sample of SMEs and the common areas of spending that that the individual SMEs had directed most of their CSR expenditure included areas relating to education and health-care.

The mode of implementation for the majority of the activities under their CSR program was disclosed by 8.48% of the sample of SMEs. With regard to this, 2.83% of the sample of SMEs disclosed that they implement their CSR program directly such as by themselves setting up and running schools. In addition, 0.81% of the sample of SMEs had disclosed that they had set up their own foundation to conduct their CSR activities. However, the majority of SMEs had disclosed to have implemented their CSR through an implementing agency such as a suitable non-profit organization or by donating money to dedicated government funds. 4.85% of the sample of SMEs had disclosed that they had implemented their CSR activities through an implementing agency or else by donating to a government fund.

The location of the CSR activities conducted by the individual SME's was also mentioned by some SMEs and were dispersed in various areas in India and a few stated that they conduct CSR activities across the whole country.

**Conclusion:**

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The findings indicate that a number of SMEs have recognised the need for business enterprises to engage in CSR activities.

A few SMEs have stated in their Annual Report 2018-19 that they were mandated to perform CSR as per Section 135 of the Companies Act, 2013 due to meeting its specified conditions. Despite only a relatively few SMEs stating that they were mandated to perform CSR activities, a number of SMEs have shown indications of having considered CSR in some form such as by having formulated a CSR Policy and displaying it on their official website. In addition, a few SMEs have also clearly stated they voluntarily practice CSR in their Annual Report.

For the SMEs that made disclosures of some aspect of CSR in their Annual Report, the most common disclosure made is of constituting a CSR Committee and the names of the committee members. The other disclosures commonly made by such SMEs are mostly influenced by the framework of CSR reporting notified by the Ministry of Corporate Affairs, Government of India for companies mandated to perform CSR and includes the prescribed and actual amount of CSR expenditure and mode of implementation of the CSR activities.

A number of SMEs including some which were mandated to perform CSR have in some cases gone beyond just complying with the basic legal requirements and made greater disclosure such as by stating the attendance of the individual CSR committee members in the meetings of the CSR Committee and followed more stringent practices such as by having an independent director as the chairperson of the CSR Committee.

A limitation faced by this study is the non-standard and partial disclosures made by many SMEs. A number of SMEs did not disclose any aspect of their CSR program through their Annual Report in a standard form but had indications on their official website of having considered CSR in some form. Furthermore, given the lack of standard disclosure practices, it is likely that some SMEs that may have also considered CSR have not disclosed this on their official website too. In addition, there were also cases of non-standard and partial disclosures made by SMEs voluntarily disclosing CSR-related information in their Annual Report that added complexity to the process of collating the data.

Nevertheless, it is seen that a number of SMEs have considered CSR in some form despite the majority of them not being mandated to do so by law. In addition, the presence of SMEs disclosing to practice CSR voluntarily and some SMEs following more stringent practices is an indication that a number of SMEs have a favourable perception towards the importance and need of CSR by businesses

SMEs are not typically associated with CSR, however there are positive indications that they are a number of SMEs in India aware of the need for CSR by business organizations in the contemporary world.

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# *Siebenrockiella crassicollis* Trade Using Marketplace in Indonesia

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**Abstract-** *Siebenrockiella crassicollis* is one of the most demanded freshwater turtle in the international market. Being indexed in Appendix II CITES and categorized as Vulnerable by IUCN, the trade of this species is regulated by the authorities in Indonesia. Being also traded in marketplace in Indonesia, it is important to monitor the online trade of this native species to achieve the legal, traceable, and sustainable wildlife trade. The result showed that *S. crassicollis* was traded in Five marketplaces. These shops were distributed in several province in Sumatra and Java, with the most number of shops found in DKI Jakarta. The size of turtle traded were vary, and the most various price found in shops located in DKI Jakarta. The trade of *S. crassicollis* on the marketplace seems to still not fulfill the three trading principles. Some recommendations are proposed based on the findings in this research.

**Index Terms-** Marketplace, *Siebenrockiella crassicollis*, trade

## I. INTRODUCTION

This Wildlife trade is an important aspect of the economy in Southeast Asia. Traded wild animals are used in a variety of needs, such as foods, medicines, pets, displays, clothing and even household items [1–4]. Among other classes, the reptile class ranks second with the most species reported in trade, after the bird class [5]. The International Union for Conservation of Nature (IUCN) has included *S. crassicollis* in the Vulnerable (VU) category, which is a species that is at risk of extinction in the medium term and is at risk of becoming Endangered (EN), while according to Rhodin, globally *S. crassicollis* has entered the EN category [8, 10]. In 2003 this species was officially categorized in Appendix II by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which means that this species is not yet rare, but has the potential to become rare if trade is not controlled. In the international market, *S. crassicollis* meat is in demand for consumption and its carapace is used as ingredients for Traditional Chinese Medicine (TCM). Indonesia is one of the main countries exporting *S. crassicollis*. In domestic market in Indonesia, *S. crassicollis* is traded as pets. However, the extent and magnitude of the trade in Indonesia is unknown.

Trade using internet has grown rapidly throughout the world. Online trade is increasingly popular because besides being easier to access, it also provides various kinds of human needs, not only clothing, medicine, food, services, but also animal trade [6, 7, 9, 11, 12]. According to a survey conducted by the Indonesian Internet Service Providers Association (*Asosiasi Penyedia Jasa Internet Indonesia*, APJII), the number of internet users in 2018 reached 171.2 million, an increase of about three times the number of internet users in Indonesia in 2012 [13]. This shows that around 64.8% of the Indonesian population has been actively using the internet, so that trading activities via the internet have also bloomed in Indonesia. Even Indonesia, with its rich biodiversity, does not excluded from animal trade through online stores [14–16]. Turtles are one of the most common groups of creatures found on the online market. Usually, turtles are traded as pets. However, there still lack of information about the wildlife trade in marketplaces in Indonesia. Evaluation of turtle trade can be carried out using a variety of methods such as interviews with trade intermediaries, studies at harvesting sites, visiting captivity sites, literature inventory from the internet and market surveys. Apart from conventional markets, currently turtles are also traded in Indonesia through the internet market. Online trading can be done through forum / community pages, web pages, social media, or marketplaces. Ease of access and confidentiality of identity are driving forces for illegal wildlife trade via the internet. The purpose of this study was to evaluate the trade of *S. crassicollis* in marketplaces in Indonesian.

## II. RESEARCH METHOD

*S. crassicollis* Online trade data was collected for three weeks in January 2020. The search was carried out with the search keywords of “kura pipi putih” (white-cheeked turtle) and “kura piput” (stand for pipi putih) using search engine Google (google.co.id). Furthermore, the search using those keyword was conducted in the marketplace. The data recorded were the name and location of the shop, the price of the turtle and the size of the turtle being sold. If possible, the seller was interviewed to obtain the information about the supplier location and the volume of turtle stock using the chat room provided by the marketplace. The result was analyzed descriptively, presented in pie chart and bar chart. There was no turtle bought in this research.

### III. RESULTS AND DISCUSSION

#### A. The Platforms of The Trade

Traces of the online turtle trade in Indonesia have been observed in 2008 and 2011[17, 18]. However, in those years, trading mostly used online forums and website addresses, among them were hewanpeliharaan.com, jakartapets.com, and noafgan.com. Communication between sellers and buyers was done using electronic mail, Yahoo masanger or mobile communication media. Currently the turtle trade is no longer found on the sites concerned and even some sites in these studies are no longer accessible, and the trade have switched to social media platforms and marketplaces. Based on the results of this study, several marketplaces in Indonesia that provide *S. crassicolis* (Figure 1).

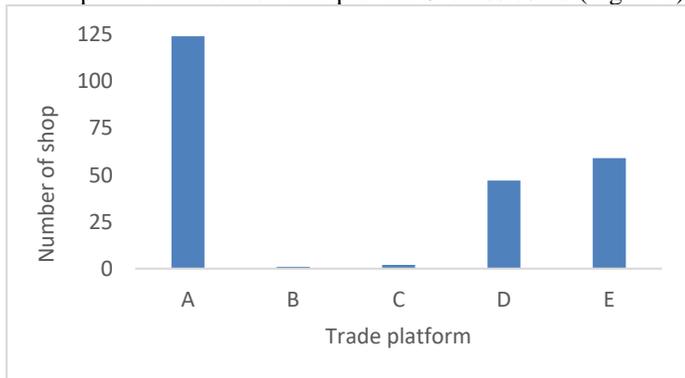


Figure 1. Number of *S. crassicolis* shop in marketplace

*S. crassicolis* sellers were mostly found in platform A (n = 124), then platform E and D. platform A and E are one of the unicorn startups in Indonesia, namely a pioneer category with an investment value of up to 1 trillion rupiah and a marketplace with the highest sales rate [19, 20]. Platform A is a marketplace in Indonesia founded in 2010, then platform B is a marketplace launched on August 2009, while platform D is a marketplace that was founded in Singapore in 2015 and operates in several countries such as Singapore, Malaysia, Thailand, Vietnam, Indonesia, Philippines, Taiwan, and Korea. The three main marketplaces have indeed occupied the top five marketplaces based on smart phones and websites in Indonesia for the last three years. Platform C was originally an online community forum, but along with the development of community users, it provided a trading platform for the users to advertise their selling products. Meanwhile, platform B is a marketplace for buying and selling new and secondhand products. The platform, which was established in 2012, apart from operating in Indonesia, it also operates in Australia, the Philippines, Hong Kong, Canada, Malaysia, New Zealand, Singapore and Taiwan.

#### B. Online stores location

Animal trade carried out through a separate website makes the location of a shop or seller difficult to identified because there is no location information, and communication between traders and sellers is more closed [17]. But now the marketplace requires every store to inform the location of the store, so that the system makes it easier to estimate shipping costs. Based on observations,

online stores selling *S. crassicolis* were spread across ten provinces in Indonesia, namely North Sumatra, West Sumatra, Jambi, Lampung, Banten, DKI Jakarta, West Java, Central Java, DI Yogyakarta and East Java (figure 2). The highest number of online shops was found in DKI Jakarta (n = 199), with the platform most used being platform A. Overall, the highest number of stores was found on the platform A, but platform E was the platform with the most users spread across the islands of Java and Sumatra.

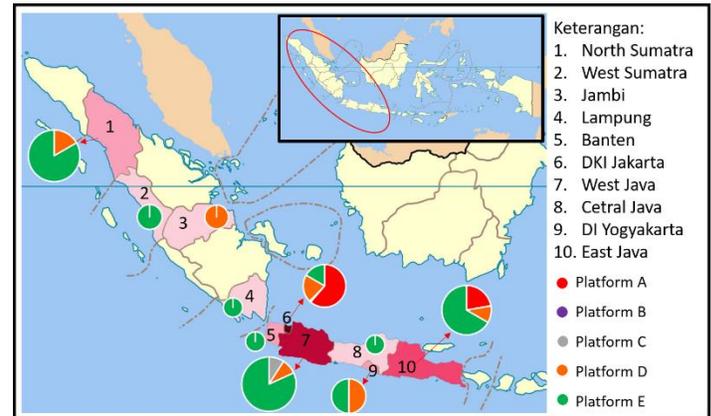


Figure 2. Locations of *S. crassicolis* online sellers in Indonesia

Several sellers in the marketplace said that they got their *S. crassicolis* stock directly from Borneo and Sumatra. Although the island of Borneo is one of the locations for harvesting *S. crassicolis* and local trade occurs, no turtle sellers were found in the marketplace. Jambi and North Sumatra are also one of the locations for harvesting *S. crassicolis*, however only a total of 7 online shops were found in both locations. On the other hand, given the densely populated human population on the island of Java, its relatively central location and long-established trade routes with other islands, and with animal markets found in nearly every major city, it was not surprising that much of the online trade in wildlife also appears to be focused on the island of Java.

#### C. Size of *S. crassicolis* traded

The online shops provide a description of the conditions *S. crassicolis* being offered. The information provided was not the same in every shop, some examples of information provided are turtle size, abrasion shell condition, feed information, care methods, ideal aquarium conditions. Based on the description of the size of the turtles being sold, as many as 10% of shops provided *S. crassicolis* with sizes less than 11 cm, 20% of shops provided sizes of 11 to 15 cm, then 35% of shops provided sizes that were more than 15 cm, while 35% of shops did not list description of the size of *S. crassicolis* offered (Figure 3).

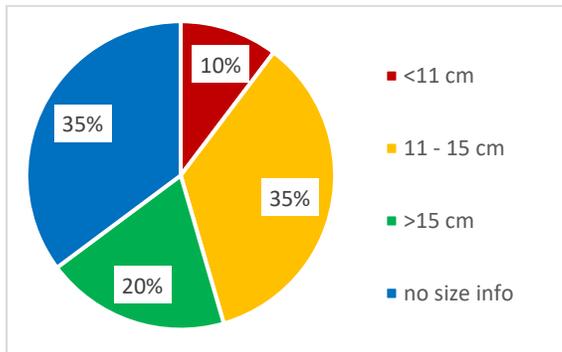


Figure 3. The size of *S. crassicolis* traded

The finding of *S. crassicolis* deals measuring less than 11 cm indicated that the turtles being sold were still in the juvenile phase. Previous research conducted in North Sumatra and Jambi stated that turtles measuring more than 15 cm or the adult phase were harvested for the purpose of community consumption, while turtles measuring less than 11 cm or juvenile harvested were destined for consumption and domestic needs [21]. In online trading through this marketplace, it still unclear about the use of *S. crassicolis* whether for consumption or pet needs.

#### D. The prices

The price of *S. crassicolis* at the harvesting location in Borneo was in accordance with the recommendation or price benchmark given by the Minister of Environment and Forestry of the Republic of Indonesia in regulation No. P86 / MENLHK / SETJEN / KUM.1 / 11/2016, namely IDR 20,000 for the domestic market [22]. However, these prices will change when offered by sellers outside the region, due to transportation costs and turtle care, as well as profits for sellers. The offering price of *S. crassicolis* on the marketplace platform varies widely, depending on body size and online market location, however, there are also many shops that offer turtles of the same size and shop location but the bidding price was far above average. Price competition in the internet market was different from conventional markets. In the marketplaces, it would be very easy for prospective buyers to compare prices, in fact almost all marketplaces also provide store filtering options so that potential buyers can choose a price range, store location, store reputation, payment method, and so on. Meanwhile, the turtle was traded in the conventional market, the price difference would not be too far away, and the stall competition will not be too tight.

Price variations based on store locations were mostly found in online markets that located in the province of DKI Jakarta, with a price range of IDR 53,000 to IDR 525,000 (figure 4). The highest prices are only at two shops but there was no description of the size of the tortoise. It was estimated that from the pictures provided, the tortoise is a adult tortoise. The most common price for turtles offered in DKI Jakarta is IDR 140,000 rupiah, which was for the turtle sizes ranging from 18-20 cm. In West Java the price ranged from IDR 60,000 to IDR 350,000 with the most frequently offered price of IDR 150,000 per individual. In East Java and Banten the most frequently offered prices were IDR 135,000 and IDR 100,000, respectively. The prices in North Sumatra and DI Yogyakarta were different from each store so it

was not possible to determine the price that is most often offered. While in Banten, Jambi, Central Java, Lampung and West Sumatra, only one store was found that provided *S. crassicolis*, so there was no price variation.

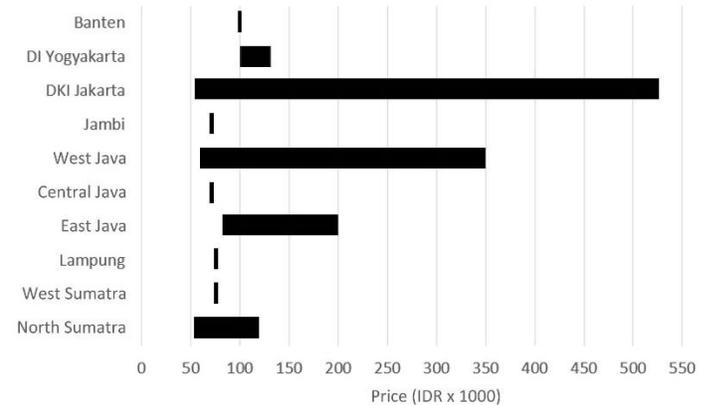


Figure 4. Price variation of *S. crassicolis* based on shop location

The transition in the turtle trade, which previously used a special website page and then currently used the marketplaces, can be caused by the website having hosting and domain costs that must be paid by the website owner annually so that the website can be continuously accessed. Thus, even though there are no buying and selling transactions, the website owner still has to pay a subscription fee for the domain. Whereas in the marketplace, sellers don't need to pay anything to open a shop and display the products to be sold. However, the results of successful transactions will be cut by a few percent for the marketplace. This is certainly quite beneficial for sellers in the marketplace compared to selling using a separate website.

The marketplace were preferred most likely because of the joint account system, where the buyer must first make payments to a joint account in the marketplace (the marketplace as a third party), and the money will not be channeled by the marketplace to the seller before the product's arrival was confirmed by the buyer. In addition, the buyer can also request a return of products or cancellation if the item sent is damaged or does not match the order, then the money will be returned to the buyer. This system is very helpful in reducing cases of fraud in online trading, so it can be assumed that people prefer to transact through the marketplace rather than through websites that do not have such a secure transaction system.

In addition, the advantage of the marketplace compared to websites and social media is that the marketplace provides store rating features and reviews from buyers, so that potential buyers can consider the product credibility and service performance of the store. According to a research using platform E, ratings and reviews on the marketplace were very positively correlated with consumer purchase intentions [23]. On websites and social media, buyers may not necessarily be able to submit reviews of the products or services provided by the seller, so new prospective buyers unable to know the performance or credibility of the store.

The trading activity of *S. crassicolis* as a pet on several marketplace platforms in Indonesia indicated the need for further study. Several marketplaces have made policies regarding which products or goods cannot be sold through their platforms through the "seller education center" menu owned by each marketplace. The marketplace has also provided a "report a product" feature that makes it easy for users to report products that violate policies that have been made. If the product is proven to violate the policy, then the product will be blocked or not displayed on the marketplace, and certain sanctions will be imposed on each marketplace.

Platform A, B and E have banned the sale of pets on these platforms, however, many sellers offer *S. crassicolis* through these platforms (Figure 5). The results of the study indicated a number of shops selling *S. crassicolis* at platform A, B and E are 124, 1, and 59 stores, respectively. Violations of these platform policies can be caused by a lack of knowledge of sellers and buyers about product policies that can be traded through these platforms, thus the sellers continue to advertise pets, and buyers also keep buying and not reporting the product. These findings may also indicate a lack of review process by the platform providers of the products sold by users.

24. Barang mistis;
25. Penjualan benda yang tidak bergerak seperti tanah, rumah, dan sejenisnya;
26. Segala jenis hewan peliharaan;
27. Pembuka kunci dan penunjang tindakan perampokan/pencurian;
28. Otomotif (mobil dan motor). Kecuali terdapat kerja sama resmi dengan Bukalapak;

Figure 5. Policy of prohibited item in Platform A. No 26."All kinds of pet"

Several marketplaces operating outside Indonesia, such as Shopee Singapore (Shopee.sg), Shopee Malaysia (shopee.com.my), and Lazada Philippines (lazada.com.ph) have stipulated a policy to prohibit the trade of various kinds of animals, both pets and wild animals as well as the product. Even Amazon (amazon.com) and Ebay (ebay.com) make a fairly detailed list of what animals are allowed and prohibited. This policy was created as a form of concern for animal welfare and protection of local species and endangered species. This is of course related to the process of sending animals if they are traded online and must be sent to a city that is quite far away, but the seller does not pay attention to the safety and comfort of the turtles being sent so it can have an impact on the turtle's condition.

The volume of turtles traded through the marketplace was quite difficult to record and monitor, allowing exploitation that exceeds the domestic use quota. One seller at the marketplace stated that in one shipment of *S. crassicolis* stock from Borneo, up to 100 turtles can be shipped. To realize the legal, traceable and sustainable trading principles of *S. crassicolis*, trade volume in the marketplace can be circumvented by creating a system to restrict turtle buying and selling transactions that can be done through the marketplace, so transactions in the marketplace will not be successful when it reaches the volume limit. In addition, it

is necessary to make a policy in the form of turtle traders needing to include a document for transporting domestic wild plants and animals (SATS-DN) which should be owned by the sender of turtle stocks in the harvesting area to reduce illegal shipping actions from the turtle harvesting area. Sellers who do not have this permit are not allowed to sell turtles in the marketplace. In addition, marketplaces that have established policies on the prohibition of pet trade need to provide more effective education for users regarding policies on prohibition of animal products, so that marketplace users or buyers can contribute if there is a policy violation so as to create an online trade ecosystem that supports wildlife conservation.

#### IV. CONCLUSION

The trade of *S. crassicolis* in the marketplaces showed a shift in the market platform from previously using a separate website to using the marketplace as a trading platform. There were five marketplace platforms that provide *S. crassicolis*. The locations of online stores are spread across the islands of Java and Sumatra, with the largest number of stores being found in Jakarta. Price variations are mostly found in Jakarta in the range of Rp. 53,000 - Rp. 525,000. The trade of *S. crassicolis* through marketplaces in Indonesia showed that the trade has not met the principle of trade, thus still need further monitoring and adjustment in trade policies, to accomplish a sustainable *S. crassicolis* trade.

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# A pilot study on Effects of Eye Yogic Exercises & alternative Therapies on Eyesight Improvement

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## I. BACKGROUND

Refractive error (RE) is one of the most common ocular conditions affecting all age groups, areas, economic status group and sex. The uncorrected refractive errors are a major cause of treatable visual impairment and blindness. More than 40% of the population needs refractive correction and the need for eyeglasses, contact or surgeries is growing continuously.

There are 4 common types of refractive errors: Nearsightedness (myopia) makes far-away objects look blurry, Farsightedness (hyperopia) makes nearby objects look blurry, Astigmatism can make far-away and nearby objects look blurry or distorted and Presbyopia makes it hard for middle-aged and older adults to see things up close. The highest prevalence of myopia and astigmatism is seen in South-East Asian adults. Refractive error in India is a major public health problem and requires concerted efforts from various stakeholders including the health care workforce, education professionals and parents, to manage this issue.

There are alternative therapy techniques existing from a long time but it lacks evidential studies over non pharmacological treatment approaches in treating RE. The alternative therapies known are types of Eye Yogic exercise ( Reading Exercise, Watching, Near/Far focus, types of Eye moments, Eye wash, types of Palming, types of Trataka,) *Hydrotherapy, Acupressure Points, Kunjal, Jalneti, Sutra & Rubber Neti, Yoga Asana etc.* Centre for vision improvement solution is a non-surgical and customized program, natural vision improvement program which is non -invasive, cost effective, with no side effects unlike the other available solutions. It is unique as it involves different modes of therapies like Naturopathy (Hydrotherapy, Mud therapy), Eye Yogic Exercises, Acupressure, Vision Therapy, and Nutrition and

treat people with combined use of these. Some initial evidential studies have been carried out scientifically involving Optician and Statistician which have been presented in this article.

## II. MATERIAL AND METHODS

A descriptive comparative study was conducted at the Centre for Vision Improvement. The subjects for the study were obtained from the Centre for Vision improvement C- 133 Raju Park New Delhi- 110062. A total of 95 subjects who have refractive errors were included in this study. The inclusion criteria in the study group were person who have any one of the three refractive errors - Myopia, Hyperopia and Astigmatism. Person with presbyopia were not included. The subjects with a cutoff point of VA of 6/12 or more. The methodology of both the assessment and the therapy was explained to the subjects. The consent form was provided, and informed consent was obtained from all of them. A detailed history and eye examination for visual acuity of the subjects were performed and recorded. The subjects underwent the Centre for Vision improvement programmer for one to two months. The clinical eye examination was conducted after the program and comparison was made between the pre and post vision therapy program.

### Results: in different age group

In our study, we conduct Pre and post Visual acuity tests with 95 subjects. We arranged them into two groups, group A and group B on the basis of equal number of participants on the basis of age. Group A had age range 4 year to 20 year with mean age  $11.62 \pm 3.86$ . & group B with age range 21 years to 50 years, had mean age  $31.13 \pm 7.89$ .

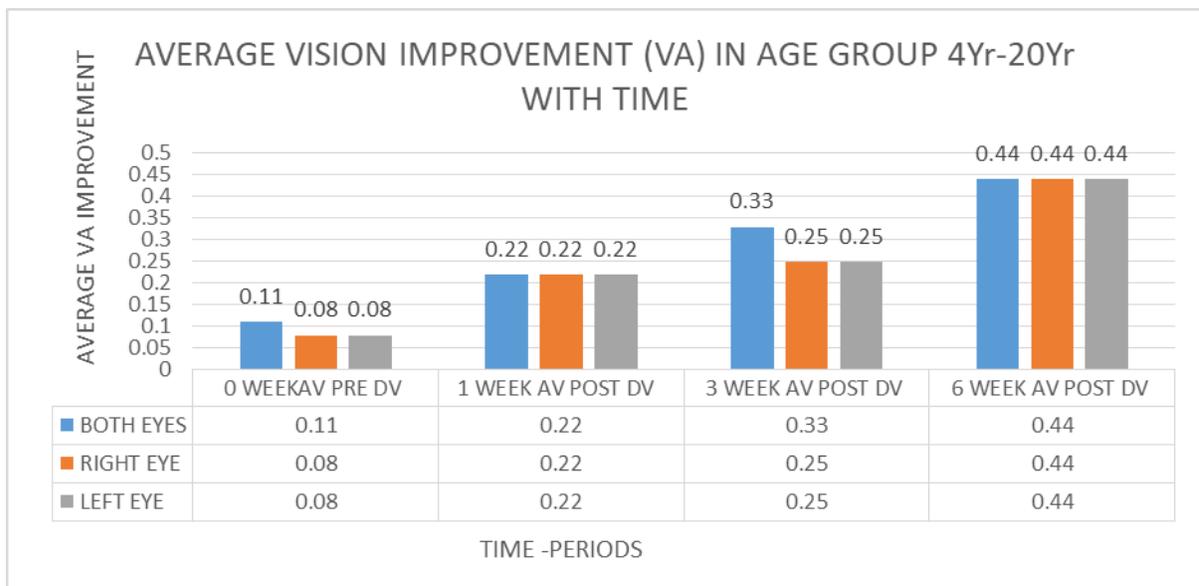


Figure 1

SUBJECT(N)	PRE	POST	BOTH EYE AV VI		POST AV	IMPROVEMENT
			POST	POST		
96	W-0	W-1	W-3	W-6	IN 6 WEEK	6W-0W
AVERAGE DV	0.11	0.22	0.33	0.44	0.33	0.33

AVERAGE DV	0.08	0.22	RIGHT EYE AV VI		0.3	0.36
			0.25	0.44		
			LEFT AV VI			
AVERAGE DV	0.08	0.22	0.25	0.44	0.3	0.36

Table -1

Group- A examined with average direct vision value (DV) of both eye (BE) was 0.11 (2/18 Visual acuity) and recorded as pre-test average direct vision of both eye. After apply the regular eye yoga therapy treatment program on group- A, we observed the average improvement among subjects after 7 days (1 week) 0.22 (3/12 VA) from 0.11 (2/18 VA), after 3 week 0.33 (4/12 VA) and after 6 weeks to 0.44 (4/9 VA). We observed the average improvement of DV of both eye after complete the program of 6 weeks (total practice day) and noted the difference of average improvement is 0.33 (4/12 VA) (as shown in figer-1, & table 1).

Average Direct vision of RE was 0.08 (1/12 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.44 (4/9VA) (Consider figure 1 & Table 1).

Average Direct vision of LE was 0.08 (1/12 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.44 (4/9VA) (Consider figure 1 & Table 1). We also observe that after 4 weeks some participants did not come regularly for exercise. So, their results also was not improved satisfactory in the comparatively who attend the exercises regularly.

Group- B examined with average direct vision value (DV) of both eye (BE) was 0.16 (2/12 VA) and recorded as pre-test average direct vision of both eye. After apply the regular eye yoga therapy treatment program on group- B, we observed the average improvement among subjects after 7 days (1 week) 0.22 (3/12 VA) from 0.16 (2/12 VA), after 3 week 0.25 (3/12 VA) and after 6 weeks to 0.33 (4/12 VA). We observed the average improvement

of DV of 0.266 (3/12 VA both eye after complete the program of 6 weeks (total practice day) and noted the difference of average improvement as 0.33 (4/12 VA) (shown in figer-2 & table 2).

Average Direct vision of RE was 0.11 (2/18 VA). After 1 week following the regular exercise program result improve 0.16 (2/12 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual

acuity was improved by 0.33 (4/12VA) (Consider figure 2 & table 2). Average Direct vision of LE was 0.16 (2/12 VA).

After 1 week following the regular exercise program result improve 0.22 (2/9 VA) And with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.33 (4/12VA) (Consider figure 2 & table 2). We also observe that improvement in the age group of 21-54 was less than the age group of 4-20.

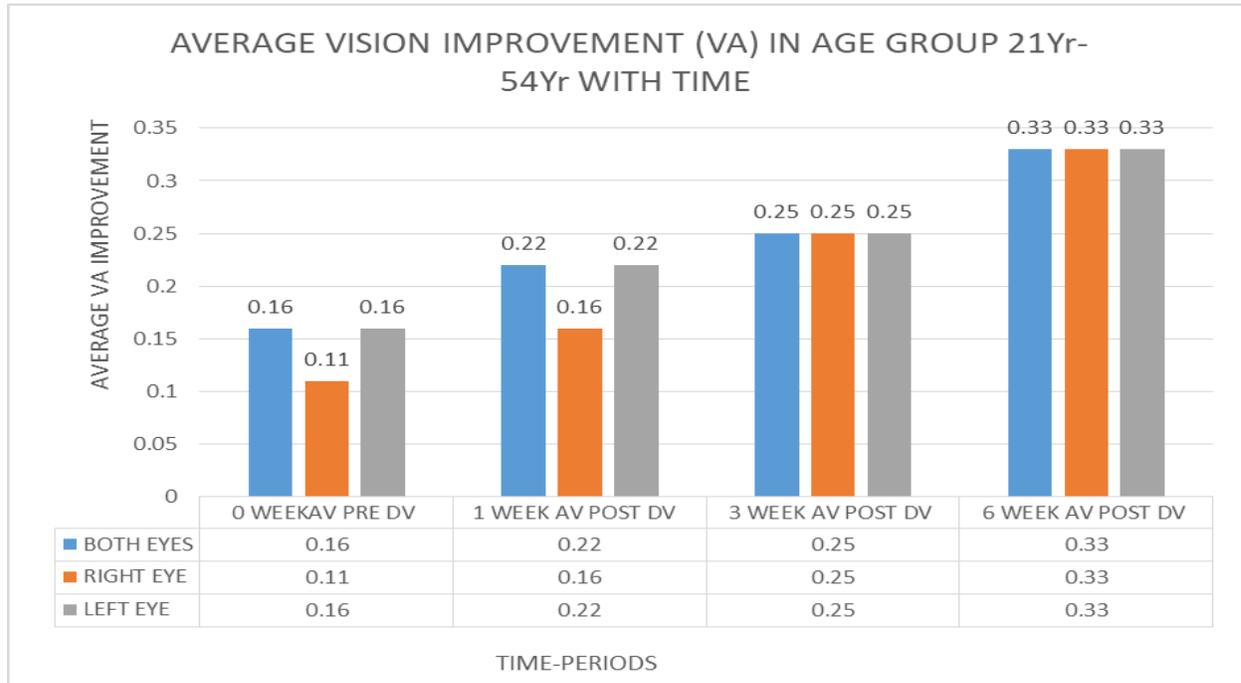


Figure 2

	PRE	POST	BOTH EYE AV VI			
SUBJECT(N)	PRE	POST	POST	POST	POST AV	IMPOVEMENT
96	W-0	W-1	W-3	W-6	IN 6 WEEK	6W-0W
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.17
			RIGHT EYE AV VI			
AVERAGE DV	0.11	0.16	0.25	0.33	0.24	0.22
			LEFT AV VI			
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.1

Table 2

Gender Based Results

In our study, we conduct Pre and post Visual acuity tests with 95 subjects. We arranged them into two groups, on the basis of gender.

Male Group examined with average direct vision value (DV) of both eye (BE) was 0.08 (2/18 Visual acuity) and recorded as pre-test average direct vision of both eye. After apply the regular eye yoga therapy treatment program on group- A, we observed the average improvement among subjects after 7 days (1 week) 0.22

(3/12 VA) from 0.08 (2/18 VA), after 3 week 0.33 (4/12 VA) and after 6 weeks to 0.44 (4/9 VA). We observed the average improvement of DV of both eye after complete the program of 6 weeks (total practice day) and noted the difference of average improvement is 0. (4/12 VA) (As shown in figer-3 & Table3).

Average Direct vision of RE was 0.16 (2/12 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual

acuity was improved by 0.33 (4/12VA) (Consider figure 3 & Table 3).

Average Direct vision of male group of LE was 0.16(2/12 VA). After 1 week following the regular exercise program result improve 0.16 (2/12 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.33 (4/12VA) (Consider figure 3 & table 3).

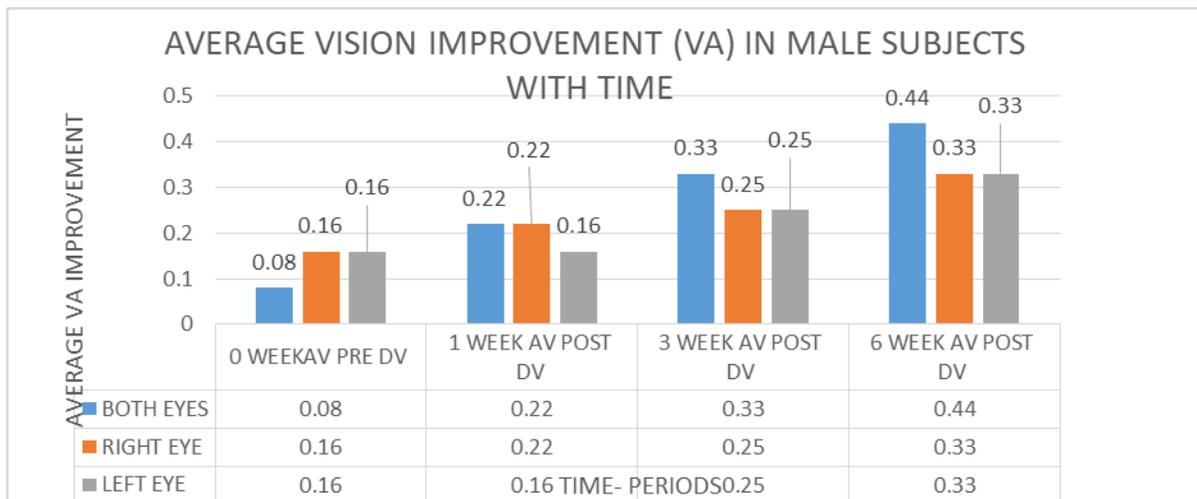


Figure 3

				BOTH EYE AV VI		
SUBJECT(N)	PRE	POST	POST	POST	POST AV	IMPROVEMENT
96	W-0	W-1	W-3	W-6	IN 6 WEEK	POST-PRE
AVERAGE DV	0.08	0.22	0.33	0.44	0.33	0.36
				RIGHT EYE AV VI		
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.17
				LEFT AV VI		
AVERAGE DV	0.16	0.16	0.25	0.33	0.24	0.17

Table 3

**Female group** examined with average direct vision value (DV) of both eye (BE) was 0.22 (2/9 VA) and recorded as pre-test average direct vision of both eye. After apply the regular eye yoga therapy treatment program on group- B, we observed the average improvement among subjects after 1 week 0.33 (2/6 VA), after 3

week 0.33 (2/6 VA) and after 6 weeks to 0.44 (4/9 VA). We observed the average improvement of DV of 0.266 (3/12 VA both eye after complete the program of 6 weeks. (Shown in figer-4 & table 4).

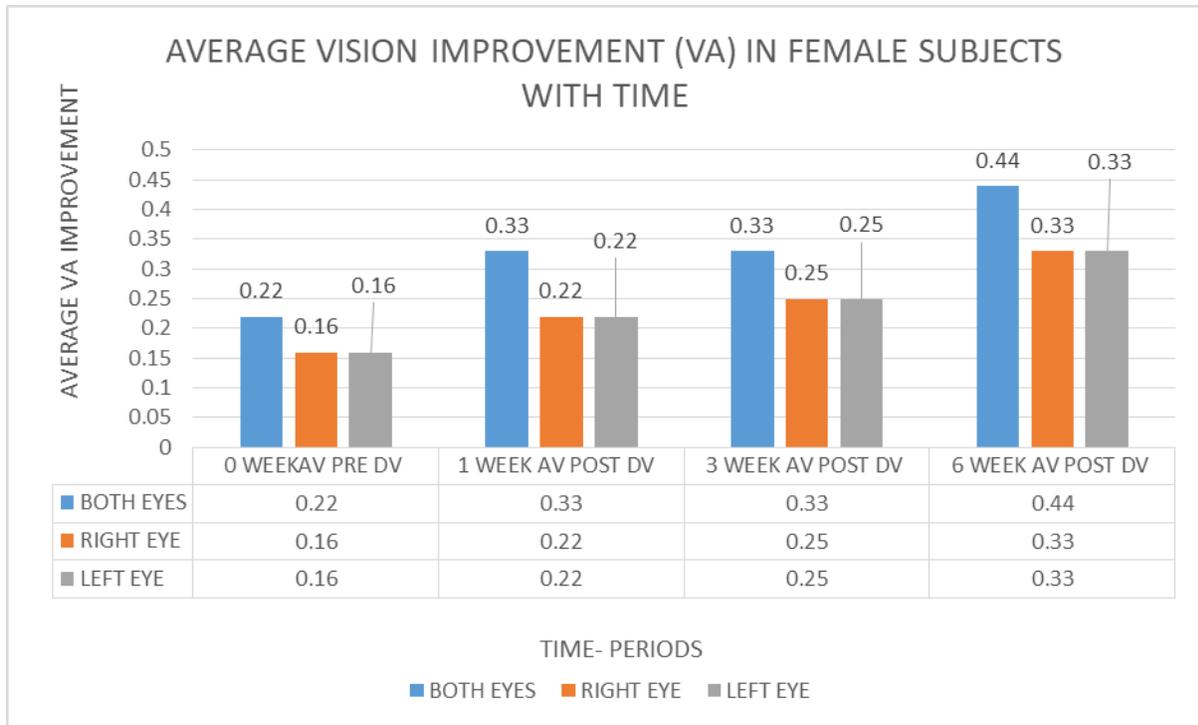


Figure 4

		BOTH EYE AV VI					
SUBJECT(N)	PRE	POST	POST	POST	POST AV	IMPOVEMENT	
41	W-0	W-1	W-3	W-6	IN 6 WEEK	6W-0W	
AVERAGE DV	0.22	0.33	0.33	0.44	0.36	0.22	
		RIGHT EYE AV VI					
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.17	
		LEFT AV VI					
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.17	

Table 4

Average Direct vision of RE was 0.16 (2/12 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result Improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.33 (4/12VA) (Consider figure 4 & table 4).

Average Direct vision of LE was 0.16 (2/12 VA). After 1 week following the regular exercise program result improve 0.22

(2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA).

Average Vision Improvement in total subjects with different time period

A total of 95 subjects examined with average direct vision value (DV) of both eye (BE) was 0.16 (2/12 Visual acuity) and recorded as pre-test average direct vision of both eye. After apply the regular eye yoga therapy treatment program. We observed the average improvement among subjects after 7 days (1 week) 0.22

(2/9 VA), after 3 week 0.25 (3/12 VA) and after 6 weeks to 0.44 (4/9 VA). (As shown in figer-5).

Average Direct vision of RE was 0.11 (2/18 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.33 (4/12 VA) (Consider figure 5).

Average Direct vision of LE was 0.16 (2/12 VA). After 1 week following the regular exercise program result improve 0.22 (2/9 VA) and with the continuous practice in 3 weeks result improved to 0.25 (3/12 VA). After six weeks post direct visual acuity was improved by 0.33 (4/9VA) (Consider figure 5)

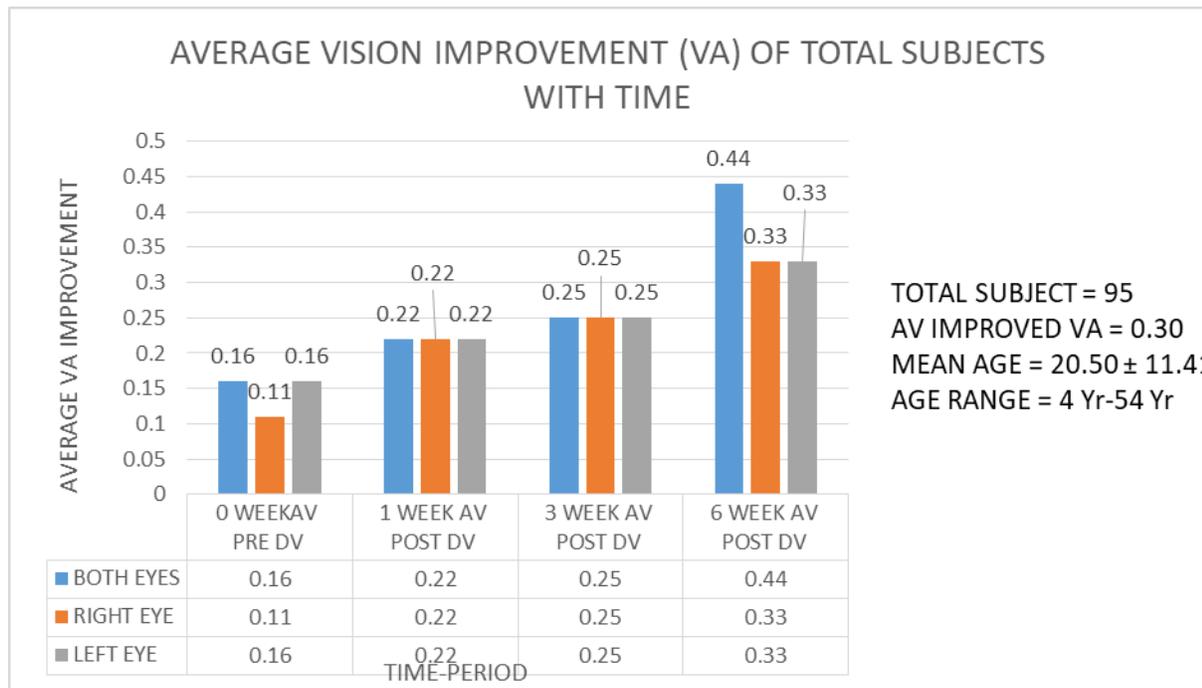


Figure 5

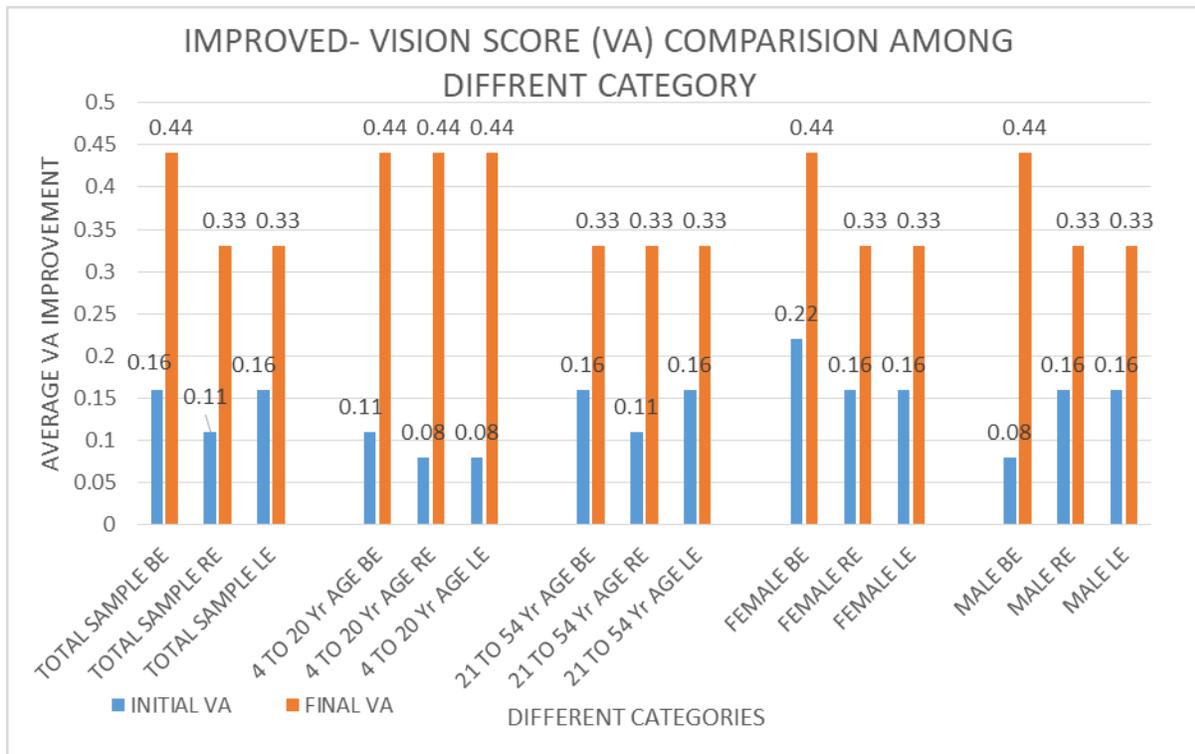
		BOTH EYE AV VI					
SUBJECT(N)	PRE	POST	POST	POST	POST AV	IMPOVEMENT	
96	W-0	W-1	W-3	W-6	IN 6 WEEK	POST-PRE	
AVERAGE DV	0.16	0.22	0.25	0.44	0.3	0.28	
		RIGHT EYE AV VI					
AVERAGE DV	0.11	0.22	0.25	0.33	0.26	0.22	
		LEFT AV VI					
AVERAGE DV	0.16	0.22	0.25	0.33	0.26	0.17	

Table 5

**Vision improvement comparison among different categories**

We found that there is no difference in improvement between male and female. But age matters a lot as we observe better result 0.44 (4/9 VA) in the age group of 4-21 and 0.33 in the

age group of 21-54. The improvement average difference is 0.11 (2/18 VA).



**Figure 6**

DIFFERENT CATEGORIES	INITIAL VA	FINAL VA
TOTAL SAMPLE BE	0.16	0.44
TOTAL SAMPLE RE	0.11	0.33
TOTAL SAMPLE LE	0.16	0.33
4 TO 20 Yr AGE BE	0.11	0.44
4 TO 20 Yr AGE RE	0.08	0.44
4 TO 20 Yr AGE LE	0.08	0.44
21 TO 54 Yr. AGE BE	0.16	0.33
21 TO 54 Yr. AGE RE	0.11	0.33

<b>21 TO 54 Yr. AGE LE</b>	<b>0.16</b>	<b>0.33</b>
<b>FEMALE BE</b>	<b>0.22</b>	<b>0.44</b>
<b>FEMALE RE</b>	<b>0.16</b>	<b>0.33</b>
<b>FEMALE LE</b>	<b>0.16</b>	<b>0.33</b>
<b>MALE BE</b>	<b>0.08</b>	<b>0.44</b>
<b>MALE RE</b>	<b>0.16</b>	<b>0.33</b>
<b>MALE LE</b>	<b>0.16</b>	<b>0.33</b>

**Table 6**

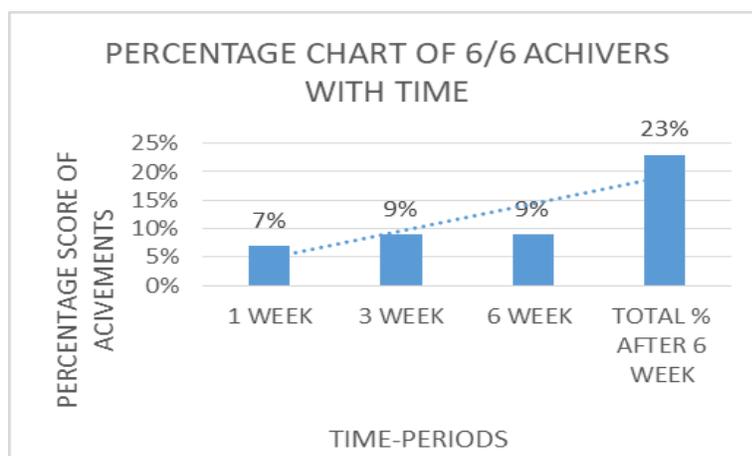
**Perfect vision 6/6**

Out of 95 participants 7% achieved 6/6 within first week, when they started, their vision was 6/9. And in the second week it

increase by 1% total 8 % achieve 6/6. After a complete program of 6 weeks 23% of participants achieve a perfect vision of 6/6. (Consider below table Figure 7 & table 7)

TIME-PERIODS	NUMBER OF PARTICIPANTS	NUMBER OF 6/6 ACHIVERS
1WEEK	95	7 (07 %)
3WEEK	88	8 (09 %)
6WEEK	80	7 (09 %)
<b>Total after 6 week</b>	<b>95</b>	<b>22 (23%)</b>

**Table 7**



**Figure 7**

## Conclusion

we found improvement in the Visual acuity of 90+ subjects out of 95. The average improvement was 0.33-0.44 in male-female respectively. It was further seen that the subjects in the age group of 6- 17yrs shows better results in comparison to the subjects above 17 yrs. We also found that there is no difference in improvement between male and female. But age matters a lot as we observe better result 0.44 (4/9 VA) in the age group of 4-21 and 0.33 in the age group of 21-54. The improvement average difference is 0.11 (2/18 VA).

## III. DISCUSSION:

The World Health Organization has estimated that there are approximately 314 million people living with vision impairment. REs are quite common in India and the prevalence of myopia or hyperopia itself is in adults is 53.1%. If we add Astigmatism, it will go further higher. India is a developing country and a major junk of Indian population falls under below poverty line who are unable to access the available correction methods which require continuous screening and monitoring in most of the cases. Near about 10.2% of adults in India are estimated to have uncorrected RE. The numbers are higher in children. RE causing visual impairment and blindness found to be ranging from 5-11% in people over 50 in various studies and reviews.

The numbers and prevalence RE as a cause of visual impairment and blindness is significant enough for us to concentrate on the working on reducing RE a providing a productive and better life to people. [29]

The situation further worsen in the rural India which is probably not due to genetics or environmental reasons but due to lack of knowledge, access to screening and treatment, finances and also due to social believes. Worldwide, URE is the leading cause of vision impairment and the second leading cause of blindness in developing countries, including India.[1], [2] Visual impairment and blindness caused by URE in adults can have severe impact on social and economic well-being, including limiting the educational and employment opportunities of economically active persons.[3] Globally, economic loss due to lost productivity caused by URE was estimated around \$269 billion [4] and due to uncorrected presbyopia was US\$11.023 billion.[5],

There is no doubt that the existing cosmetic and medical treatments are effective solutions which has been scientifically proved based on the evidential studies but it is also true that these solutions are not permanent , don't have 100% success rate and come with risk of possible side effects which could be both minor or major. These methods and spectacles, contact lenses and RE correction surgeries like LASIK sugery. The spectacles are the most cost effective and without side effects method but it is not a permanent solution in all as the RE can change with time and has the cosmetic effects. The contact lenses can cause complications which could be minor complications like discomfort, redness, itching etc. and also complications keratitis, conjunctivitis etc. L that are troublesome for the patients.

Despite the success of laser refractive surgery to correct low order aberrations, the incidence of postoperative symptoms like glare, halos and reduced night vision remains to be relatively high.1, 2, 3 these visual outcomes can duster the quality of life of patients. Both the contact lenses and surgeries are expensive

treatment. Therefore the age factor, cost of the treatment, complications limit its applications. Recent claims of genetic modulation therapy are under evaluation and its success rate is doubtful.

There are various alternative therapy available and practiced in various countries like Eye exercise, Trataka Yoga Kriya , eye exercises, Acupuncture etc. It is practiced in many reputed institutes of India like School for perfect eyesight at Pondicherry. . There have been various studies published on these methods efficacy and acceptance.

Et al reported a performance enhancement for the detection of visual targets when presented in very rapid succession (i.e., separated by one or no distractors) following repetitive eye movements. Although the RSVP task did not demonstrate any differences in reaction time following the eye exercises, there was a significant increase in letter identification accuracy in the experimental group on.

In a prospective, randomized, controlled, cross-over trial, Lam et al (2011) evaluated the safety and adjunctive effect of acupuncture added to refractive correction for anisotropic amblyopia in younger children. The authors concluded that acupuncture is a potentially useful complementary treatment modality that may provide sustainable adjunctive effect to refractive correction for anisotropic amblyopia in young children. et al noted one line improvement was noted in Snellen's chart reading. They also reported a moderate improvement in clarity of vision, contrast sensitivity, and fineness of objects. It is an encouraging finding that a non-pharmacological, low cost, relaxation technique can improve the quality of vision, by which it indirectly checks the progression of the disease condition. Both these techniques act as adjuvant therapy hence one should adopt pharmacological interventions (medical management), life style, and diet modifications to get a better result.

The genetics, diet, life style and occupation also play a major role in development of RE. The children of people with RE have higher incidence of RE. The children and adults with unhealthy eating habits and involved in continuous use of phones and computers have higher incidence of RE. Although much can't be done about Genetics but better nutrition and lifestyle modifications can help significantly.

Centre for vision improvement solution is a non-surgical, customized, natural vision improvement program. It is a non -invasive, cost effective and permanent solution with no side effects unlike the other available solutions. It is unique as it involves different modes of therapies like Naturopathy (hydrotherapy, mud therapy), Eye Yogic Exercises, Acupressure, Vision Therapy, and Nutrition and treat people with combined use of these. Our vision therapy method of Vision therapy could be a permanent, economical and without side effects therapy. Although it needs more evidential data for the scientific society to believe in the same.

There are various studies suggesting use of réfraction as better way to assess the REs compared to estimating REs based on vision improvement with pin hole. There is a difference of opinion on the cutoff point of 6/18 or 6/12 in these studies.

We choose 6/12 as the cutoff point and pin whole assessment for our study.

In our study, we found improvement in the Visual acuity of 90+ subjects out of 95. There was less improvement in those

people, who practice it occasionally. We noticed better outcomes in case of Astigmatism and Hyperopia. Visual acuity improves faster in these conditions. It was further seen that the subjects in the age group of 6- 17yrs shows better results in comparison to the subjects above 17 yrs.

The results in our study show significant and encouraging results but there is a need to collect more data to present a concrete and unchallengeable solution

#### IV. CONCLUSION

The initial study results shows considerable improvement in the refractive error and visual acuity of the subjects. This needs to be interpreted cautiously at this stage and needs to further evaluate in details.

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# Nano Regular Generalized Irresolute Maps in Nano Topological Spaces

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**Abstract:** In this paper we introduce and study new class of maps, namely Nano regular generalized irresolute maps, strongly Nano regular generalized continuous maps and perfectly Nano regular generalized continuous maps in Nano topological spaces. We define and analyze some of the properties of these mappings in terms of Nano rg-closed map, Nano rg-open map.

**Keywords:** Nano rg-closed map, Nano rg-open map, Nano rg-closure, Nano-continuity, Nano rg-continuity, Nano-irresolute, Nano rg-irresolute.

## 1. Introduction

The concept of regular continuous and completely continuous functions was first introduced by Arya .S.P and Gupta.R[1]. Later Y.Gnanambal [4] studied the concept of generalized pre regular continuous functions. R.S Wali et al [3] introduced and studied the properties of rgw-irresolute maps and strongly rgw-continuous maps, perfectly rgw-continuous maps. N.Nagaveni[9] introduced and studied the concept of regular generalized irresolute maps. Bhuvaneswari et al [2] introduced and studied some properties of Nano generalized irresolute maps, Nano semi generalized irresolute maps and Nano pre generalized irresolute maps in Nano topological spaces. In this aim of this paper concepts of Nano irresolute maps, Nano regular generalized irresolute maps in Nano topological spaces and some of their properties.

## 2. Preliminaries

**Definition 2.1:** [7] A subset  $A$  of a space  $(U, \tau_R(X))$  is called a regular generalized closed set if  $\text{rcl}(A) \subseteq V$  whenever  $A \subseteq V$  and  $V$  is regular open.

**Definition 2.2:** [7] The regular generalized closure of a subset  $A$  of a space  $U$  is the intersection of all rg-closed sets containing  $A$  and is denoted by  $\text{rgcl}(A)$ .

**Definition 2.3:** [7] The regular generalized interior of a subset  $A$  of a space  $U$  is the union of all rg-open sets contained in  $A$  and is denoted by  $\text{rgInt}(A)$ .

**Definition 2.4:** [7] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is regular generalized continuous (rg-continuous) if  $f^{-1}(B)$  is rg-closed set in  $U$  for every closed set  $B$  of  $V$  or equivalently a function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is rg-continuous if and only if the inverse image of each open set is rg-open set.

**Definition2.5:** [4] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be irresolute if the inverse image of every regular open set in  $V$  is regular open in  $U$ .

**Definition2.6:** [4] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be rg-irresolute if the inverse image of every rg-closed set in  $V$  is rg-closed in  $U$ .

**Definition2.7:** [6] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be strongly continuous if  $f^{-1}(B)$  is both open and closed in  $(U, \tau_R(X))$  for each subset  $B$  of  $(V, \tau_R'(Y))$ .

**Definition2.8:** [7] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be strongly rg-continuous if the inverse image of every rg-open set in  $V$  is open in  $U$ .

**Definition2.9:** [7] A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be perfectly rg-continuous if the inverse image of every rg-open set in  $V$  is both open and closed in  $U$ .

**Definition 2.10:** [8] Let  $U$  be a non-empty finite set of objects called the Universe and  $R$  be an equivalence relation on  $U$  named as the indiscernibility relation. Then  $U$  is divided into disjoint equivalence classes. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair  $(U, R)$  is said to be the approximation space. Let  $X \subseteq U$ .

1. The lower approximation of  $X$  with respect to  $R$  is the set of all objects, which can be for certainly classified as  $X$  with respect to  $R$  and it is denoted by  $L_R(X)$ . That is  $L_R(X) = \cup \{R(x): R(x) \subseteq X\}$ , where  $R(x)$  denotes the equivalence class determined by  $x \in U$ .

2. The upper approximation of  $X$  with respect to  $R$  is the set of all objects, which can be possibly classified as an  $X$  with respect to  $R$  and it is denoted by  $U_R(X)$ . That is  $U_R(X) = \cup \{R(x): R(x) \cap X \neq \emptyset\}$ .

3. The boundary region of  $X$  with respect to  $R$  is the set of all objects, which can be classified neither as  $X$  nor as not  $X$  with respect to  $R$  and it is denoted by  $B_R(X) = U_R(X) - L_R(X)$ .

**Definition 2.11:** [8] If  $\tau_R(X)$  is the Nano topology on  $U$  with respect to  $X$ , then the set  $\beta = \{U_R(X), L_R(X), B_R(X)\}$  is the basis for  $\tau_R(X)$ .

**Definition 2.12:** [8] If  $(U, \tau_R(X))$  is a Nano topological space with respect to  $X$  where  $X \subseteq U$  and if  $A \subseteq U$ , then

- (i) The Nano interior of the set  $A$  is defined as the union of all open subsets contained in  $A$  and it is denoted by  $NInt(A)$ . That is,  $NInt(A)$  is the largest Nano open subsets of  $A$ .
- (ii) The Nano closure of  $A$  is defined as the intersection of all Nano closed sets containing  $A$  and is denoted by  $NCl(A)$ . That is,  $NCl(A)$  is the smallest Nano closed set containing  $A$ .

**Definition 2.13:** [8] If  $(U, \tau_R(X))$  is a Nano topological space with respect to  $X$  where  $X \subseteq U$  and if  $A \subseteq U$ , then

- (i) The Nano regular interior of  $A$  is defined as the union of all Nano regular open subsets of  $A$  and it is denoted by  $NrInt(A)$ . That is,  $NrInt(A)$  is the largest Nano regular open subsets of  $A$ .
- (ii) The Nano regular closure of  $A$  is defined as the intersection of all Nano regular closed sets containing  $A$  and is denoted by  $NrCl(A)$ . That is,  $NrCl(A)$  is the smallest Nano regular closed set containing  $A$ .

**Definition 2.14:** [8] A subset  $A$  of  $(U, \tau_R(X))$  is called Nano regular-generalized closed set (briefly Nrg-closed) if  $Nrcl(A) \subseteq V$  and  $A \subseteq V$  and  $V$  is Nano regular-open in  $(U, \tau_R(X))$ . The subset  $A$  is called Nano rg-open in  $(U, \tau_R(X))$  if  $A^c$  is Nano rg-closed.

**Definition 2.15:** [9] If  $(U, \tau_R(X))$  is a Nano topological space with respect to  $X$  where  $X \subseteq U$  and if  $A \subseteq U$ , then

- (i) The Nano regular generalized interior of  $A$  is defined as the union of all Nano regular generalized open subsets of  $A$  and it is denoted by  $NrgInt(A)$ . That is,  $NrgInt(A)$  is the largest Nano regular generalized open subsets of  $A$ .
- (ii) The Nano regular generalized closure of  $A$  is defined as the intersection of all Nano regular generalized closed sets containing  $A$  and is denoted by  $NrgCl(A)$ . That is,  $NrgCl(A)$  is the smallest Nano regular generalized closed set containing  $A$ .

**Definition 2.16:** [10] Let  $(U, \tau_R(X))$  and  $(V, \tau_R'(Y))$  be two Nano topological spaces. Then a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano continuous on  $U$  if the inverse image of every Nano open set in  $V$  is Nano open in  $U$ .

**Definition 2.17:** [10] Let  $(U, \tau_R(X))$  and  $(V, \tau_R'(Y))$  be two Nano topological spaces. Then a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano rg-continuous on  $U$  if the inverse image of every Nano open set in  $V$  is Nano rg-open in  $U$ .

### 3. Nrg - IRRESOLUTE MAPS

In this section, we introduce the concept of Nano irresolute maps, Nrg-irresolute maps in Nano topological spaces and investigate some of their properties.

**Definition 3.1:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano irresolute map if the inverse image of every Nano regular open set  $A$  in  $V$  is Nano regular open in  $U$ .

**Definition 3.2:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be Nano regular generalized irresolute map (briefly Nrg-irresolute) if the inverse image of every Nrg-closed set  $A$  in  $V$  is Nrg-closed in  $U$ .

**Example 3.3:** Let  $U = \{a, b, c, d\}$  with  $U|R = \{\{a\}, \{c\}, \{b, d\}\}$  and  $X = \{a, b\}$ . Then  $\tau_R(X) = \{U, \phi, \{a\}, \{b, d\}, \{a, b, d\}\}$ . Let  $V = \{x, y, z, w\}$  with  $V|R' = \{\{y\}, \{w\}, \{x, z\}\}$ . Then  $\tau_R'(Y) = \{V, \phi, \{y\}, \{x, y, z\}, \{x, z\}\}$ . Define a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  as,  $f(a) = x, f(b) = y, f(c) = w, f(d) = z$ . Then  $f^{-1}(V) = U, f^{-1}(\phi) = \phi, f^{-1}(\{x, y, w\}) = \{a, b, c\}, f^{-1}(\{x, z, w\}) = \{a, c, d\}, f^{-1}(\{y, z, w\}) = \{b, c, d\}, f^{-1}(\{x\}) = \{a\}, f^{-1}(\{y\}) = \{b\}, f^{-1}(\{w\}) = \{c\}, f^{-1}(\{z\}) = \{d\}, f^{-1}(\{x, z\}) = \{a, d\}$ . Thus the inverse image of every Nrg-closed set in  $V$  is Nrg-closed set in  $U$ . Hence  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nrg-irresolute.

**Theorem 3.4:** Let  $(U, \tau_R(X))$  and  $(V, \tau_R'(Y))$  be any two Nano topological spaces, where “every Nrg-closed subset is Nano closed” and  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  be a map. If  $f$  is Nrg-irresolute map then it is Nrg-continuous but not conversely.

**Proof:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  be an Nrg-irresolute map. Then the inverse image  $f^{-1}(A)$  of every Nrg-closed set  $A$  in  $V$  is Nrg-closed set in  $U$ . Since every Nano closed set is Nano regular generalized closed, the inverse image of every Nano closed set in  $V$  is Nrg-closed in  $U$ . whenever the inverse image of Nrg-closed is Nrg-closed. Hence Nrg-irresolute function is Nrg-continuous.

The converse of the above theorem need not be true as seen from the following example.

**Example 3.5:** Consider  $U=\{a, b, c, d\}$  with  $U|R=\{\{a\},\{c\},\{b, d\}\}$ ;  $X=\{a, b\} \subseteq U$   $\tau_R(X)=\{U,\phi,\{a\},\{a, b, d\},\{b, d\}\}$  and  $V=\{a, b, c, d\}$  with  $V|R'=\{\{a\},\{b, d\}\}$ ;  $Y = \{a, b\} \subseteq V$ .  $\tau_{R'}(Y)=\{U, \phi,\{a\},\{b, d\},\{a, b, d\}\}$ . Define  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  as the identity map. Then  $f$  is Nrg-continuous but not Nrg-irresolute map.

**Theorem 3.6:** Let  $(U, \tau_R(X)), (V, \tau_{R'}(Y))$  and  $(W, \tau_{R'}(Z))$  be Nano topological spaces. If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  and  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  be two maps. If  $f$  is Nrg-irresolute and  $g$  is Nrg-continuous then  $g \circ f$  is Nrg-continuous.

**Proof:** Let  $A$  be a Nano closed set in  $W$ . since the map  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  is Nrg-continuous the inverse image  $g^{-1}(A)$  is Nrg-closed set in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  is Nrg-irresolute, the inverse  $f^{-1}(g^{-1}(A))$  of Nrg-closed set  $g^{-1}(A)$  in  $V$  is Nrg-closed in  $U$ . Thus the inverse image  $(g \circ f)^{-1}(A)$  is Nrg-closed in  $U$  for every Nrg closed set  $A$  in  $W$ . Hence the composition  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_{R'}(Z))$  is Nrg-continuous.

**Theorem 3.7:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  and  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  be two maps. If  $f$  is Nrg-continuous and  $g$  is Nrg-irresolute then  $g \circ f$  is Nrg-continuous.

**Proof:** It is obvious.

**Theorem 3.8:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  and  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  be two maps. If  $f$  and  $g$  are both Nrg-irresolute then  $(g \circ f)$  is Nrg-continuous.

**Proof:** As the map  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  is Nrg-irresolute, the inverse image  $g^{-1}(A)$  of every Nrg-open set  $A$  in  $W$  is Nrg-open in  $V$ . Hence  $g^{-1}(A)$  is Nrg-open set in  $V$  and  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  being Nrg-irresolute implies that  $f^{-1}[g^{-1}(A)]$  is Nrg-open in  $U$ . Thus  $(g \circ f)^{-1}(A) = f^{-1}[g^{-1}(A)]$  is Nrg-open set in  $U$  for every Nrg-open set  $g^{-1}(A)$  in  $V$ . Hence  $(g \circ f)$  is Nrg - continuous.

**Theorem 3.9:** Let  $(U, \tau_R(X)), (V, \tau_{R'}(Y))$  and  $(W, \tau_{R'}(Z))$  be Nano topological spaces. If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  and  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  be two maps. If  $f$  and  $g$  are both Nrg-irresolute then  $g \circ f$  is Nrg - irresolute.

**Proof:** As the map  $g: (V, \tau_{R'}(Y)) \rightarrow (W, \tau_{R'}(Z))$  is Nrg-irresolute, the inverse image  $g^{-1}(A)$  of every Nrg-open set  $A$  in  $W$  is Nrg-open in  $V$ . Hence  $g^{-1}(A)$  is Nrg-open set in  $V$  and  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  being Nrg-irresolute implies that  $f^{-1}[g^{-1}(A)]$  is Nrg-open in  $U$ . Thus  $(g \circ f)^{-1}(A) = f^{-1}[g^{-1}(A)]$  is Nrg-open set in  $U$  for every Nrg-open set  $g^{-1}(A)$  in  $V$ . Hence  $(g \circ f)$  is Nrg-irresolute.

**Theorem 3.10:** If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  is bijective, Nano pre regular open and Nrg-continuous then  $f$  is Nrg-irresolute.

**Proof:** Assume that  $A$  is a Nrg-closed set in  $V$ . Let  $X$  be any Nano regular open set in  $U$  such that  $f^{-1}(A) \subset X$ . Then  $A \subset f(X)$  where  $f(X)$  is Nano regular open. Since  $A$  is Nrg- closed.  $NCl(A) \subset f(X)$ . Which implies  $f^{-1}[NCl(A) \subset X]$ . By assumption  $f$  is Nrg-continuous. Therefore  $f^{-1}(NCl(A))$  is Nrg-closed. Hence  $NCl(f^{-1}(NCl(A))) \subset f(X)$ . That is  $NCl(f^{-1}(A)) \subset NCl(f^{-1}(NCl(A))) \subset X$ . Thus  $f^{-1}(A)$  is Nrg-closed set in  $U$ .

**Theorem 3.11:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  is Nrg – irresolute if and only if the inverse image of an Nrg – open set in  $V$  is Nrg- open in  $U$ .

**Proof:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  be a Nrg – irresolute and  $A$  be a Nrg – open set in  $V$ . Then  $A^c$  is Nrg – closed in  $V$ . Since  $f$  is Nrg – irresolute,  $f^{-1}(A^c)$  is Nrg – closed in  $U$ . Since  $f^{-1}(A^c) = (f^{-1}(A))^c$  and so  $f^{-1}(A)$  is Nrg – open in  $U$ .

Conversely, assume that  $f^{-1}(A)$  is Nrg – open in  $U$  for each Nrg – open set  $A$  in  $V$ . Let  $F$  be Nrg – closed set in  $V$  and by assumption  $f^{-1}(F^c)$  is Nrg – open in  $U$ . Since,  $f^{-1}(F^c) = (f^{-1}(F))^c$ , we have  $f^{-1}(F)$  is Nrg – closed in  $U$  and so  $f$  is Nrg – irresolute.

**Definition 3.12:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_{R'}(Y))$  is said to be Nrg-closed map if the image of every Nano closed set in  $U$  is Nrg – closed set in  $V$ .

**Remark 3.13:** Every Nano closed map is Nrg-closed but not conversely.

**Proof:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  be Nano closed map. Let  $A$  be any Nano closed set in  $U$ . Then  $f(U)$  is Nano closed set but every Nano closed set is Nrg – closed set. Hence  $f$  is Nrg – closed map.

The converse of the above remark need not be true as seen from the following example,

**Example 3.14:** Consider  $U=\{a, b, c, d\}$  with  $U|R=\{\{a\},\{c\},\{b, d\}\}$   $X=\{a, b\} \subseteq U$   $\tau_R(X)=\{U, \phi, \{a\}, \{a, b, d\}, \{b, d\}\}$  and  $V=\{a, b, c, d\}$  with  $V|R'=\{\{a\},\{b, d\}\}$   $Y = \{a, b\} \subseteq V$   $\tau_R'(Y)=\{V, \phi, \{c\}, \{a, c\}, \{b, c, d\}\}$ . If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is the identity map. Then  $f$  is Nrg-closed but not Nano closed.

**Theorem 3.15:** If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano continuous, Nrg-closed and  $A$  is a Nano generalized closed set of  $U$  then  $f(A)$  is Nrg-closed.

**Proof:** Suppose that  $S$  is Nano regular open set such that  $f(A) \subset S$  then  $A \subset f^{-1}(S)$  where  $f^{-1}(S)$  is Nano open. Since  $A$  is Nano generalized closed set.  $NCl(A) \subset f^{-1}(S)$ . Therefore  $f(NCl(A))$  is Nrg-closed by assumption. Hence  $NCl(f(A)) \subset NCl(f(NCl(A)))$ . Thus  $f(A)$  is Nrg-closed.

**Theorem 3.16:** If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nrg - irresolute, Nrg-closed and  $A$  is an Nrg-closed set of  $U$  then  $f(A)$  is Nrg-closed.

**Proof:** Let  $f(A) \subseteq G$ , where  $G$  is a Nrg – open in  $V$ . Since  $f$  is Nrg – irresolute,  $f^{-1}(G)$  is Nrg – open in  $U$ , by definition 2.6 and  $A \subseteq f^{-1}(G)$ . Since  $A$  is a Nrg – closed set in  $U$ ,  $NCl(Nint(A)) \subseteq f^{-1}(G)$ . Since  $f$  is Nrg – closed,  $f(NCl(Nint(A)))$  is Nrg – closed set contained in Nrg – open set  $G$  implies that  $NCl(Nint(f(NCl(Nint(A)))) \subseteq f(NCl(Nint(A))) \subseteq G$  and so  $NCl(Nint(f(A))) \subseteq G$ . Hence,  $f(A)$  is Nrg – closed set in  $V$ .

The following example proves that the composition of two Nrg-closed maps need not be Nrg-closed.

**Example 3.17:** Consider  $U=\{a, b, c, d\}$  with  $U|R=\{\{a\},\{c\}, \{b, d\}\}$   $X= \{a, b\} \subseteq U$   $\tau_R(X)=\{U, \phi, \{a\}, \{a, b, d\}, \{b, d\}\}$  and  $V=\{a, b, c, d\}$  with  $V|R'=\{\{a\},\{b, d\}\}$   $Y = \{a, b\} \subseteq V$ . Define  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  and  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  as follows:  $f(a)=b, f(b)=c, f(c)=a, f(d)=d, g(a)=b, g(b)=a, g(c)=d, g(d)=c$ . Then  $f$  and  $g$  are Nrg-closed maps. But their composition  $(g \circ f)$  is not Nrg-closed. Since for the Nano closed set  $\{c\}$ ,  $(g \circ f(c)) = g[f(c)] = g(a) = b$  is not Nrg-closed.

**Definition 3.18:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be Nrg – open map if the image of every Nano open set in  $U$  is Nrg – open set in  $V$ .

**Theorem 3.19:** A map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nrg-closed if and only if for each subset  $S$  of  $V$  and for each Nano open  $X$  containing  $f^{-1}(S)$  there is a Nrg-open set  $Y$  of  $V$  such that  $S \subset Y$  and  $f^{-1}(Y) \subset X$ .

**Proof: Necessity:** Let  $S$  be a subset of  $Y$  and  $X$  be a Nano open set of  $U$  such that  $f^{-1}(S) \subset X$ , then  $V \setminus f(U \setminus X) = Y$  is an Nrg-open set containing  $S$  such that  $f^{-1}(Y) \subset X$ .

**Sufficiency:** Let  $B$  be a Nano closed set of  $U$ . Then  $f^{-1}(V \setminus f(B)) \subset U \setminus B$  and  $U \setminus B$  is Nano open. By hypothesis there is an Nrg-open set  $Y$  of  $V$  such that  $V \setminus f(B) \subset Y$  and  $f^{-1}(Y) \subset U \setminus B$ . Hence it follows that  $B \subset U \setminus f^{-1}(Y)$  and  $Y \setminus V \subset f(B) \subset V \setminus Y$ . This proves that  $f(B) = V \setminus Y$ . Since  $V \setminus Y$  is Nrg-closed then  $f(B)$  is Nrg-closed.

**Theorem 3.20:** If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nrg – open then  $f^{-1}(Nrg - cl(A)) \subseteq NCl(f^{-1}(A))$  for each subset of  $A$  of  $V$ .

**Proof:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  be Nrg – open and  $A$  be any subset of  $V$ . Then  $f^{-1}(A) \subseteq NCl(f^{-1}(A))$  and  $NCl(f^{-1}(A))$  is Nano closed set in  $U$ . Then by the above theorem 3.18, there exists a Nrg – closed set  $B$  of  $V$  such that  $A \subseteq B$  and  $f^{-1}(B) \subseteq NCl(f^{-1}(A))$ . Now,  $Nrg - cl(A) \subseteq Nrg - cl(B) = B$ . Therefore  $f^{-1}(Nrg - cl(A)) \subseteq f^{-1}(B)$  and so  $f^{-1}(Nrg - cl(A)) \subseteq f^{-1}(B) \subseteq NCl(f^{-1}(A))$ . Thus,  $f^{-1}(Nrg - cl(A)) \subseteq NCl(f^{-1}(A))$  for each subset of  $A$  of  $V$ .

**Definition 3.21:** A space  $(U, \tau_R(X))$  is said to be Nrg-normal if for any two disjoint Nano regular closed sets  $A$  and  $B$  there exist disjoint Nrg-open sets  $X$  and  $Y$  such that  $A \subset X; B \subset Y$ .

**Theorem 3.22:** If  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano continuous, Nrg-closed surjection from a normal space  $U$  onto a space  $V$ , then  $V$  is Nrg-normal.

**Proof:** Let  $A$  and  $B$  be two disjoint Nano regular closed sets of  $V$ . Then  $A$  and  $B$  are Nano closed sets in  $V$ . Which implies that  $f^{-1}(A)$  and  $f^{-1}(B)$  are disjoint Nano closed sets of  $U$ . Since  $U$  is normal, there are disjoint Nano open sets  $X, Y$  in  $U$  such that  $f^{-1}(A) \subset X$  and  $f^{-1}(B) \subset Y$ . Then there are Nrg-open sets  $F, S$  in  $V$  such that  $A \subset F, B \subset S$  and  $f^{-1}(F) \subset X; f^{-1}(S) \subset Y$ . Since  $X$  and  $Y$  are disjoint, that is  $f^{-1}(F) \cap f^{-1}(S) \subset X \cap Y = \phi$ . Hence the space  $V$  is Nrg-normal.

**Definition 3.23:** Let  $(U, \tau_R(X))$  and  $(V, \tau_R'(Y))$  be two Nano topological spaces. Then a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nano continuous if  $f^{-1}(A)$  is both Nano open and Nano closed in  $(U, \tau_R(X))$  for each subset  $A$  of  $(V, \tau_R'(Y))$ .

**Definition 3.24:** Let  $(U, \tau_R(X))$  and  $(V, \tau_R'(Y))$  be two Nano topological spaces. Then a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nano rg-continuous (briefly strongly Nrg-continuous) if  $f^{-1}(A)$  is Nano open in  $(U, \tau_R(X))$  for every Nrg-open set  $A$  in  $(V, \tau_R'(Y))$ .

**Theorem 3.25:** If the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nano rg-continuous, then it is Nano continuous but not conversely.

**Proof:** Let  $A$  be a Nano open set in  $(V, \tau_R'(Y))$ . As every Nano open set is Nrg-open,  $A$  is Nrg-open in  $V$ . By the given hypothesis,  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nrg-continuous and hence  $f^{-1}(A)$  is Nano open in  $U$  for every Nrg-open set  $A$  in  $V$ . Hence  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano continuous.

The converse of the above theorem need not be true as seen from the following example.

**Example 3.26:** Let  $U = \{a, b, c, d\}$  with  $U|R = \{\{a\}, \{c\}, \{b, d\}\}$  and  $X = \{a, b\}$ . Then  $\tau_R(X) = \{U, \phi, \{a\}, \{b, d\}, \{a, b, d\}\}$ . Let  $V = \{x, y, z, w\}$  with  $V|R' = \{\{y\}, \{w\}, \{x, z\}\}$ . Then  $\tau_R'(Y) = \{V, \phi, \{y\}, \{x, y, z\}, \{x, z\}\}$ . Define a mapping  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  as,  $f(a) = x, f(b) = y, f(c) = w, f(d) = z$ . Then  $f$  is Nano continuous. Since the inverse image of every Nano open set in  $V$  is Nano open in  $U$ . But  $f$  is not strongly Nrg-continuous. Since  $f^{-1}(\{x, z, w\}) = \{a, c, d\}$  is not Nano open in  $U$  even though  $\{x, z, w\}$  is Nrg-open in  $V$ . Hence  $f$  is Nano continuous is not strongly nrg-continuous.

**Theorem 3.27:** If the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nano continuous, then it is strongly Nrg-continuous but not conversely.

**Proof:** Let  $A$  be a Nrg-open set in  $(V, \tau_R'(Y))$ . The map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nano continuous and hence the inverse image of every subset of  $V$  is both Nano open and Nano closed in  $(U, \tau_R(X))$ . Hence  $f^{-1}(A)$  is Nano open in  $(U, \tau_R(X))$  for every Nrg-open subset  $A$  of  $(V, \tau_R'(Y))$ . Hence  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nrg-continuous.

**Corollary 3.28:** If the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  and  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  are strongly Nrg-continuous, then their composition  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is also strongly Nrg-continuous.

**Theorem 3.29:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  and  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  are any two maps. Then their composition  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is

- (i) Strongly Nrg-continuous if  $g$  is strongly Nrg-continuous and  $f$  is Nano continuous.
- (ii) Strongly Nrg-continuous if  $g$  is strongly Nano continuous and  $f$  is Nano irresolute.

(iii) Nano continuous if  $g$  is Nrg-continuous and  $f$  is strongly Nrg-continuous.

**Proof:** (i) Let  $A$  be a Nrg-open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is strongly Nrg-continuous,  $g^{-1}(A)$  is Nano open set in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano continuous, the inverse  $f^{-1}(g^{-1}(A))$  is Nano open in  $U$ . Thus the inverse image

$$(g \circ f)^{-1}(A) = f^{-1}(g^{-1}(A)) \text{ is Nano open in } U \text{ for every Nrg-open set } A \text{ in } W. \text{ Hence the}$$

composition

$$(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z)) \text{ is strongly Nrg-continuous.}$$

(ii) Let  $A$  be a Nrg-open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is strongly Nano-continuous,  $g^{-1}(A)$  is both Nano open and Nano closed set in  $V$ . As every Nano open set is nano regular-open, since  $g^{-1}(A)$  is Nano regular-open in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nano irresolute, the inverse  $f^{-1}(g^{-1}(A))$  is Nano-regular open in  $U$ . Thus the inverse image

(g

$\circ f)^{-1}(A) = f^{-1}(g^{-1}(A))$  is Nano regular- open in  $U$  and  $g$  is strongly Nano continuous. Hence the map  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is strongly Nrg-continuous.

(iii) Let  $A$  be a Nano-open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is Nrg-continuous,  $g^{-1}(A)$  is Nrg-open in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nrg-continuous, the inverse  $f^{-1}(g^{-1}(A))$  is Nano-open in  $U$ . Thus the inverse image  $(g \circ f)^{-1}(A) = f^{-1}(g^{-1}(A))$  is Nano - open in  $U$ . Hence the map  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is Nano-continuous for every Nano open set  $A$  in  $(W, \tau_R'(Z))$

**Theorem 3.30:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  and  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  be two maps. If  $f$  is Nrg-continuous and  $g$  is strongly Nrg-continuous then  $g \circ f$  is Nrg-irresolute.

**Proof:** Let  $A$  be a Nano open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is Nrg-continuous the inverse image  $g^{-1}(A)$  is Nrg-closed set in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is strongly Nrg-continuous, the inverse  $f^{-1}(g^{-1}(A))$  of Nrg- open set in  $U$ . Thus the inverse image  $(g \circ f)^{-1}(A) = f^{-1}(g^{-1}(A))$  is Nrg-open in  $U$  for every Nrg open set  $A$  in  $W$ . Hence the map  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is Nrg-irresolute.

**Definition 3.31:** A function  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is said to be perfectly Nrg-continuous if the inverse image of every Nrg-open set in  $V$  is both Nano-open and Nano-closed in  $U$ .

**Theorem 3.32:** Let  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  and  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  be two maps. Then their compositions  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is

- (i) If  $f$  is Nrg-continuous and  $g$  is perfectly Nrg-continuous then  $g \circ f$  is Nrg-irresolute
- (ii) If  $f$  is perfectly Nrg-continuous and  $g$  is strongly Nano-continuous then  $g \circ f$  is perfectly Nrg-continuous.

**Proof:** (i) Let  $A$  be a Nrg-open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is perfectly Nrg-continuous, the inverse image  $g^{-1}(A)$  is both Nano open and Nano closed in  $V$ . since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is Nrg-continuous, the inverse  $f^{-1}(g^{-1}(A))$  of Nrg- open set in  $U$ . Thus the inverse image  $(g \circ f)^{-1}(A) = f^{-1}(g^{-1}(A))$  is Nrg-open in  $U$  for every Nrg open set  $A$  in  $W$ . Hence the map  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is Nrg-irresolute.

is Nrg-irresolute.

(ii) Let  $A$  be a Nrg-open set in  $W$ . since the map  $g: (V, \tau_R'(Y)) \rightarrow (W, \tau_R'(Z))$  is strongly Nrg-continuous, the inverse image  $g^{-1}(A)$  is both Nano open and Nano closed in  $V$ . As every Nano open set is Nrg-open,  $g^{-1}(A)$  is both Nrg- open and Nrg closed. Since the map  $f: (U, \tau_R(X)) \rightarrow (V, \tau_R'(Y))$  is perfectly Nrg-continuous, the inverse  $f^{-1}(g^{-1}(A))$  of Nano open and Nano closed set in  $U$ . Thus the

inverse image  $(g \circ f)^{-1}(A) = f^{-1}(g^{-1}(A))$  is both Nano-open and Nano-closed in  $U$  for every Nrg open set  $A$  in  $W$ . Hence the map  $(g \circ f): (U, \tau_R(X)) \rightarrow (W, \tau_R'(Z))$  is perfectly Nrg - continuous.

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# Management Of Accounts Receivable And Financial Performance Of Manufacturing Firms Listed In Nairobi Stock Exchange, Kenya

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## ABSTRACT

Management of receivables is a key aspect of working capital management. This paper seeks to establish the relationship between management of accounts receivable on financial performance of manufacturing firms listed in NSE. The study used descriptive research design where data was collected in order to establish the current status of the population. The population of the study comprised of 147 finance and accounts staff of all the manufacturing firms listed in NSE for period of Six (6) months from April to October 2016. Data was collected by use of self-administered questionnaires and analyzed using both descriptive and inferential data analysis. Study established that there was significant relationship between Credit extension policies, further it established that financing receivables has significant effect on the financial performance and receivable collection period has significant effect on the financial performance of the firm. The results of the study showed a value of  $R^2=0.889(p=0.01)$  this means that independent variables collectively account for 88.9% of the depended variable. The study established that there was significant relationship between accounts receivable management and financial performance of manufacturing firm. The study recommends that the management of the manufacturing firms should have clear policies on management of accounts receivables, that is, credit extension policy, financing receivable and receivable collection period since it significantly affected their financial performance of the firms.

**Key words:** Working capital management, Performance, NSE

## I. INTRODUCTION

Accounts receivable is money owed to a firm when it sells its products or services on credit and it does not receive cash immediately (Pandey, 2004). The objective for managing accounts receivable is to collect them as quickly as possible without losing sales from high-pressure collection techniques. The primary goal of accounts receivables management is to maximize the value of the enterprise by striking a balance between liquidity, risk and profitability (Hrshikes, 2002). The main purpose of maintaining receivables neither is not sales maximization nor is it for minimization of risks involved by way of bad debts but growth of sales, the concern would have opened credit sales to all sorts of customers. This is because, if minimization of risk of bad debts were to be the objective, the firm would not have to make any credit sale at all. It is noted that many organizations thrive on credit sales and therefore management of accounts receivable becomes a pivotal point in maximization of profits. That means a firm should indulge in sales expansion by way of receivables only until the extent to which the risk remain within an acceptably manageable limit.

According to Waweru (2013), poor management and control of accounts receivable frequently results in interference of the firm's daily operations as a result of cash flow problems which results in non-payment of suppliers of goods and services, it also impacts adversely on profits in two ways; first, bad debts written off reduce the firm's profitability. Secondly, when a lot of funds are tied up in accounts receivable, the company may find itself borrowing funds to finance operations; these borrowed funds attracts interest which also reduces profit.

Waweru (2013) further argues that ineffective management of debtors may also result to poor credit rating from financial institutions. This makes it difficult to obtain financing from the institutions to finance the firms' working capital and if it does then it

is at a high interest rate since it is unable to negotiate for better terms. Severe liquidity problems caused by so much funds held in accounts receivable may lead to total collapse in production since the firm can no longer meet its financial obligations, which in extreme cases may lead to the firm becoming insolvent and consequently being placed under receivership. Ultimately, the firm may be wound up. Efficient receivables management entails the management of various elements which include the credit extension policy, receivable conversion period, accounts receivable turnover and financing of receivable, this is because they affect the financial performance. Cash conversion cycle (CCC) is used as an overall measure of working capital, as it shows the gap between expenditure for purchases and collection of sales (Padachi 2006). According to Arnold (2008) the shorter the CCC, the fewer are the resources needed by the company. Therefore, the longer the cycle the higher will be the investment in the working capital, while on the other hand; longer cycle could increase sales, which could lead to higher profitability. Pandey (2004) argued that an extended collection period delays cash inflows which impairs the firm's liquidity position and increases the chances of bad debt losses which then impact negatively on the financial performance.

Financial performance involves measuring the results of a firm's policies and operations in monetary terms. This term is also used as a general measure of a firm's overall financial health over a given period of time, and can be used to compare similar firms across the same industry or to compare industries or sectors in aggregation (Miller. and Craig 2001). Financial performance is measured through liquidity, profitability, financial efficiency and repayment capacity. Efficient management of accounts receivables may impact positively the financial performance of a firm.

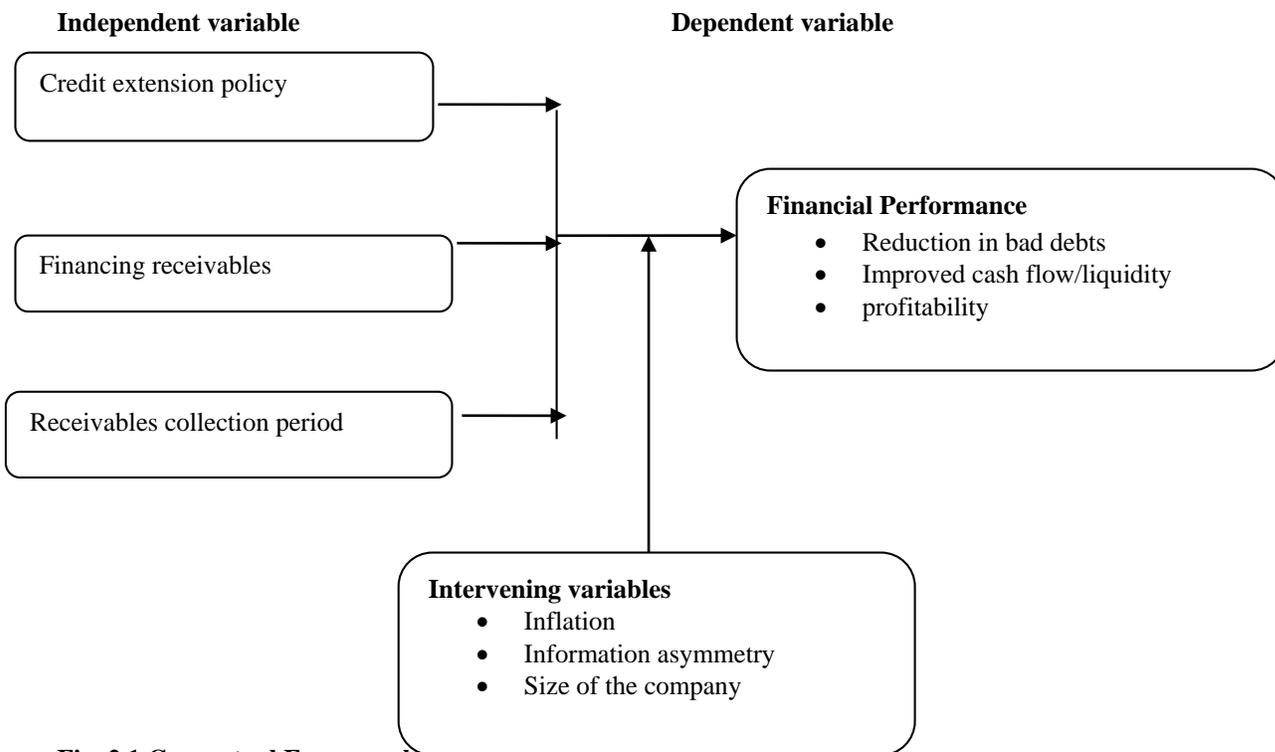
According to Pedro and Pedro (2008), trade credit has an effect on the level of investment in assets and consequently may have an important impact on the profitability and liquidity of the firm and also granting trade credits improves the sales for the firm but over-investment in accounts receivables can be costly due to increase of investment in current assets. Considering the importance of management of receivables and its impact on the financial performance, most researchers have done research on the entire working capital management, but very few research have been done particularly on accounts receivables as an element of working capital. Research studies by Samiloglu & Demrigunes (2008) and Mathura (2010), in Turkey and Kenya respectively, all point out to a negative relation between accounts receivable management and firms' profitability. At the same time, managers are faced with the challenges of achieving optimal profits, improving the company's performance and maximizing the shareholders wealth which can only be achieved through increase in revenue obtained from sales and cost cutting on expenses (Barad, 2010).

Selling on credit is one of the company's approaches in enhancing sales and it has turned up to be an enticement for customers in retaining the business relationship with the company and in time increase the company's profit (Barad, 2010), eventually optimizing the company's profit. The purpose of offering credit is to maximize profit (Damilola, 2005). Management of accounts receivable is complex as it forms an integral part of the marketing function as the granting of credit attracts customer thus resulting to increased sales and sales revenue (Cooper, 2008). Management of the accounts receivables asset is a complex task as it addresses the ramifications of practices and processes usually outside the sphere of the responsible manager, thus they may require liquidating their investments in securities. Whenever investors are certain of the possibility of selling out what they hold, as and when they want, they have a major incentive for investment as it guarantees mobility of capital in the purchase of assets ([www.nse.co.ke](http://www.nse.co.ke), 2016).

Accounts receivable is an important component of the firm's current assets. Management of receivables is an important function of a finance manager to ensure that the firm is liquid enough to meet its short term obligations by ensuring that the debtors pay their debts when they fall due. Efficient management of receivables leads to profitability of the firm. Poor management of receivables leads to poor liquidity which means inadequate inventory hence low sales and eventually low profitability. The longer period of collection of account receivables could result into higher sales, and more sales bring more profit into the business. However, when there is a build-up of receivables, funds are unavailable to have been put into efficient use within the firm as to earn profit. Therefore they could exist a relationship between accounts receivables management and financial performance of the firm. Research have been done on accounts receivable individually, but mostly as a part of working capital management, from various points of view, Manyo & Ike (2013) conducted a research on the effect of accounts receivables on return on assets (ROA) of selected Nigerian firms and found a negative relationship with return on assets. On the contrary Sharma & Kumar (2011) found a positive relation between Return on assets (ROA) and accounts receivable. There seems to be no conclusive finding which therefore calls for more research with defined variables. Effective management of the credit and accounts receivable process involves cooperation among sales, credit control marketing, finance and accounting function staff. Management of accounts receivable is made complex by the fact that it involves credit control, sales, marketing and finance functions of the business. It is therefore crucial that management formulate effective and efficient management of this sensitive yet important asset of accounts receivable so as to ensure that high turnover resulting from credit sales actually result to improved cash flows and higher profitability. This study is seeking to establish effects of management of accounts receivable on financial performance.

## II. CONCEPTUAL FRAMEWORK

A conceptual framework is a model of presentation where the researcher conceptualizes or represents the relationship between variables diagrammatically. The purpose of the conceptual framework is to help the reader to quickly see the proposed relationship. Figure 1 shows the relationship between the independent variables and the dependent variable of the study.



**Fig. 2.1 Conceptual Framework**

### III. RESEARCH METHODOLOGY

The study used descriptive research design to determine whether this relationship between the variables exists. The major purpose of descriptive research is to provide information on characteristics of a population or phenomenon Kothari (2004). Population is generally the total number of units with specific characteristic that the researcher can use to obtain a sample for the study. A population element is the subject such as a person, an organization, customer database, or the amount of quantitative data on which the measurement is being taken (Cooper and Schindler, 2003). The target population was all the finance and accounts staff of the listed manufacturing firms at the NSE. The study adopted census sampling since the population is small, therefore all the 9 manufacturing firms listed in the NSE were sampled.

The study used questionnaires for data collection. The questionnaire were be used since it was direct to the point and take shorter time for both the researcher and the respondents (Owen 2002). A standard questionnaire was designed in a simple way so as to guide and enable the participants to provide simple responses. According to Kothari (ibid) a questionnaire consists of a number of questions printed or typed in a definite order on a form or set of forms. The study also used document analysis for collecting secondary data. The documents analyzed were financial statements.

The study used descriptive and regression analysis. The aim of this was to assemble or reconstruct the data into a meaningful or comprehensible fashion (Jorgensen, 1989). The categorizing was typically based on the major questions guiding the study. Generalization from the themes about the phenomena in question and discussion in the light of the available literature was then made. The regression model was used to determine the relationship between dependent and independent variables. The effect of management of accounts receivable on financial performance was determined by the equation below.

$$Y = a + b_1(X_1) + b_2(X_2) + b_3(X_3) + \mu$$

Where;

Y= Financial performance

X<sub>1</sub>= Credit extension policy

X<sub>2</sub> = financing receivables

X<sub>3</sub> = receivable collection period

a = Constant Term

b<sub>1</sub>, b<sub>2</sub>, b<sub>3</sub> =Regression Co-efficient of Independent Variables

μ = Error Term

#### IV. RESULTS AND DISCUSSION

This chapter presents the findings of the study and discussion. The presentations are in form of tables and statements. The presentation is according to the objectives of the study and the hypothesis generated. The study targeted a sample of 147 respondents from the listed manufacturing firms at NSE. The high response rate (94%) shown in the table 4.1 resulted from the method of administration of the instrument, which was in this case researcher administered. This method was acceptable according to Mugenda and Mugenda (2003). This method also ensured that the respondents' queries concerning clarity were addressed at the point of data collection.

The respondents demographic characteristics which the researcher asked included; Age, Gender, Level of education and working experience.

The study obtained the age of the respondents in the manufacturing firms. The findings showed that people with 21 and 30 years stood at 19.6% , 31 and 40 years were 29.7%, 41 and 50 years are 41.3% and 51 years and above represent 9.4% this suggest that majority of the respondents were middle aged people (71%) aged between 31 and 50 years.

The study sought and obtained details about the gender of the respondents in the manufacturing firms for purposes of knowing their number. Details of the respondents as per their gender are shown in Table 1

**Table 1**

**Distribution of the respondent by their gender**

Gender	Frequency	Percent (%)	Cumulative Percent (%)
Male	81	58.7	58.7
Female	57	41.3	100.0
Total	138	100.0	

Source: Research data (2016)

The analysis results in Table 1 show that majority of the respondents in this study are male (81) which represent 58.7% and female (57) represented 41.3%.

The study sought to obtain the level of education of the respondents. Table 2 show the distribution of staff as per their education levels.

**Table 2**

**Distribution of the respondents according to their level of education**

Educational level	Frequency	Percent (%)	Cumulative Percent (%)
Masters Degree	45	32.6	32.6
Bachelors Degree	77	55.8	88.4
Diploma	16	11.6	100.0
<b>Total</b>	<b>138</b>	<b>100.0</b>	

Source: Research data (2016)

Table 2 shows that the respondents with diploma were (16) which representing 11.6%, Degree (77) which represent 55.8% and Master Degree (45) which represent 32.6%. The majority of the respondents are Master Degree, Bachelors Degree holders (122) which represent 88.4%. The study shows that majority of the manufacturing firms employees are those with Master Degree and Bachelors Degree.

The study also sought to find out working experience of the respondents. Table 3 show the working experience of the respondents

**Table 3**  
**Working experience of the respondents**

Working experience	Frequency	Percent (%)	Cumulative Percent (%)
1-3years	22	15.9	15.9
4- 6 year	72	52.2	68.1
7 years and over	44	31.9	100.0
<b>Total</b>	<b>138</b>	<b>100.0</b>	

**Source: Research data (2016)**

Table 3 shows that 15.9% of the respondents (22) have 1 to 3 years experience, 68.1% (72) have experience of 4-6 years, 31.9% (44) have experience of 7years and above in the manufacturing firms. Study revealed that majority of the employees in the manufacturing firms have 4-6 years working experience.

**Descriptive Statistics on effects of credit extension policy**

Table 4 shows details of measures of effects of the credit extension policy under different key statement obtained from the respondents this statement have been ranked in terms of their mean and standard deviation so as to deduce meaning out of the results.

**Table 4.6**  
**Mean and Standard deviation of responses to credit extension policy**

	N	Minimum	Maximum	Mean	Std. Deviation
There is existing credit extension policy	138	1	5	3.91	.940
Credit terms affect the size of the receivables	138	1	5	3.80	.881
Lenient credit terms attract customers	138	0	5	3.67	1.069
There is credit risk and evaluation on credit customers	138	0	5	3.91	1.091

**Source: Research data (2016)**

The study (as reflected in Table 4) found that the respondents agreed that there was existing credit extension policy in the organization with mean of 3.91. However, the corresponding standard deviation also revealed a significant value of 0.94. This shows that there is a clear variation in the responses provided by the respondents about the existence of credit extension policy. From the Table 4.6 respondents seemed to agree that credit terms affect the size of the accounts receivables as reflected by the mean value of 3.80 which is tending towards the maximum point of 5. However, a significant standard deviation of 0.881 suggests varied responses regarding credit terms affecting the size of the accounts receivables.

Results in Table 4 show a mean of 3.91. Which show that respondents agreed with the statement that there is credit risk and evaluation on credit customers. Consequently, a standard deviation figure of 1.091 raises concerns regarding credit risk and evaluation on credit customers. The figure of standard deviation further reveals that the respondents had varied opinion about presence of credit risk and evaluation on credit customers. In the Table 4.7 are details of measures of effects of financing receivables under different key statement obtained from the respondents this statement have been ranked in terms of their mean and standard deviation so as to deduce meaning out of the results.

**Table 5**  
**Mean and Standard deviation of responses to financing receivables**

	N	Minimum	Maximum	Mean	Std. Deviation
Financing receivables lead to high cost of capital	138	1	5	3.80	.830
Financing receivables increases administration cost	138	1	5	3.71	.890
Financing receivables leads to increase in production and selling cost in the firm	138	1	5	3.32	.770
Financing receivables leads to increase in default cost	138	1	5	4.11	.808

**Source: Research data (2016)**

From the results in Table 5, it is clearly evident that respondent were in total agreement that financing receivables leads to high costs capital as reflected by a mean value of 3.80 which is tending towards maximum value of 5 (i.e. strongly agreeing). However, the standard deviation of 0.830 suggests variations in responses by the various respondents. From the results of the study as reflected by Table 5, respondents agree as to whether the financing receivables increases administration costs. This is revealed by a mean of 3.71. However, a standard deviation of 0.890 suggests a significant variation in the responses generated by the respondents.

Results of the study as reflected in Table 5 also suggest that Respondents agree that the financing receivables leads to increase in production and selling costs in the firm. This is revealed by a mean of 3.31, although the standard deviation of 0.77 seems to suggest variation in the responses generated for the test. From the study, as reflected in Table 5, it can be deduced that respondents strong agree that financing receivables leads to increase in default cost; this is revealed by a mean value of 4.11, although the standard deviation under the same test revealed a variations of 0.808 in responses.

In the Table 6 are details of measures of effects of the receivable collection period on firm performance under different key statement obtained from the respondents this statement have been ranked in terms of their mean and standard deviation so as to deduce meaning out of the results.

**Table 6**  
**Mean and Standard deviation of responses to receivables collection period**

	N	Minimum	Maximum	Mean	Std. Deviation
There is clear receivables collection policy in the firm	138	2	5	4.44	.904
Customers observe their credit period promptly	138	1	5	3.04	.895
Extended receivables collections period leads to delay in cash flow	138	1	5	3.67	1.054
Receivable collections period helps customer retention	138	1	5	4.06	1.016

**Source: Research data (2016)**

Results of the study in Table 6 shows a mean of 4.44 which is above the average; this suggests that respondents believe that there is clear receivable collection policy in the firm. However, a standard deviation of 0.904 suggests varied responses as to whether there is clear collection of receivables. From the results of the study in Table 4.8, respondents seem to agree that customers observe their credit period promptly. This is revealed by a mean of 3.04 which is the average of 3. However, a standard deviation of 0.895 suggests a significant variation in the responses generated by the respondents. The study as reflected in Table 6, it can be deduced that respondents agree that extended receivable collection period leads to delay in cash flow, this is revealed by a mean value of 3.67, although the standard deviation (1.054) under the same test revealed a variations in responses generated

From Table 6, respondents seem to strongly agree that receivable collection period helps in customer retention as reflected by the mean value of 4.06. However, a significant standard deviation figure of 1.016 reveals varied responses from the respondents on the same statement.

**Descriptive statistics on financial performance**

The study also sought to establish the financial performance of the firms listed in the NSE. Results of this variable are summarized in Table 7. The performance was measured using liquidity, profitability and levels of bad debts. These were considered to be the most appropriate measures of performance related to accounts receivable.

**Table 7: Mean and Standard deviation of responses to financial performance**

	N	Minimum	Maximum	Mean	Std. Deviation
High liquidity in the firm	138	2	5	3.98	.678
High profitability in the firm	138	2	5	4.01	.645
Reduction in bad debts in the firm	138	1	5	4.04	.744

**Source: Research data (2016)**

Table 7 show that respondents agree that there was high liquidity in firm presented by a mean of 3.98 and a standard deviation of 0.678. They also strongly agreed that there was high profitability in the firm as shown by mean of 4.01 and standard deviation of 0.645 and reduction in bad debts in the firm as represented by the mean of 4.04 and standard deviation of 0.744

**Table 8**

**Correlation analysis**

\*\*r=0.01 (correlation is significant at 0.01)

\*r=0.05 (correlation is significant at 0.05)

	Financial performance	Credit extension policy	Financing receivables	Receivable collection period
Financial performance	1**			
Credit extension policy	.929**	1**		
Financing receivables	.359**	.227**	1**	
Receivable collection period	.296**	.352**	.215*	1*

Table 8 presents the relationship between dimensions of account receivable management

measured by credit extension policy, financing receivable and receivable collection period against financial performance of manufacturing firms listed in NSE. The results show that all the dimensions relate positively. Specifically, credit extension policy relates positively with financial performance with r=0.929 (p<0.01), the relationship between financing receivable and financial performance was significant at r=0.359 (p<0.01). Receivable collection period also relates positively with the financial performance with r=0.296 (p<0.01).

A Pearson coefficient of 0.929 (p < 0.01) shows a strong, significant, positive relationship between credit extension policy and financial performance of manufacturing firms listed in NSE as shown in Table 4.10. The results of the study agreed with the findings of study done by Muthuva (2010) which found that there is significant relationship between credit management policies and firms financial performance. Waweru (2011) found that receivable management policies have positive relationship with financial performance of a firm also Duru *et al* (2014) conducted a study on accounts receivable management and corporate performance of companies in the food & beverage industry in Nigeria and found that there was significant relationship between accounts receivable management and corporate performance. Therefore basing on these findings the study rejects the hypothesis that there is no significant relationship between credit extension policy and financial performance of manufacturing firms listed in NSE.

The results in Table 8 indicate a positive relationship between financing receivables and financial performance of the firms listed in NSE with  $r=0.359$  ( $p<0.01$ ). This is in agreement with the findings of Lazaridis & Tryfonidis (2006) and Narware (2004) who concluded that financing receivables will significantly affect the financial performance of the firm. Therefore we can conclude that the study rejects the hypothesis that there is no significant relationship between financing receivables and financial performance of manufacturing firms listed in NSE. Results in table 4.10 also shows a positive relationship between receivable collection period and financial performance of the manufacturing firms listed in NSE with  $r=0.296$  ( $p<0.01$ ). This in line with the findings of Sushma & Bhupesh (2007) that affirm that, putting in place proper debt collection procedures is pivotal in improving efficiency in receivables management hence the financial performance of firms

Multiple regression equation was used to determine the level of prediction of the independent variable (Receivable collection period, Financing receivables, and Credit extension policy) for accounts receivable management, by the dependent variable for financial performance of manufacturing firms listed in NSE.

**Table 9:**  
**Summary of regression model**

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate	Change Statistics				
					R <sup>2</sup> Change	F Change	df1	df2	Sig. F Change
1	.943 <sup>a</sup>	.889	.887	.235	.889	359.090	3	134	.000

- a. Predictors: (constant), Receivable collection period, Financing receivables, Credit extension policy
- b. Dependent variable: Financial performance

Table 9 shows a summary of the regression model. The predictors in this model are Receivable collection period, financing receivables, credit extension policy and the dependent variables is the financial performance. Findings revealed that collectively the predictors accounts for 88.9% of the financial performance of the firm as shown by  $R^2=0.889$  ( $p<0.01$ ). This indicates that there is a significant relationship between accounts receivable management and financial performance of the manufacturing firms listed in NSE

**Table 10:**  
**Regression Coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error				
1	(Constant)	-.559	.240	-2.328	.021	
	Credit Extension Policy (x <sub>1</sub> )	.834	.028	.913	.000	
	Financing Receivables (x <sub>2</sub> )	.340	.062	.165	5.521	.000
	Receivable Collection Period(x <sub>3</sub> )	-.053	.027	-.061	-1.978	.050

- a. Dependent Variable: Financial Performance

Table 10 shows analysis of the regression coefficient model and it established a positive beta coefficient of 0.834 with p-value of 0.00, 0.340 with p-value of 0.00 and a negative beta coefficient of -0.53 with p-value of 0.05. The constant value was -0.559 with p-value of 0.021. Therefore, the constant and the credit extension policy, financing receivables, and receivable collection period contribute significantly to the financial performance of the firms. The regression equation is presented as: Financial performance (Y) =  $-0.559+0.834x_1+0.340x_2-0.053x_3$

## V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

The results show that credit extension policy relates positively with financial performance of the firms with 0.929 ( $p < 0.01$ ), the results shows that good credit policies in firms and ensuring that there is a good credit terms to its customers, lenient credit standards and credit risk and evaluation on credit customers affects the financial performances of the firms. Therefore, ensuring that there are good clearly established credit management policies positively affects the financial performance of the firms (Muthuva 2010; Waweru 2011).

There was a positive relationship with financial performance of the firm with  $r=0.359$  ( $p<0.01$ ) thus the null hypothesis that financing of receivables has no significant effect on the financial performance was rejected implying that there is statistically significant relationship between financing of receivables and financial performance of the firm. Lazaridis & Tryfonidis (2006) and Narware (2004) concluded in their studies that financing receivables affect financial performance.

Receivable collection period related positively with the financial performance of the firms with  $r=0.296$  ( $p<0.01$ ). Clear receivable collection policy in the firm and ensuring Customers observe their credit period promptly, affects positively the financial performance financial performance of the firms. Proper debt collection and management procedures is pivotal in improving efficiency in receivables management (Sushma & Bhupesh 2007)

It can be concluded that effective receivable management in the firms leads to improved financial performances of the firms listed in the NSE. Therefore, the firms should ensure they put in place very effective and clear credit extension policies. It can also be concluded that cost associated with receivable in manufacturing firm affected the financial performance. Further, it can be concluded that receivable collection period significantly affected the financial performance of the manufacturing firms, and therefore manufacturing firms should have clear receivable collection period in the firms.

Finally the study therefore, concludes that manufacturing firms should ensure that they have a very effective accounts receivable management as this will help improve their financial performance. From the findings discussed above the study recommends that management of manufacturing firms should put in place effective management of accounts receivables.

The firms should put in place a sound credit policy that ensures proper debt collection procedures since it's important in improving efficiency in receivables management hence the performance of firms. The firms should adopt a shorter receivable collection period since a longer period delays cash inflows, impairs the firm's liquidity position and increases the chances of bad debt losses. As a result, the firm will be forced to borrow money at high interest rates to finance it operations and hence lower its performance.

Further research should be conducted on the effect of receivables management on performance taking into account the prevailing macroeconomic situation in the country. A study should be done on the effect of receivables management on the performance of government entities. The study was limited to accounts receivable management. Further studies should be done on other elements of working capital such as cash flow management, accounts payable management and inventory management

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# Analysis Domain Fish Resources of Shark (*Carcharhinus melanopterus*) For Sustainable Management in Spermonde Islands

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**Abstract-** *Carcharhinus melanopterus* has been designated by the IUCN Red List as a near threatened species because the level of utilization is quite high. This study aims to analyze the condition of the *Carcharhinus melanopterus* shark resources through an ecosystem approach (EAFM) that focusing on the dimensions of fish resources (SDI). It can becomes part of the information in developing a shark fisheries management strategy in the Spermonde Islands. This study used a survey method of respondents at Paotere Fish Auction Makassar City. Retrieval of questionnaire data on fishermen is determined using purposive sampling method. Shark samples were obtained from Paotere Fish Auction in Makassar City during August - November 2019. The attributes measured were CPUE, Catch Size Trend, Juwana Proportion, Species Composition, Range Collapse, and ETP Species. The results of the leverage analysis show that the most sensitive attribute during the last 5 years is the proportion of juveniles of sharks caught. As much as 44.59% of the sharks caught were in the juvenile category. This is considered to greatly affect the population of sharks in the wild, because juvenile sharks are expected to grow up and reproduce before being caught in order to maintain their population in the wild..

**Keywords:** *Carcharhinus melanopterus*, SDI dimensions of the Ecosystem Approach, Leverage Analysis, and Spermonde Islands

## I. INTRODUCTION

he population and diversity of sharks in Indonesia waters have recently become a concern among observers of the sustainability of fish resources. The high level of shark populations in Indonesia supports the interest of fishermen to take advantage of this high economic value fish resource. Currently, fisheries management prioritizes utilization for the social and economic welfare of the community rather than maintaining the health of the ecosystem. As a consequence, the approach taken is still partially integrated in an ecosystem boundary that becomes a container for fish resources as a management target.

The waters of the Spermonde Islands become a fishing area for sharks by fishermen and bring their catch to the Paotere fish auction in Makassar City. In the shark and ray enumerator report of BPSPL Makassar (2018), one of the species of shark with the highest number of catches at Paotere fish auction is *Carcharhinus melanopterus*. This shark is a species that traded in living conditions or processed into frozen meat and dried fins. The result of observations at Paotere fish auction, Makassar City, fisherman admitted that shark is a bycatch. Although sharks are not the main target for fishing, a new profession has emerged to collect shark products at Paotere and export shark product.

*Carcharhinus melanopterus* has been assigned as a near threatened species by IUCN Red List (Cavanagh, 2003) and the status of Vulnerable species in the wild (KKP, 2016). Analysis the domain of fish resources through an ecosystem approach, EAFM (Ecosystem Approach for Fisheries Management)

expected to provide information on shark fisheries management in formulating shark fisheries management strategies in the Spermonde Islands. Therefore, a comprehensive assessment is needed for the management of the shark species *Carcharhinus melanopterus* in the Spermonde Islands.

## II. METHODS

This study used a survey method of respondents at Paotere Fish Auction Makassar City and Spermonde Islands. Retrieval of questionnaire data on fishermen is determined using purposive sampling method. Shark samples were obtained from Paotere Fish Auction in Makassar City during August - November 2019. Respondents at the Paotere Fish Landing Auction Site (TPI) in Makassar City and several islands in the Spermonde Islands such as Sarappo Caddi Island, Podang-Podang Island, Pajenekang Island, Bontosua Island, Balang Caddi Island, and Balang Lompo Island. Determination of respondents was done by purposive sampling (Lestaluhu and Wasahua, 2014), based on the consideration that the respondent fishermen are fishermen who have and still catch sharks. The identification of shark species landed refers to a shark and ray identification manual (KKP, 2015)The attributes measured were CPUE, Catch Size Trend, Juwana Proportion, Species Composition, Range Collapse, and ETP Species.

### Data Analysis

#### 1) Sustainability Analysis

SDI-EAFM shark fisheries sustainability analysis is carried out by providing a score (value) based on the measurement results of fish data, interview results, and secondary data. The score given ranges from 1-3 depending on the circumstances of each based on the modification of the EAFM (Ecological Approach to Fisheries Management) module. Each attribute is used to determine the value / score of each dimension so that it can be objectively assessed.

**2) Composite Values**

Composite values are obtained by the equation (NWG EAFM, 2014):

Composite Value

$$Nilai\ Komposit,\ NK = \frac{Cat}{Cat-max} \times 100..... (1)$$

**3) Leverage Analysis**

This analysis is used to identify the attributes that are a factor in the problem. Then the attributes that have an extreme point can be used as a reference in developing a management strategy for the shark species studied.

**III. RESULTS AND DISCUSSION**

**1. Attribute Assessment**

The weighted score of each indicator in the fish resource domain can be seen in Table 1.

Table 1. Assessment and attribute sensitivity

No.	Indicator	Criteria	Score	Weight	Index value	Maximum Score
1	CPUE	1 = decreased sharply > 25% / year 2 = Decreased slightly ≤ 25% / year 3 = stable or increasing > 25% / year	1	40	40	120
2	Catch Size Trends	1 = The size of the fish is getting smaller 2 = Fixed relative size 3 = Size is getting longer	3	20	60	60
3	Proportion of Juwana	1 = Number of Juveniles (> 60%) 2 = Number of Juveniles (30-60%) 3 = Number of Juveniles (<30%) roportion of target fish (≤15% of olume)	2	15	30	45
4	Species Composition	ortion of target fish is the same as rget (16-30% of total volume) roportion of target fish (≥30% of olume)	3	10	30	30
5	Range Collapse	1 = Fishing Ground is very far (> 10 miles) 2 = Fishing Ground far (> 5 miles) 3 = Fishing Ground is relatively fixed (<2 miles)	3	10	30	30
6	ETP species	1 = Number of ETP catches (> 5 Species) 2 = Slight ETP catch (1-5 Species) 3 = No ETP capture	1	5	5	15
Total					195	300
Composite Value					65	

Composite value of Shark resources *Carcharhinus melanopterus* at a good level in implementing EAFM (Table 1) with a value of 65. The presence of sharks can maintain the balance of marine ecosystems by acting as top-level predators. Decreasing shark populations can cause problems for marine animal populations. Sharks prey on weak and sick animals so that they can maintain the genetic quality of the types of animals that are in the food chain below them. (WWF, 2015). The amount of pressure experienced by sharks in their habitat due to

exploitation from catch fisheries activities even though it is the object of non-target catch by fishermen in the Spermonde Islands.

**CPUE**

CPUE for shark fishing rates in the Spermonde Islands measured from the catch of fishermen land at TPI Paotere Makassar City. The highest CPUE value in 2019 was 33,479 kg / trip and the lowest in 2016 was 19,460 kg / trip. Following the development of the CPUE trend is presented in Figure 1.

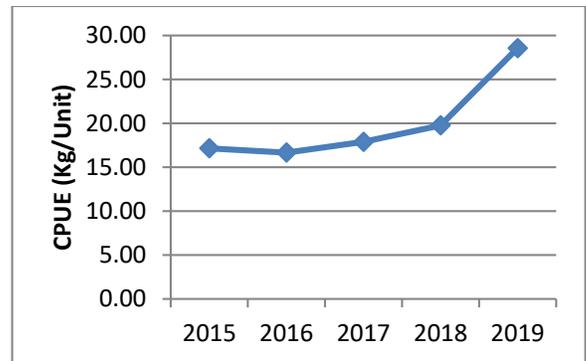


Figure 1. CPUE Trends for *Carcharhinus melanopterus* Sharks in 2015-2019

Based on the CPUE parameter assessment criteria in the SDI domain, the CPUE score for *C. melanopterus* species is 1 due to the sharp increase in catch. As a bycatch object, *C. melanopterus* is still experiencing an increase in the number of catches from 2017 to 2019. This occurs because almost all parts of the shark's body can be used, such as fins, meat, and liver. The selling price tends to be high considering the weight and body size of the sharks caught. In addition, this method of processing sharks is quite easy because most fishermen do not carry out special handling such as applying ice to these fish. This makes fishermen consider utilizing rather than releasing bycatch.

The Spermonde Islands have a variety of coral fish species that vary in each group of islands with the dominance of different forms of growth and physical condition of coral reefs on each island, this condition causes the distribution of reef fish in the Spermonde Islands to also vary (Nurjiranah and Burhanuddin, 2017). It is not uncommon for fishermen who target grouper, catombo, and siberian fish to catch sharks that live in coral reef ecosystems by mistake. This happens because sharks as bycatch are generally obtained from the use of longline fishing gears and gill nets (Rahardjo, 2009).

**Shark Size Trends**

Measurement of the sample length of the Blackfin Coral Shark (*Carcharhinus melanopterus*) as many as 74 samples caught using fishing rods (longline drift) and landed at TPI Paotere Makassar City. The size of the first mature gonads (Lm) of *Carcharhinus melanopterus* was at a length of 95 cm males and 97 cm females (Lyle, 1987). Class intervals and percentage of total shark length are shown in Figure 2.

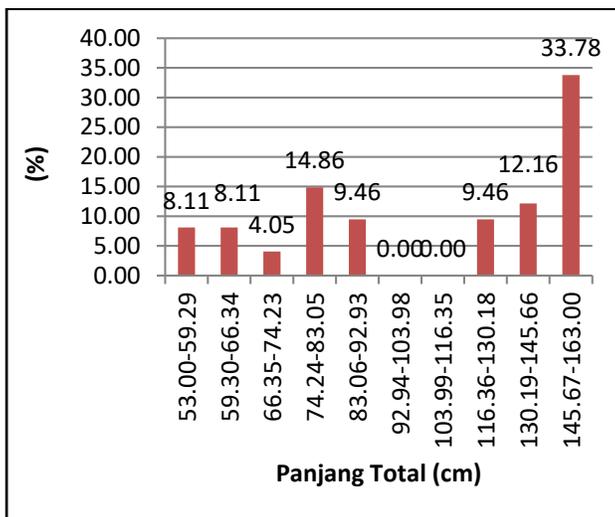


Figure 2. Class Intervals and Percentage of Total Length Measurement Results for Sharks (*Carcharhinus melanopterus*) August-November 2019 at TPI Paotere Makassar City

Figure 2 shows the highest percentage of the total length of the *Carcharhinus melanopterus* shark caught in the class interval 145.67 cm to 163.00 cm with a percentage of 33.78%. Based on the body length standard for sharks that first matured gonad, the percentage of shark fishing size trends for this species was mostly above the standard (> Lm) of 55.41%. The results of interviews with fishermen who collect sharks at TPI Paotere admit that landed sharks are often still in the juvenile category, while adults only appear 1-2 times a month. Based on field observations, this type of shark is often caught along with sharks from other Carcharhinidae families such as *Carcharhinus limbatus* and *Triaenodon obesus*. Although the catch size of the *Carcharhinus melanopterus* shark is considered variable, however current research shows the highest percentage of the graph of the trend of catch size is getting bigger. Therefore, based on the EAFM module this indicator gets a score of 3.

### Proportion of Juwana

*Carcharhinus melanopterus* which is included in the juvenile category, namely sharks that have a body size of less than 95 cm (<95 cm) for males while females with a body size below 97 cm (<97 cm) (Lyle, 1987). The results of measuring fish samples during August-November 2019 from 74 samples of *Carcharhinus melanopterus* were found to be 44.59% with a length that was included in the juvenile category and 55.41% in the adult category. Therefore, based on the juvenile proportion indicator, a score of 2 was given, namely the number of juveniles (30-60%) of the total sample (Figure 3).

On the other hand, fishermen find sharks on their fishing rods, of course they will still take their catch to collectors to cover the operational costs of catching them. Even though sharks have a fairly high economic value in TPI, shark fishermen who are on Spermonde islands such as Sarappo Caddi Island, Podang-podang Island, Pajenekang Island, Bontosua Island, Balang Caddi Island, and Balang Lompo Island say that they do not need bring the catch of the sharks directly to the TPI because of the

availability of collector services on the island. Therefore, based on the EAFM module, this indicator is given a score of 2 where the proportion of juveniles is 30-60% of the total catch.

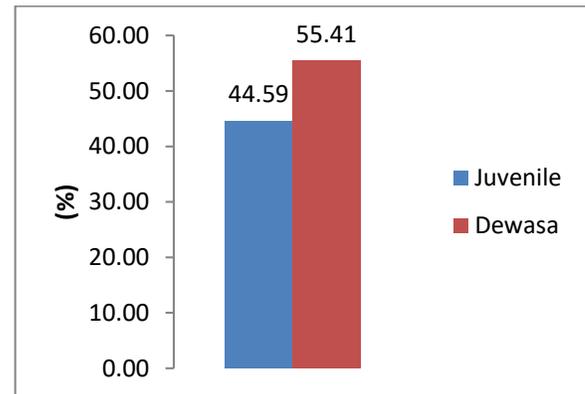


Figure 3. Proportion of Juwana Sharks *Carcharhinus melanopterus* in August-November 2019

### Species Composition

The composition of the catch of fishermen using fishing rods is quite diverse. Based on the research results, it is known that the catch of fishermen's fishing rods in the research location is dominated by reef fish targeting the Katamba and Sibula fish. The percentage of total catch can be seen in Figure 4.

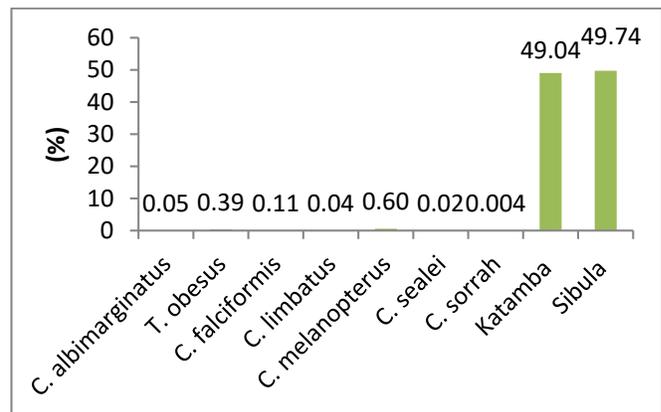


Figure 4. Target and non-target catches at TPI Paotere Makassar City for the period August-November 2019. Source: BPSPL Makassar Enumerator Report and PPI Paotere Production Report Makassar City

The composition of species caught by fishing rod fishermen shows the proportion of target fish is greater than non-target. The proportion of shark catch on respondent's fishing line is generally 1-2 of the 50 hooks installed. The emergence of sharks as a non-target species is still landed at TPI even though it is in the Eastern season. This season, the wind and wave speed is high enough in Spermonde waters so that fishermen will adapt to the climate by changing fishing targets such as squid or even reducing the amount of fishing activity. Therefore, based on the EAFM module, this indicator is given a score of 3 where the target proportion is > 30% of the total catch.

## Range Collapse

The average distance from the point of departure to the fishing location is less than 2-3 miles to the West (> 2 nautical miles) with a travel time of ± 45-60 minutes. Fishermen whose fishing ground is in the waters of Spermonde explained that there is no special area for shark fishing, the general target is small pelagic fish that inhabit coral reef ecosystems such as katamba, grouper and sibula. On the other hand, fishermen are more worried about the unpredictable fishing season in the last few months. Of course, fishermen will take advantage of all the catch as long as the type of fish caught has economic value and is not in a protected category. Based on the EAFM module, the Range Collapse indicator is given a score of 3 because the fishing ground area of the fishermen is relatively fixed, which is > 2 nautical miles to the west of Sarappo Caddi Island.

## ETP species

Respondent fishermen who come from dominant islands choose to utilize all their catch as long as the fish caught are not from the prohibited fishing category and have economic value. Meanwhile, respondent fishermen with vessels <30 GT choose to release their catch of sharks if they are caught by their fishing rods to avoid the risk of inspection by officers. Most of the identification results of shark catches obtained by fishermen and landed at TPI Paotere, Makassar City are Near Threatened (NT) such as (KKP, 2016): *Carcharhinus melanopterus*, *Carcharhinus albimarginatus*, *Carcharhinus limbatus*, *Carcharhinus sealei*, *Carcharhinus sorrah*, and *Triaenodon obesus*. While one type is included in the CITES Appendix II, namely the type *Carcharhinus falciformis*. Therefore, A score of 1 is given for the ETP species indicator because there were ETP individuals who were caught but not released. This continues to be socialized at TPI because there are still species of appendix sharks that were caught accidentally by fishermen.

## 2. Leverage analysis

The results of the leverage analysis on the dimensions of fish resources (Figure 5) show the most sensitive attribute, namely the proportion of juveniles caught in the last 5 years. The shark *Carcharhinus melanopterus*, which was found at 44.59% with length included in the juvenile category. This is considered to greatly affect the population in nature, because based on the biological characteristics of sharks, generally have a slow growth rate, have a long life, are slow to reach sexual maturity and have a small number of tillers. . Juvenile sharks are expected to remain in nature and experience growth until they reach adult size.

During the breeding season, female *Carcharhinus melanopterus* sharks will undergo phylopathy so they tend to give birth in their original waters. Some offspring show inbreeding which results in reduced population size, movement and limited distribution. This makes male sharks act as transmitters of genes between populations (Mouries and Planes, 2013). Female sharks can only give birth to 3-4 juvenile sharks in one season (Chin et al, 2013). If the spreader of this gene is caught in juvenile size, the population of *Carcharhinus melanopterus* can certainly will decrease.

Export commodities of sharks from Makassar and Takalar come from the catch of fishermen in the Spermonde Islands. Shark fishing activities in Indonesia take place throughout the year without being limited by certain seasons (Arisandi et al, 2020). On the other hand, the uncertain season makes fishermen continue to utilize all the catch that has economic value to cover the operational costs of fishing and other living needs. Interviews with fishing rods on several Spermonde Islands with more than 10 years of experience stated that the sharks caught were not the target catch due to the low prices offered by collectors on the Island. Even fishermen and collectors on the island only set prices based on the body weight of the sharks, not based on the species caught

The high international market demand for blackfin reef sharks (*Carcharhinus melanopterus*) is one of the reasons the shark trade continues to this day (Arisandi et al, 2020). CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) does not categorize blackfin reef sharks (*Carcharhinus melanopterus*) in the Appendix II list so that foreign trade is still allowed (Fahmi and Dharmadi, 2013). If this condition continue, then shark fishing activities will increase.

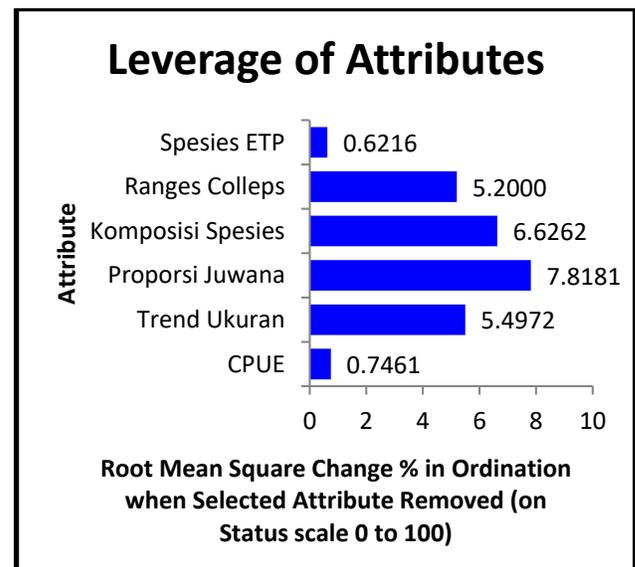


Figure 5. The results of the analysis of the leverage domain of fish resources

## IV. CONCLUSION

The most sensitive attribute in the management of *Carcharhinus melanopterus* shark fisheries is the proportion of juveniles caught by fishermen. The strategy suggested for the sustainable management of this type of shark is to establish marine conservation areas in several points of coral reef areas that become shark spawning, nursery and foraging areas. This can reduce the chances of catching sharks by catch, especially those that fall into the juvenile / juwana category.

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# A study on the impact of cultural dimensions on occupational stress of managerial level employees in hotel industry

(Special reference to star hotels in Kandy district, Sri Lanka)

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**Abstract-** Human activities have become more complex and rush in today's world. Therefore, human activities and organizational activities are changing too much faster. As the result of that the word "stress" has become a frequently used word in today. Occupational stress is one of the most common topics which is taken in to consideration when discussing about any organizational context. Hospitality industry is continually challenged in coping with stress due to the nature of the industry. According to many evidences, occupational stress has a significant occurrence in Sri Lankan hotel sector which is covered a major area of hospitality industry. The aim of this study was to find out whether there is an impact of Hofstede's cultural dimensions namely individualism - collectivism, uncertainty - avoidance, power distance and masculinity – femininity on occupational stress of managerial level employees in hotel sector as different cultural contexts and practices in hotel industry may have an influence on occupational stress. Further, it was expected to identify the most influential factor from cultural dimensions on occupational stress. This study was a quantitative study where occupational stress acted as the dependent variable and Hofstede's cultural dimensions were the predictors of the study. Regression analysis was performed to investigate the impact of the variables interested. Moreover, the demographic factors were analyzed by using descriptive statistics and Pearson's correlation analysis was used to identify the relationship between selected variables. The researcher considered 150 managerial level employees as the sample based on stratified sampling. Data were collected through structured questionnaires developed by previous authors. This study brought evidence of significant impact of Hofstede's cultural dimensions on occupational stress of managerial level employees in hotel industry. Moreover, the impact of power distance could be identified as the most influential factor comparatively. This study created a novel contribution to the existing literature as

well as to the managerial level employees in hotel sector who are expecting to avoid occupational stress in their organizational context.

**Index Terms-** Hofstede's Cultural Dimensions, Occupational Stress, Hotel Industry

## I. INTRODUCTION

Human activities have become more complicated in today's world. Their lives are changing rapidly. Therefore, all individuals in public and private organizations have to cope with these changes as fast as possible. As the result of that the word "occupational stress" has become a frequently used word in today. Occupational stress is a very significant factor in current competitive and changing environment (Cotton & Hart, 2003). Occupational stress can be defined as "the harmful physical and emotional responses occur when job requirements do not match the workers' capabilities, resources and needs" (National Institute of Occupation Safety & Health Report, 1999). Sri Lanka has become one of the top tourist destinations in the world in past few years (Fernando, Bandara & Smith, 2017). Currently, Sri Lanka's hotel industry is a key driver of economic growth. Its' direct contribution to GDP is 4.3 % (Sri Lanka Tourism Development Authority Statistics Report, 2019). The past year recorded nearly 2.3 million visitors to Sri Lanka, with tourism earnings reaching \$ 3.5 billion (The Hotels Association of Sri Lanka, 2019). Therefore, Hotel industry takes a valuable position in Sri Lanka. The nature of working environment within hotels such as hard deadlines, unexpected interactions with guests, long working hours, night and evening work, repetitive work, work demands, intensive customer interactions, rapidly changing work environment, high emotional demands, unpredictable shifts, few breaks, ambiguity, work overload and

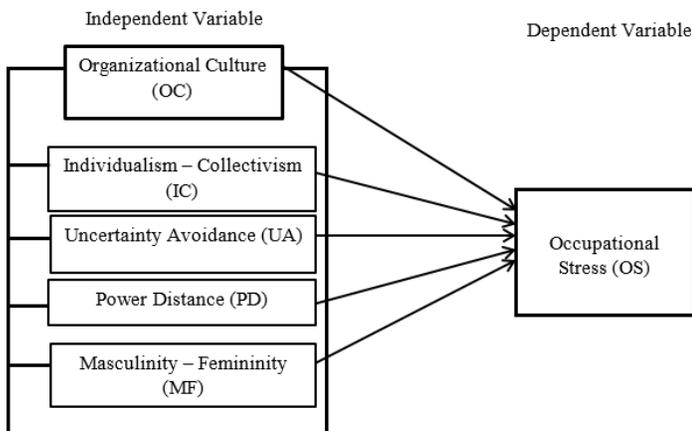
organizational changes (Mohan, 2017) can be recognized as some factors leading to occupational stress.

Hospitality industry is a service oriented industry that has the higher stress level (Mohan, 2017). Employee stress is a significant problem in the hospitality industry, and it is costly for employers and employees (Neill, 2011). In hotel and hospitality industry, the staff turnover ratio is very high and the major reason behind this is stress and work pressure (Cotton & Hart, 2003). Compared to the other industries, hotel managers' stress has been increased rather than managerial employees in other industries (Mohan, 2017).

But, the occupational stress within the hotel industry is less investigated (Zohar, 1994). For managers to address the problems of occupational stress, they need a good appreciation of the concept of stress, its causes, its consequences and the variety of management techniques and tools available (Cleg, 2001). Furthermore, Kandy area takes valuable position in Sri Lankan hospitality industry due to the reasons such as the highest tourists occupancy rate among other ancient cities (Sri Lanka Tourism Development Authority Statics Report, 2019), being a developing city, the second largest city in Sri Lanka etc. and UNESCO has declared as a world heritage site in 1988. Rich cultural heritage and ancient cities will provide a wide range of tourism opportunities in future. Therefore, in order to address for the above mentioned stress factor, the researcher had taken star hotels in Kandy district and identified a research problem to investigate whether there is an impact of organizational culture on occupational stress of managerial level employees in hotel industry with special reference to star hotels in Kandy.

The conceptual framework for the study was derived as follows.

### Conceptual Framework



Source: Developed by the author based on the literature

Figure 1: Conceptual Framework

According to the above conceptual framework, following hypotheses were addressed by the research;

H1: Organizational culture has an impact on occupational stress of managerial level employees in hotel industry

H2: Individualism – Collectivism has an impact on occupational stress of managerial level employees in hotel industry

H3: Uncertainty Avoidance has an impact on occupational stress of managerial level employees in hotel industry

H4: Power Distance has an impact on occupational stress of managerial level employees in hotel industry

H5: Masculinity – Femininity has an impact on occupational stress of managerial level employees in hotel industry

## II. LITERATURE REVIEW

### Organizational Culture

Employees in an organization are affected by many factors in term of determining their occupational stress. When it considers about the organizational culture, the beginning of formal writing on the concept of organizational culture with Pettigrew in 1979. Pettigrew (1979) introduced the anthropological concept of culture and showed how related concepts like “symbolism”, “myth” and “rituals” can be used in organizational analysis (as cited in Lee & Yu, 2004). According to the Dandridge et al. (1980) showed how the study of these myths and symbols help in revealing the “deep structure” of an organization by developing the concept introduced by Pettigrew in 1979 (as cited in Lee & Yu, 2004). Moreover, organizational culture on being traditionally determined and socially structured that involves beliefs, behaviors, values and morals allied with different levels of the organization and incorporates to all aspects of organizational life (Pettigrew, 1990; Hofstede, Neuijen, Ohauv & Sanders, 1990 as cited in Uddin, Luva & Hossian, 2013). More recent researchers including Denison and Mishra (1995); Schein (1985); Siehl and Martin (1988, 1990) and Wallach (1983) introduced various definitions of the culture concept (Lee & Yu, 2004). Organizational culture is conceptualized as shared beliefs and values within the organization that helps to shape the behavior patterns of employees (Kotter & Heskett, 1992 as cited in Uddin, Luva & Hossian, 2013). Organizational culture is the way of people do things around organization (Deal & Kennedy, 1982 as cited in Lee & Yu, 2004) or expressive non-rational qualities of an organization (Lee & Yu, 2004). According to Hofstede (1991) organizational culture means mindset of people which distinguishes them from others within or outside of the organization (as cited in Shahzad, 2014). According to Denison et al. (2006) Organizational Culture can be defined as values, beliefs, and assumptions that are held by the members of an organization and which facilitates shared meaning and guide behavior at varying levels of awareness. Consequently Culture can be defined as a pattern of shared values and beliefs that help individuals to understand organizational functioning and provide them with the norms for behavior in the organization (Deshpande and Webster, 1989 as cited in Agbejule, 2011). Schein (2004) has noted that some organizations have no important culture because those organizations do not carry a common history within the organization for a long time period whereas some organizations can be presumed to have strong culture because they have long shared history or shared intense experiences. When a group holds common assumptions, it results to a unique way of perceiving, thinking, feeling and behaving within the group. The anxiety that emerges because of inability to understand or predict event happening around the group is reduced by the shared learning (Schein, 2004). According to the Hofstede (1980) four dimensions of organizational culture can be named as power distance, individualism, uncertainty avoidance and masculinity. Power distance can be defined as the degree of

employee and management behavior that have been based upon perfect relationship between formal and informal set of planning action. Individualism means perfect match the difference between organization interest and self-interest. Uncertainty avoidance can be defined as the uncertainty and ambiguity based upon tolerance helps in mitigating willingness of people. Masculinity comes in avoidance of caring and promotion rather than level of success based upon challenges, insolence and ambition (as cited in Awadh & Saad, 2013). According to the literature, there are four dimensions of organizational culture can be identified; named as Individualism - Collectivism, Uncertainty Avoidance, Power Distance and Masculinity - Femininity (Denison & Mishra, 1995).

### **Occupational Stress**

Occupational stress is defined as the “harmful physical and emotional response that occurs when job requirements do not match the worker’s capabilities, resources and needs” (National Institute of Occupational Safety and Health Report, 1999). Job related stress is an uncomfortable feeling which is experienced by the individual, who is required to change his or her desired behavior related with the work objectives (Dette, 2008). The leading stress expert discusses stress as a dynamic activity of individual is confronted with an opportunity, constraint or demand (Selye, 1936 as cited in Dette, 2008). The experience of stress level is depending on individuals. According to characteristics, intelligence and other individualistic qualities different the level of feeling stress in each one (Lazarus & Folkman, 1984). Work stress affect the performance of all levels of staff, from senior management to the operational staff and newly employed. Many workers in their daily experiences are aware that conflict and it does differ from person to person (Ross, 1995). Organizational culture influences to develop the negative outcomes of workers and organizations (Gardner, 2005). Occupational stress influence to reduce work output and increase accidents, absenteeism and employee turnover (Spector, 2003). Job stressor has grouped into the following six categories: physical environment, role stressors, organizational structure and job characteristics, relationships with others, career development, and work-family conflict (Burke, 1983, Fairbrother & Warn, 2002). In life situations, the workplace stands out as a potentially important source of stress purely because of the amount of time that is spent in this setting. Over the years, a large number of workplace stressors of varying degrees of gravity have been identified (Vokic & Bogdanic, 2006). And specific conditions that make jobs stressful can be categorized either as exogenous (i.e. inappropriate working conditions, heavy workload, lack of collaboration, etc.) or endogenous pressures (i.e. individual personality characteristics, etc.) (Antonioni, 2006 as cited in Dette, 2008). Furthermore, there are main three causes associated by the occupational stress as extra organizational factors, organizational factors and group factors. Extra organizational factors are refers to the factors that are more personal and related more to individual (Societal patterns, Technological changes, Changed lifestyle, Relocation of work or family, Unexpected happening or changes in life). Organizational Factors are refers to factors that related to organization or job assigned to individual (High stress job, Job role, Improper working condition, role ambiguity, instability and dissatisfaction

and Competition within departments). Group Factors are refers to three areas of Lack of group cohesiveness, Lack of social support and Intra individual, interpersonal & inter group conflict (Shankar and Keerthi, 2010). Furthermore, there are three main causes associated with the occupational stress as individual, interpersonal and structural. These are suggested through the investigation of Miles and Perreault regarding four types of role conflicts as intra-sender role conflict; inter-sender role conflict, personal role conflict and role overload which create stress (Malik, 2011).

### **Organizational Culture and Occupational Stress**

When an organization holds a strong culture, it is very helpful to reduce the work stress of the employees that leads to the goal achievement and increases the overall performance of the organization. And also when a new employee enter in to the organization, that employee has different mindset and strong culture directs employees to a common pathway to achieve organizational goals and provide opportunity to grow in the organization by performing better in the way of managing stress (Deal & Kennedy, 1982 as cited in Shahzad, Iqbal & Gulzar, 2013). According to the findings of Marchand, Haines, and Dextras-Gauthier (2013), organizational culture needs to be considered as a relevant factor in occupational health studies. Content analysis of the study of Chang and Lu (2007) revealed that characteristics of organizational culture could either alleviate or aggravate stress, depending on employees' perception and attribution. In the same study, it has cited that recent studies of organizational management have addressed the significance of organizational culture on stress formation, since sources of stress can depend on the characteristics of the culture existed in organizations.

## **III. METHODOLOGY**

### **Research Philosophy**

This study is focused on the philosophy of positivism because the researcher conducts an objective research study which is independent of social factors (Saunders et al., 2009). Moreover, the researcher concerns about the observable phenomena which can provide credible data and facts. In addition to that generalizability of the results of the research study was highly concerned. Also, the researcher developed hypotheses and those hypotheses were tested and confirmed for development of a theory which may be tested by future research.

### **Research Methodology**

According to Saunders et al., (2009), quantitative is used for any data collection technique (Such as questionnaires) or data analysis procedure that generates or uses numerical data and in contrast, qualitative is used for any data collection or analyzing procedure that generates non-numerical data. In the present study, the researcher intended to find out whether there is an impact of organizational culture and its dimensions on occupational stress. As that study dealt with numerical values, in its collection and analyzing process, the researcher used quantitative method for the present study.

### **Population and Sample**

The sample which was selected by the researcher was manageable as there were only 150 managerial level employees who are working in Star Hotels in Kandy area. The sample was selected out of the population by using stratified sampling technique. The sample was stratified according to the star category of working hotel and designation.

(Includes 4 Hotels)	Supervisors – 85	Executives 20 + Supervisors 22
2 Star Hotel (Includes 5 Hotels)	Executives – 46 Supervisors – 68	30 Executives 12 + Supervisors 18
1 Star Hotel (Includes 3 Hotels)	Executives – 31 Supervisors – 44	20 Executives 8 + Supervisors 12

**Table I – Population and Sample**

Star Category of the Hotel	Population (Total number of population)	Sample (Population of each category/ Total number of population)*150
5 Star Hotel (Includes 3 Hotels)	Executives – 61 Supervisors – 95	41 Executives 16 + Supervisors 25
4 Star Hotel (Includes 2 Hotels)	Executives – 28 Supervisors – 39	17 Executives 7 + Supervisors 10
3 Star Hotel	Executives – 75	42

**Validity and Reliability**

Validity of the instrument of cultural dimensions is already tested by the authors and it is validated (Hofstede, 2008). According to (Puri, 2011), validity of the occupational stress instrument is 0.82 and therefore, the validity of the instrument can be identified as good. To measure organizational culture and its’ dimensions, it was used Value Survey Model (VSM) 08, built by Hofstede (2008). The total reliability of this construct is high and recorded as 0.95. The reliability value of occupational stress is 0.89 according to the occupational stress index (Puri, 2011).

**IV. DATA ANALYSIS**

**Test of Normality**

The researcher has carried out a normality test for the dependent variable of occupational stress in order to measure the normality of its data distribution. If the output P value of the normality test is greater than the critical P value ( $P > .05$ ), distribution of the sample is not differ from the normal distribution (Field, 2009). According to the results, the output P value is 0.140. Therefore, with 95% confidence, the researcher concluded that occupational stress follows a normal distribution (See Table II).

**Table II – Test of Normality**

Dependent Variable	P Value (KS Test)
Occupational Stress	0.140

Source: Census Data (2020)

**Correlation Analysis**

As per the table III, it can be concluded with 95% level of confidence that there are relationships between all the dimensions of organizational culture and occupational stress. Moreover, all the dimensions of organizational culture were positively correlated with occupational stress as with the Pearson Correlation Coefficient ( $r$ ) of 0.473, 0.373, 0.415 and 0.437 of Individualism - Collectivism, Uncertainty Avoidance, Power Distance and Masculinity - Femininity respectively ( $P$  value $<0.05$ ). As all Pearson correlation coefficients are between 0.5 and 0.3, there is a low degree of positive correlation between each pair of variables under 95% confidence level (See Table III).

**Table III – Correlation Testing**

Variable	Correlation Coefficient ( $r$ )	P Value
Individualism - Collectivism	0.473	0.001
Uncertainty Avoidance	0.373	0.043
Power Distance	0.415	0.012
Masculinity - Femininity	0.437	0.034

Note: Dependent variable: Occupational Stress  
 Source: Census Data (2020)

**Regression Analysis**

Regression analysis is used to assess the strength of relationship between a numerical dependent variable and one or more numerical independent variable (Saunders et al., 2009). As the researcher tested the impact of the independent variable and its dimensions on occupational stress, it was used simple regression analysis and multiple regression analysis for the study. Multicollinearity poses a problem only for multiple regressions. Normally multiple regression consists with two or more predictor variables. Multicollinearity exists when there is a strong correlation between two or more predictor variables in regression model (Field, 2009). According to Field (2009) SPSS produces various collinearity diagnostics, one of which is the Variance Inflation Factor (VIF) and VIF indicates whether independent variable has a strong linear relationship with the other independent variables. VIF value should be less than 10 (VIF<10). Then it can be concluded that particular model is not suffering from multicollinearity effect. As all the VIF values of dimensions of the independent variable of the selected model is less than 10, it can be concluded that there is no multicollinearity issue in the present study (See Table IV).

As per the Table V, constant term or the  $\beta_0$  is 1.175. This emphasis that, it is expected to have 1.175 units of occupational stress when there is no effect of organizational culture. Moreover, 1.065 is the regression coefficient of the organizational culture and it means that occupational stress can be increased by 1.065 units, if organizational culture increases by 1 unit while keeping other factors as constant.

Results of multiple regression analysis show that constant term or the  $\beta_0$  is 0.737. This emphasizes that, it is expected to get 0.737 units of occupational stress, when there is no effect of any variables. The regression coefficient of Individualism - Collectivism is 0.145 and that means occupational stress can be increased by 0.145 units, if Individualism - Collectivism increases by 1 unit while keeping other factors as constant. If Uncertainty Avoidance increases by 1 unit, it could be able to increase occupational stress by 0.042. In the same manner occupational stress can be increased by 0.743 units, if Power Distance increases by unit while keeping other factors as constant as the regression coefficient of Power Distance takes 0.743. Finally, Masculinity - Femininity shows 0.468 of regression coefficient. Therefore, it can be concluded that Occupational Stress can be increased by 0.468 units when Masculinity - Femininity increases by 1 unit while keeping other factors constant (See Table V).

As per the Table VI, 73.9% variation of the occupational stress can be explained through the fitted model 01. Therefore remaining 26.1% changes of occupational stress can't be explained through the fitted regression line. Moreover, adjusted R square value (0.789) emphasizes that 78.9% of the variation of occupational stress is going to be explained by Individualism - Collectivism, Uncertainty Avoidance, Power Distance and Masculinity - Femininity of managerial level employees in hotel industry. Therefore, remaining 21.1% changes of dependent variable can't be explained through dimensions of organizational culture and there might be other factors that can be explained this variation.

**Table IV – Test of Multicollinearity**

Variables	VIF Value
Individualism - Collectivism	1.342
Uncertainty Avoidance	1.131
Power Distance	1.279
Masculinity - Femininity	1.089

Source: Census Data (2020)

**Table V – Regression Analysis**

Type of Analysis	Model	Variable	B	P Value	95% Confidence Level	
					Lower Bound	Upper Bound
Simple Regression Analysis	1	(Constant)	1.175	0.000	0.709	1.641
		Organizational Culture	1.065	0.000	0.992	1.209
Multiple Regression Analysis	2	(Constant)	0.737	0.028	0.081	1.393
		Individualism - Collectivism	0.145	0.000	0.401	1.084
		Uncertainty Avoidance	0.042	0.012	-0.309	0.393
		Power Distance	0.743	0.041	-0.422	0.120
		Masculinity - Femininity	0.468	0.001	0.200	0.737

Source: Census Data (2020)

**Table VI – Goodness of Fit**

Type of Analysis	R Square	Adjusted R Square
Model 01	0.739	-
Model 02	-	0.789

Source: Census Data (2020)

## V. CONCLUSION

This study brought evidence of significant impact of Hofstede's cultural dimensions on occupational stress of managerial level employees in hotel industry. Moreover, the impact of power distance could be identified as the most influential factor comparatively.

## VI. MANAGERIAL IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

It is suggested for future researchers to conduct their research on organizational culture with occupational stress in different contexts and to investigate whether cultural dimensions significant in that contexts and different levels of an organization. Moreover, other than the organizational culture it suggested to refer another variable which effect on occupational stress. Present study is based on managerial level employees' (middle management) perspective, it is suggested for future researchers to conduct their studies in the perspectives of superiors. Also, researcher suggests future researchers to carry out on a large scale in the country to find out the impact of cultural dimensions on occupational stress of employees in hotel industry.

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# An Analysis Of The Concept Of Derogation In Regional And Continental Integration: A Case Of Zimbabwe?

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**Abstract-** Africa, like any other continent, has embraced continental integration, to create continental economies of scale in pursuit of sustainable economic growth and development. The notion of resource pooling, collective capacity development, complementary management of resource endowments and indeed creation of internal markets will provide opportunity for creation of a robust African economy, capable of overcoming poverty, unemployment and social distress.

The African development architecture, as created by the founding nationalists, neglects the concept of continental collective capacity development for shared economic performance, enhanced and simplified movement of persons and goods, development of common regional infrastructure, promotion of conducive macroeconomic environment favourable to facilitation of economic development amongst African states.

The recent realisation by Pan-African Institutions, that deeper intra Africa collaboration is possible beyond matters of continental peace and security to engendering macroeconomic convergence a departure from the usual rhetoric of national sovereignty. Research has shown that 80 cents out of every dollar made in Africa is as a result of trade. The realisation that continental integration remains a logical option, came about against a background of efforts to railroad other multi-lateral arrangements with Africa particularly on raw material trade. Progress has been made in creating African regional trade blocs albeit with inherent constraints largely driven by turfism, historical colonial attachments, a leadership gap and general institutional weaknesses in member-states. Of grave concern however, is the general failure of rules-based economic engagements in Africa militating against the vast potential Africa has, to increase intra African trade.

This paper shall cross-examine and engage in an in-depth analysis on the concept of derogation in integration, putting into perspective Zimbabwe's derogation experiences in SADC, COMESA and the CFTA, whilst making comparative scrutiny with cases in other continents. Derogation by nature impacts not only the country seeking the derogation but retards progress with the group that has committed to the cause of the economic cooperation.

**Index Terms-** derogation, continental free trade area, industrialisation, regional integration, bilateral agreements

## I. INTRODUCTION

Zimbabwe is a land linked country located at the centre of Sub Saharan Africa. A modest population of approximately 15million inhabitants, has an averagely developed infrastructure by regional standards. It can be described as a country in immense political dire straits with an economy performing worse than most countries at combat war. Whilst there is generally an outcry on 'economic sanctions' imposed on the country by the west and their allies, a significant number of national challenges faced are self-inflicted resulting in consistent negative economic growth, dwindling per capita incomes, high levels of inflation, very high unemployment and underemployment, poor agrarian sector performance leading to food insecurity of astronomical proportions, foreign exchange shortages, dead economic enablers and public sector decay.

In its medium-term vision, Zimbabwe aspires to be an upper middle-income country by year 2030. It therefore translates to a consistent annual double-digit growth to 2030. The vision statement competently describes indicators and character of an upper middle-income country. These include access to high quality education, health, low levels of unemployment, effective debt management policies, incremental economic growth thresholds, bankability of both fiscal and monetary policy standards, good corporate governance, reporting and accountability, and macroeconomic stability. However, weakening national institutions, unavailability of efficient and correct productive infrastructure for both industrialisation and trade, weak economic enablers and deepening corruption against a crippling national debt are components militating against all the efforts to create a developmental state aspiring to be an upper middle-income country by 2030.

The traditional Zimbabwean economy is agriculture based with the greatest percentage of the population surviving on agriculture related activities. Backward and forward integration in agriculture value chains have been destroyed, particularly those that provided the much-needed sophisticated industrial linkages for value addition and beneficiation. Historically these linkages are associated with excellent agriculture value added and manufactured exports contributing significantly to economic growth.

Trade and investment opportunities existed in services, tourism, horticulture, agricultural commodities and minerals. This extended to elaborate linkages with other sectors particularly

manufacturing, mining and agroprocessing. Industrial development and trade policy mix enhanced Zimbabwe chances of achieving the country's productivity and trade objectives.

Zimbabwe is a member of the WTO, has been a GATT contracting party. Zimbabwe domesticated the WTO agreement to the same status as all treaties the country has entered into with other parties. The country has been a member of the ACP group, the G90, as well as the G33, a member of the AU and its economic community, COMESA, SADC, and the tripartite by virtue of being in COMESA and SADC.

Zimbabwe entered into bilateral arrangements with Botswana, DR Congo, Mozambique, Namibia, Malawi and South Africa among others. Whilst these bilateral arrangements remain in force, the introduction of the SADC Free Trade area toned down these bilateral agreements in some areas. The country was delisted from the US driven AGOA, EPA were negotiated and ratified under ESA and has a trade and investment technical cooperation with China. The country is signatory to Multilateral Guarantee Agency, Overseas Private Investment Cooperation (OPIC), International Convention of Settlement of Investment Disputes, New York Convention on the enforcement of foreign arbitral awards and the United Nations Convention on International Trade Law. Some of these treaties may have fallen on the way side and overtaken by global and continental trade developments

The Zimbabwe constitution guarantees protection of private property. This extends to all the assets acquired under bilateral investment promotion and protection with countries in Africa, Europe, South America and the Middle East. These commitments came under the spotlight during the period of the land seizures, with white commercial farmers winning all the cases heard before regional courts particularly the SADC tribunal.

The chief disconnects between intra -African regional and continental trade and trade between Africa and other multilateral organisation is the inability of Africa to conform to rules-based trading principles. The group of (G7) approach to trade has been traditionally based on a set of key principles on which all member countries agreed to, namely the commitment to fight protectionism and the prominence of the rules-based multilateral trading system, anchored in the WTO (Françoise NICOLAS, Sébastien JEAN 2019) Africa, in particular, is unable to institute trade sanctions on other African countries because of various errors of omission or commission. This becomes an inherent weakness in economic relations of African states.

## II. THE PROBLEM

There is a nexus between economic performance, competitiveness as well as macroeconomic stability and country competitiveness in both regional and continental integration. National competitiveness is achieved through national collective energies harnessed across national economic sectors deployed to develop an exclusively competitive Zimbabwean economy. The collective effort is ordinarily government led. Government leadership is demonstrated by provision of national engagement platforms assuring all stakeholders that the government has genuine commitment to creating a robustly competitive Zimbabwe. Whilst Zimbabwe plays a significant role in creating both regional and continental integration frameworks (at both secretarial and strategic levels) the country remains inherently

weak in national trade and industrialisation capacities. The IMF notes with concern that weak financial reporting in the Zimbabwean government persistently erodes economic confidence Sharing of financial information among government ministries to enhance public sector coordination and organisation stands out as a factor in the lack of financial accountability in local authorities and all state-owned enterprises. The integrity of critical national statistics and public information is put under spot light particularly as it relates to unrestrained use of statutory instruments, imposition of subsidies, budget overruns, and liability management.

Creation of conditions for market failure in country sends erroneous signals to external markets. Role clarity and misplaced national priorities in Zimbabwe is and elephant in the leaving room, lending all economic policies ineffective. Repeated Loss of value of investments, pensions and other national assets deepens uncertainty coupled with growing institutionalised corruption. A compromised monetary regime, crippling national debt contribute to the assessment that Zimbabwe is an extremely high-risk investment destination. Generally, SADC recognises that attracting foreign direct investment is competition among the member states in sub-Saharan Africa as well as with other nations throughout the globally SADC further recognises that A stable political and macroeconomic environment, favourable investment and trade regulations, quality economic infrastructure, qualified human capital base, and a transparent legal system is a necessary and sufficient condition. Integration of the national markets into an expanded regional market with a higher level of liquidity; and A harmonised investment regime subtends a credible macroeconomic environment. Consequently, Zimbabwe's Investment share continues to drop compared to other countries in the region. Countries such as Angola, DRC, Botswana and little Lesotho continue to do well in investment attraction. Company mortality rate in Zimbabwe is at its all-time high and all businesses continue to operate in survival mode. The country cannot access or borrow offshore because a bad repayment record among other effects.

One therefore develops enthusiasm to evaluate whether there is any merit in Zimbabwe seeking repeated derogations in regional and continental integration. Zimbabwe continues to fair lowly in regional growth statistics in SADC and COMESA. Repeated denial of the country being highly indebted and poor, disrespect of most of its bilateral and multilateral commitments continues to militate against the country's potential for full competitiveness. Will derogation assist in restoring the county's opportunities for regional integration.

Finally, the country continues to ascend to all regional and continental integration protocols most of which have a negative impact on national revenue performance particularly trade related duties and taxes. Further, according to the confederation of Zimbabwe industries, capacity utilisation in the manufacturing sector remain constrained and focus tend to show a consistent trend till 2027 unless a robust strategy to deal with the performance of economic enablers is implemented. Generally, Zimbabwe is complicit in domesticating regional policies. Domestication of regional and continental policies ensures harmonisation of regional trade regimes. Zimbabwe requested for a derogation from the AfCFTA for 15 years. Is repeated derogation the solution?

### III. METHODOLOGY

This paper shall engage with trade experts, writings of trade economists, regional economic communities in and out of Africa to interrogate the concept of trade derogation. Best practice and case studies shall enhance the researcher to provide a critical analysis on whether Zimbabwe has optimally utilised the derogation concept in its pursuit to recalibrate the Zimbabwean economy for regional competitiveness.

Regional and continental integration aspires to increase intra and interregional trade. Member states are at different levels of growth and size. The study will also incorporate various trade protocols which were entered into and ratified by member states, tariffs liberalisation and the systems of nontariff barriers as it relates to reciprocity in integration. The study will then provide a qualitative evaluation of the impact of derogations in implementation of trade liberalisation and ascertain whether derogation is an appropriate tool employed by member states in seeking a waiver to deal with potential inherent constraints they face in participating in integration processes.

### IV. RESEARCH QUESTIONS

Is regional and continental integration advantageous to Zimbabwe?

Does regional or continental integration enhance the economic wellbeing of Zimbabwe?

Has derogation assisted Zimbabwe for reintegration?

Is Integration Derogation effective where rules-based trade relations, reciprocation and national sovereignty play a central role?

#### Hypothesis

Regional integration derogation is not significantly beneficial to Zimbabwe

#### Objectives

- To evaluate whether Zimbabwe derives direct or indirect benefits in regional and continental integration.
- To ascertain whether regional and continental integration are purely an economic phenomenon to Zimbabwe
- To provide an analysis of whether the current phase of derogation has enhanced Zimbabwe's opportunities in reintegration
- To provide an in-depth evaluation of Integration Derogation, rules-based trade relations, reciprocation and national sovereignty as they relate to regional and continental integration

### V. CONCEPTUAL FRAMEWORK

Regional and continental integration derogation is not a solution to fixing inherent macroeconomic weaknesses of a country. Derogation implies seeking more room for a country to reorganise its priorities in line with its existing capacities and abilities. Conceptually, the multiplicity of activities largely undertaken during periods of derogations do not justify seeking of derogations by countries. Derogations are a delaying tactic to pursue protectionism and retard the process of regional or

continental integration. The question that is often asked is whether the benefits of given derogation are outweighed by the effects missing out on positive advantages derived from remaining in integration.

The researcher shall study relevant literature and engage experts to extrapolate facts about the subject particularly economic analysis of the rationale for integration.

#### Background to Zimbabwe's Application

the prevailing deteriorating macro-economic conditions in Zimbabwe, e characterized by low production capacity; inflationary pressures, coupled with low economic growth rates; shortage of cash specifically the USD which has necessitated the existence of a dual-currency system; and so, called sanctions impacting on Foreign Direct Investment and foreign currency reserves justified the request for integration derogation. The application was made in 2017.

#### Trade Deficits?

The last decade has seen Zimbabwe failing to manage the delicate relationship of the trade balance with Zimbabwean exports far less than its imports, resulting in sustained trade deficit. The country remains a net importer of all critical goods and services. Whilst efforts to promote local procurement, consumption of locally produced goods and services through buy local initiatives, the country's productive capacity remains constrained, coupled with suppressed quality standards and the cost of these goods are at their all-time high. Exogenous and endogenous factors have been identified as causes of Zimbabwe's inability to eclipse the trade balance i.e reduction of imports and achieving increased manufactured exports. The dependence on primary product exports continues to retard progress in industrialisation undermining the ability of the country to exploit benefits of value addition and beneficiation particularly mining and agricultural products. Conversely, the greatest percentage of Zimbabwean imports are finished products, giving credence to the perception that the country has turned into a regional supermarket and dumping ground for low quality products. The World Trade Organisation recognises the existence of Dumping and it allows within its rules, a government to put protective measures to "act against dumping where there is genuine 'material' injury to the competing domestic industry" Anti-dumping tariffs are an option. Ad valorem, specific, variable and lesser duties are normally charged to correct dumping.

Economists agree that "Improvement in export policy is critical, value addition to exports, market fetching through regionalism and import substitution is essential to manage the trade balance" With this state of affairs, would regional and continental integration be beneficial to Zimbabwe?

#### Top Exports and Top Imports for Zimbabwe 2016

##### Top Exports

- Gold (\$896M),
- Raw Tobacco (\$383M),
- Diamonds (\$206M),

- Ferroalloys (\$163M)
- Nickel Mattes (\$149M),

**Top imports**

- Refined Petroleum (\$1.19B),
- Corn (\$285M),
- Electricity (\$162M),
- Packaged Medicaments (\$158M)
- Delivery Trucks (\$114M).

Source: OCD, 2018

**Top Exports Destinations and Top Imports Origin for Zimbabwe 2016**

**Top Exports Destination**

1. South Africa (\$1.31B),
2. Mozambique (\$267M),
3. United Arab Emirates (\$216M),
4. China (\$134M),
5. Belgium-Luxembourg (\$102M).

**Top Imports Origin**

1. South Africa (\$2.21B),
2. Singapore (\$1.02B),
3. China (\$380M),
4. India (\$170M),
5. Zambia (\$170M).

**Findings and discussions**

Africa union developed a long-term vision, Agenda 2063, objectively to create a coherent Africa capable of self-sustenance, economically, politically and socially integrated. The 2063 agenda, is expected “to elucidate critical issues underpinning its successful implementation, ensure its strengths and weaknesses are interrogated, ways of dealing with persisting challenges are crafted. Continental cohesion is achieved through a number of thematic areas which include, the Agenda 2063 and African Integration, socio-economic aspects of Agenda 2063 and the political philosophical basis of the agenda. There is general acknowledgement that this agenda provides an excellent vision for African countries and African people to consolidate African emancipation. Further, the vision is expected to enhance a broad-based bottom-up participatory approach, and advocates for inclusion and empowerment of all groups of people. Inherent

weaknesses still exist with potential impact “that the agenda 2063 is likely to be confronted by the same or similar setbacks which prevented previous African long-term plans from achieving significant results. These include limited finances, lack of ownership, lack of political will, diverse and sometimes conflicting interests, and lack of ideological backup to sustain the vision” It therefore calls for integrity of leadership to craft adequate measures to overcome these challenges.

An evaluation of agreed SADC tariff modalities

The recent SADC Summit adopted tariff modalities tabulated below that would be used by state parties (those that have ratified) to develop tariff offers. These tariff offers will be the basis upon which goods will be traded among the state parties withing the SADC FTA.

	Non –LDCs	LDCs	Timefram e: Non-LDCs	Timefram e: LDCs (SDT)
<b>Non sensitive products</b>	90 percent	90 percent	5 years	10 years
<b>Sensitive Products</b>	7 percent; Subject to Notification and Negotiations ; Method of Negotiation: Request and Offer.	7 percent; Subject to Negotiations ; Method of Negotiation: Request and Offer.	10 years	13 years
<b>Exclusion List</b>	3 percent; Review after 5 years; subject to negotiation; Subject to anti-Concentration Clause.	3 percent; Review after 5 years; subject to negotiation; Subject to anti-Concentration Clause.		

**Transition Period**  
Tariff phase down shall be in equal installments i.e., Linear Approach.

**Supplementary Modality**  
Member States may complement the linear approach with request and offer approach.

**Variable Geometry**

Member States who may wish to make deeper cuts within a shorter time period may do so, on the basis of reciprocity.

Zimbabwe is developing its tariff offer under the category of Non- LDC countries whereby non sensitive products (90%) will be phased over 5 years and sensitive products (7%) over 10 years. The remaining 3% will be excluded from liberalisation. The Non-LDC status of Zimbabwe continues to be debatable. Whilst the integrity of the argument and statistics used to sustain the argument that Zimbabwe is a Non- LDC country further controversial declaration that Zimbabwe is not a poor country and highly indebted.

For Zimbabwe, the classification of each category in terms of the agreed thresholds are in table 2

	THRESHOLDS	TARGET TARIFF LINES
<b>TOTAL TARIFF LINES</b>		6 377
<b>NON-SENSITIVE LIST</b>	90%	5 738
<b>SENSITIVE LIST</b>	7%	447
<b>EXCLUSION LIST</b>	3% (Not more than 10% of import value from Africa (2014-2016 or 2015-2017)	192

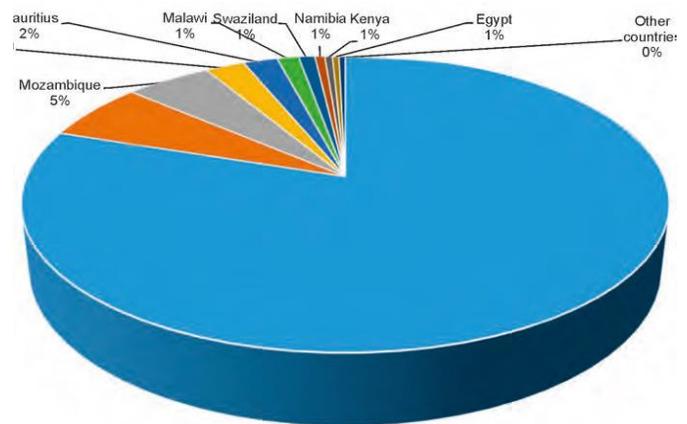
Given its application under SADC, Zimbabwe together with 6 other countries now as the G7 requested for a phase own period of the non-sensitive products according to the agreed modalities. During the 2019 Summit all member states agreed to implement this according to the adopted tariff modalities.

According to the CZI in the 2019 manufacturing sector survey, the country’s unenviable trade balance position is an indicator of a deficiency of country competitiveness. The doing business index provides direction to which the country must take, ensuring prioritisation and streamlining of planning for national competitiveness. Supply side constraints coupled with foreign money shortages are weighing heavily on the country’s ability to increase manufactured exports. The survey further acknowledges that Zimbabwe’s exports are largely driven by mineral products, them being predominantly unprocessed. Zimbabwe ratified the AfCFTA, in March 2019 amid high expectations that the bigger market shall usher in an opportunity for Zimbabwe to be part of continental value chains. Downstream benefits will incorporate increased productive capacity, quality of products and improved logistics.

Of grave concern to CZI, are the big elephants in the living room. The currency issues remain unresolved to date though some levels of stability have been obtaining in the last four months.

Huge National debt in excess of 40% of GDP and the country’s ability to extinguish this debt, particularly where the country continues to contract more local and foreign debt is worrying. Endemic corruption and political polarisation are militating against the country’s ability to locate itself at the centre regional and continental exports growth. It therefore gives credence to the proposition why Zimbabwe must invest in national competitiveness rather than seeking repeated derogations.

ZEPARU, in its paper on the assessment of Zimbabwe’s trade performance within the context of regional integration, studied the extend of liberalisation and commitments undertaken under various trading blocs, the impact of Zimbabwe’s trade policy regime, strengths and weaknesses of local institutions, human capital, and Zimbabwe’s capacity to fully exploit the integration program. The country has ratified a number of bilateral and multilateral arrangements commitments of which have a direct effect on the country’s competitiveness. Liberalisation under SADC, COMESA, the TFTA, IEPA and the AfCFTA opens up the country to competition in country whilst its capacity to exploit the bigger market outside is compromised. Zimbabwe is signatory to the ACP trade grouping, ratified EPAs under ESA. The interim EPA was ratified in 2012.



**Zimbabwe’s import sources from the TFTA countries**

The study concluded that Zimbabwe is currently not competitive due to a number of factors. These factors are internal and takes the government to introspect into the broad macroeconomic environment to ensure necessary policy mix for national competitiveness is instituted.

The European centre for development policy management engaged in a comparative study of ECOWAS and SADC economic partnership agreements.

*“In terms of product coverage, ECOWAS will liberalise 75% of its tariff lines, based on its common external tariff, over a period of 20 years. The list of exclusion covers a wide range of products, ranging from agricultural goods to industrial goods. It is meant to ensure that local industries will not be subject to competition from duty-free products from Europe. Regional unity and strong political leadership have proved very useful”*

*“The SADC EPA negotiating group comprises seven member states. These are Botswana, Lesotho, Namibia, Swaziland and South Africa, as well as Mozambique and Angola. While Angola was part of the negotiations, it did not conclude the EPA. Prior to the EPAs, South Africa’s trade was covered by a different*

regime, the Trade and Development Cooperation Agreement, concluded in 1999. South Africa joined the EPA negotiations to improve its market access to the EU and to ensure functional coherence of the Southern African Customs Union (SACU), a customs union, of which it is the largest member. The current market access schedule of the SADC EPA group consists of a single offer for the five SACU countries, based on SACU's Common External Tariff (CET) and a separate offer for Mozambique, which is not part of the SACU. As a group, the SADC EPA group is expected to liberalise 80% of its trade with the EU" The paper concluded that political will is an integral attribute to achieve coherent regional integration. A natural phenomenon is that trade between Europe and Africa has minimal challenges. EU – Africa relationship continue to deepen trade ties particularly where EU continues to finance African markets development.

According to a technical report by the Southern Africa Trade hub of June 2011, on the impact of derogations from implementation of the SADC FTA Obligations on intra – SADC trade, Tanzania and Zimbabwe had requested to impose duty on selected sugar products and a two-year suspension on tariff phase down schedule category C respectively. The Southern The SADC Protocol on

trade covers provisions, on tariff phase-down schedules for each SADC Member State, which was to be completed by 2012.

"Article 3(1)(c) of the Protocol states that "Member States that have been adversely effected by the removal of tariffs ... may be granted a grace period to afford them additional time for the elimination of tariffs and (NTBs)"

The paper notes that trade in SADC outside South Africa to be affected by the derogation request was insignificant particularly where these derogations are implemented for a limited period of time. Market access opportunities are insignificantly affected by these derogations particularly for small economies in SADC. enforcement and approval of derogations run the risk of compromising trade in SADC because there is hardly an enforceable mechanism to police compliance with derogation.

For the purpose of this study, "smaller economies" are countries classified by the World Bank as low-income (GDP of US\$ 995 or less) and as lower-middle-income (GDP between US\$ 996 and US\$ 3,945). Based on this definition, SADC economies fall into the following categories:

**Smaller Economies**

**Low-income**

- Congo, Democratic Rep.
- Madagascar
- Malawi
- Mozambique
- Tanzania
- Zambia
- Zimbabwe

**Lower-middle income**

- Angola
- Lesotho
- Swaziland

**Other Economies**

**Higher-middle income**

- Botswana
- Mauritius
- Namibia
- South Africa
- Seychelles

Source: world bank

Despite the necessity of intra trade derogations allowed in the protocol, tariffs of goods under derogations among others, the "indexes of revealed comparative advantage" derogation poses insignificant impact on overall SADC trade. This is mainly due country and trade size, the number of products lines affected by

the derogations, availability of alternative product producers in the region, and the period of derogation implementation. The concept of reciprocity is also invoked where there is perceived to deliberate disrespect of the set principles of the protocol.

**Gross Domestic Product Annual Real Growth Rates (%) in SADC. 2009-2019**

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Angola</b>	0.8	5.2	4.1	8.8	5	4	0.9	0	0.7	-1.1	-0.9
<b>Botswana</b>	-7.7	8.6	6	4.5	11.3	4.1	-1.7	4.3	2.9	4.5	3
<b>Comoros</b>	3.2	3.8	4.1	3.2	4.5	2.1	1.1	2.3	2.5	3.3	2
<b>DRC</b>	2.9	7.1	6.9	7.1	8.5	9.5	6.9	2.4	3.7	5.8	4.4
<b>Eswatini</b>	1.6	3.8	2.2	5.4	3.9	0.9	2.3	1.3	2	2.4	1.6
<b>Lesotho</b>	2.2	6.7	5.4	6.7	4.2	2.9	2.7	5	-1.3	-0.5	-0.8

<b>Madagascar</b>	-4	0.6	1.6	3	2.3	3.3	3.1	4	3.9	4.6	4.4	
<b>Malawi</b>	7.5	6.9	4.9	-0.6	6.3	6.2	3.3	2.7	5.2	3.9	5.2	
<b>Mauritius</b>	3.3	4.4	4.1	3.5	3.4	3.7	3.6	3.8	3.8	3.8	3	
<b>Mozambique</b>	6.4	6.5	7.4	7.3	7	7.4	6.7	3.8	3.7	3.4	2.3	
<b>Namibia</b>	0.3	6	5.1	5.1	5.6	5.8	4.5	-0.3	-0.3	0.7	-1.1	
<b>Seychelles</b>	-0.2	5.9	5.4	3.7	6	4.5	4.9	4.6	4.4	3.8	4.7	
<b>South Africa</b>	-1.5	3	3.3	2.2	2.5	1.8	1.2	0.4	1.4	0.8	0.2	
<b>Tanzania</b>	5.4	6.3	7.7	4.5	6.8	6.7	6.2	6.9	6.8	7	7	
<b>Zambia</b>	9.2	10.3	5.6	7.6	5.1	4.7	2.9	3.6	3.7	4	1.4	
<b>Zimbabwe</b>	12.6	19.7	14.2	16.7	2	2.4	1.8	0.8	0.8	4.8	2.3	
<b>SADC-Average</b>	0.2	4.5	4.2	4.5	4	3.5	2.2	1.5	2.1	1.9	1.4	

Source: SADC selected Economic and Social Indicators (2020)

#### SADC (EAP group)

Tanzania was on schedule with its tariff commitments, the Government applied for derogation to levy a 25% import duty on sugar and paper products until 2015 in order for the industries to take measures to adjust. Tanzania has made a request for derogation for its paper industry to support it in achieving required economies of scale and to successfully compete in international markets. Mozambique-Mozambique obtained a derogation on shrimp and lobster. Namibia obtained an automatic derogation of 800 tons for preserved tuna (HS 1604, 0302, 0304).

In COMESA, Swaziland Derogation had been granted not to implement the COMESA FTA in recognition of the fact that Swaziland is required to maintain the Common External Tariff of the Southern Africa Customs Union (SACU)

#### European Integration Experience

Europe underwent multiplicity of experiences in ensuring maintenance of a cohesive integrated group. Brexit is but one of the many integration weaknesses experienced to date, with Britain opting out because of a number of economic challenges the country was undergoing. Whilst on one hand Europe is frantically signing up economic partnership agreements with the world, Britain took a bold step to exit the European union.

Robust internal national conversation on the merits and demerits of Brexit took place, particularly on areas of economic advantages/ disadvantages, national interest and national sovereignty, benefits accruing to Britain in European union

integration and indeed whether London would lower its leaving standards by exiting the EU group. According to Robert Fay (2019) the integration of Britain into the EU was “never really about supposed European Union control over the United Kingdom or about Britain’s inability to set its own destiny without the encumbrance of myriad rules and regulations mandated by the European Union, Rather, it was a lightning rod for an intertwined set of long-simmering issues that have plagued the UK economy: stagnant incomes as a result of languishing productivity growth — it has essentially not risen in a decade — which the chief economist of the Bank of England, Andrew Haldane, notes is “almost unprecedented” in the modern era; the regional divide, in part brought on by trade and deindustrialization; rising inequality; inadequate funding for welfare programs and the National Health Service; and so on”. United Kingdom took a position which undermined global consensus that the more integrated countries are the better the opportunities and economic fortunes for the members of the integration.

#### Europe and Differentiated Integration

Europe continues to debate on the concept of differentiated integration. Despite the drive by non-member states of the EU to implement “European Union (EU) rules as exemplified by the European Neighbourhood Policy” The certainty of differentiated integration remains under the spot light. Broadly the concept of differentiated integration involves “opting-out and inducing-in. In the case of opting-out, EU member states can refrain from

adopting EU rules; inducing-in refers to providing non-member states with incentives to adopt EU rules”

On the other hand, there are some schools of thought which believe the European Union is important albeit with some inherent challenges. They believe fixing these challenges is the most optimal option considering the milestones already covered particularly as it relates to collective effort in confronting the challenges around streamlining EU wide business processes, engendering the digital market and ensure the future economic prosperity of the EU union region.

Despite the broad criticism, Europe still enjoys the support of 66 percent of member states. It is a fact that the EU is experiencing substantial challenges, Brexit being one of them. The rise of nationalism and populism has also posed a major hurdle and collective energies to deal with these is key. Intra and inter EU trade has fast been growing and this is credited to managing red tape and bureaucracy. Businesses find this to be critical in facilitating trade and investment. Big data management is also a critical economic management tool necessary for sustainable integration. Countries such as America and China have installed capacity for efficient management of big data for use by economic players. The EU General Data Protection Regulation (GDPR) gave impetus to the region and has enormous potential to positively impact trade and investment in the EU.

## VI. DEROGATION EXPERIENCES IN THE EU

While in the previous rules of origin the provisions on derogation were applicable only to Least Developed Countries, (LDCs), the current rules of origin extend the possibility of derogation to developing countries. Cyprus requested for Temporary derogation, Cambodia and Nepal derogation for textile products, Denmark and the United Kingdom, it is a permanent derogation and these states are not obliged to join the European Monetary Union and Sweden was given temporary derogation for the use of the Euro as a domestic currency.

The 2018 Convergence Report covers seven Member States with a derogation and these include Bulgaria, the Czech Republic, Croatia, Hungary, Poland, Romania and Sweden. Major issues emanating from these derogations include:

**Bulgaria-** currently fulfils three out of the four economic criteria necessary for adopting the euro: the criteria relating to price stability, public finances and long-term interest rates. Bulgaria does not fulfil the exchange rate criterion and legislation in Bulgaria is not fully compatible with the Treaty.

**Czech Republic:** currently fulfils two out of the four economic criteria necessary for adopting the euro: the criteria relating to public finances and long-term interest rates. The Czech Republic does not fulfil the price stability and exchange rate criteria and legislation in the Czech Republic is not fully compatible with the Treaty.

**Croatia:** currently fulfils three out of the four economic criteria necessary for adopting the euro: the criteria relating to price stability, public finances and long-term interest rates. Croatia does not fulfil the exchange rate criterion. Legislation in Croatia is fully compatible with the Treaty.

**Hungary:** currently fulfils two out of the four economic criteria necessary for adopting the euro: the criteria relating to public finances and long-term interest rates. Hungary does not

fulfil the price stability and exchange rate criteria and legislation in Hungary is not fully compatible with the Treaty.

**Poland:** currently fulfils two out of the four economic criteria necessary for adopting the euro: the criteria relating to price stability and public finances. Poland does not fulfil the exchange rate and long-term interest rate criterion and legislation in Poland is not fully compatible with the Treaty.

**Romania:** currently fulfils one out of the four economic criteria necessary for adopting the euro: the criteria relating to public finances. Romania does not fulfil the price stability, exchange rate and long-term interest rate criteria and legislation in Romania is not fully compatible with the Treaty.

**Sweden:** currently fulfils three out of the four economic criteria necessary for adopting the euro: the criteria relating to price stability, public finances and long-term interest rates. Sweden does not fulfil the criteria related to the exchange rate and legislation in Sweden is not fully compatible with the Treaty.

Furthermore, the review of other factors shows that the countries examined are generally well integrated economically and financially in the EU. However, some of them still experience macroeconomic vulnerabilities and/or face challenges related to their business environment and institutional framework which may pose risks as to the sustainability of the convergence process. Regional Economic Communities in Africa

Continental integration is REC driven. The Tripartite is a cooperation of SADC, COMESA and EAC (The Common Market for Eastern and Southern Africa; the East Africa Community and the Southern African Development Community) According to EAC, the Tripartite Comprises of 26 member countries, formed for the purposes of accelerating economic integration for the people of the Eastern and Southern African Region. EAC further highlights that the tripartite supreme objective is to contribute to the broader objectives of the African Union that is accelerating economic integration of the continent and achieving sustainable economic development leading to poverty alleviation and improvement in quality of life for the people of the Eastern and Southern African Region. Despite the Tripartite integration’s weaknesses, it instructed the formation of the AfCFTA. Lessons learnt from this initiative provided guidance to the creation of the continental integration initiative. Africa has 8 Regional Economic Communities (RECs) and sub-regional bodies which are the building blocks of the African Economic Community established in the 1991 by the Abuja Treaty. The treaty provides the overarching framework for continental economic integration.

- The Arab Maghreb Union (AMU/UMA) External Link in the north,
- The Economic Community of West African States (ECOWAS) External Link in the west,
- The East African Community (EAC) External Link in the east,
- The Intergovernmental Authority on Development (IGAD) External Link also in the east,
- The Southern African Development Community (SADC) External Link in the south,
- The Common Market for Eastern and Southern Africa (COMESA) External Link in the southeast,
- The Economic Community of Central African States (ECCAS) External Link in the centre, and

- The Community of Sahel-Saharan States (CENSAD)  
External Link in the north.

**Source: African Union**

The foundation and Building Blocks for the African Union are its RECs principally to constitute capacity for economic integration in Africa, but are also key actors working in collaboration with the African Union (AU), in ensuring peace and stability in their regions (AUC). Further the RECs have been central to various transformative programs of the continent, including the New Partnership for Africa's Development (NEPAD) adopted in 2001, and the AU's Agenda 2063 adopted by its Summit in January 2015. The First Ten-Year Implementation Plan was adopted by the 25th Summit of the AU heads of state and government in June 2015.

Whilst peace and security are important in continental economic development, "RECs have the immense challenge of working with governments, civil society and the AU Commission in raising the standard of living of the people of Africa and contributing towards the progress and development of the continent through economic growth and social development"

## VII. RECOMMENDATIONS

Regional and continental integration in Africa is a "nice to have". Macroeconomic conditions of member states vary. African countries have varied levels of Vulnerabilities caused by international factors and by local factors. These vulnerabilities are the basis for the complexities in regional economic relationships among countries in Africa. State leadership in creating developmental states in African is weak particular with the prevalence of politically induced uncertainty on the rise. African leaders are vulnerable to strong national institutions in their states. They believe in creating strong men and women who are politically sensitised to safeguard and consolidate their leadership political power at all costs. The study therefore elaborately exposes a number of weaknesses in African states governance systems leading to the below recommendations:

1. Seeking Derogation in regional and continental integration is basically acknowledgement that Zimbabwe has a deficiency or a gap in readiness to implement agreed integration milestones. Countries in Africa, Zimbabwe included, have a general tendency of ascending to agreements which they are not bound by. It is therefore important to avoid signing up to these multilateral and bilateral arrangements when the conditions in country are suboptimal to comply with and not in the best interest of the country.
2. Over Dependency on taxation alone demonstrates the lack of fiscal innovation by Zimbabwe. Whilst rationale taxation is acceptable, Zimbabwe continues to destroy the ability of productive sectors to create trade related capacity because they are overtaxed. To achieve optimal growth, streamlining tax heads in line with desired economic growth targets has a knock-on effect on tax voluntary compliance, simplification of revenue collection and eradication of corruption.
3. Creation of local infrastructure for trade and industrialisation increases national competitiveness.

Deploying resources to achieve national productivity naturally sets up the country for regional, continental and global competitiveness. The over-all national aspiration (vision 2030) is to create economies of scale to satisfy the demand of the bigger market.

4. National stakeholder participation in designing solutions to matters affecting economic activities is crucial for holistic buy-in and ownership. Zimbabwe Government has a tendency to govern by divide and rule, resulting in restrictions to national coherence. Economic players, academia, labour and civil society are development partners in a nation and are partners to the government of Zimbabwe. They play a significant role, not only in ensuring checks and balances on the state but they facilitate operationalisation of government policies at local, regional and continental levels. Public-private dialogue (PPD), though very weak in Zimbabwe, plays a vital role in facilitating collective efforts to achieve defined national targets.
5. Human capital development strategies answer to the question of relevant skills mix in keeping with achieving set national economic goals. Zimbabwe, among Countries which invest in education, entrepreneurship and innovations has harvested from huge banks of knowledge relevant solutions to national economic, social and political challenges. Zimbabwe national leadership, sadly is intimidated by highly trained and educated people particularly in areas of business and politics.
6. National introspection is necessary to ensure the integrity of national economic statistical data for futuristic planning as well as candid evaluation of the existing economic macroeconomic conditions. Zimbabwe, like many Countries in Africa, which survive on perennial denial of their inherent national macroeconomic and political problems, are prone to repeated derogations because national economic data is inaccurate to give impetus to objective decision making. Robust structural transformation is necessary to warrant harmonisation of industrialisation and trade strategies. Synchronisation of trade and industrial policies is imperative for economic convergence.
7. A whole government approach to development of an economic marshal plan is an immediate necessity. Competition for individual or sectorial recognition continues to dampen role clarity, complementarity and support in meeting desired national economic objectives.

## VIII. CONCLUSION

The paper qualitatively argued that Zimbabwe, despite the derogation requests, has weak economic fundamentals necessary for effective exploitation of regional and continental opportunities. The country would emerge weaker if all pre-requisites of the SADC FTA, COMESA and the AfCFTA are genuinely implemented particularly the tariff phase down. There are no direct benefits accruing to the country as a result of the introduction of the bigger market precisely because Zimbabwe has no installed capacity for value added exports, is a high-cost

producer in the region, and has very low product standards among other weaknesses.

For Zimbabwe, Regional integration is not purely an economic phenomenon. Historically, the country has failed to harmonise and domesticate regional policies and laws to facilitate smooth integration. The effect of the SADC Tribunal is a case in point. Further, the country cannot respect its own laws particularly on property rights, rule of law and commitment to existing bilateral and multilateral arrangements. No meaningful progress has been made in improving ease of doing business despite the rhetorical and hollow open for business mantra. Like most African countries, weak economic governance institutions in country are militating against concerted efforts to boost investor confidence and achieve inclusive growth.

The current regime of national policies has led to the destruction of critical productive assets in mining, manufacturing and agro processing particularly where fiscal and monetary instruments lead to erosion of investments, savings and confidence. This state of affairs makes the country, not only uncompetitive but unsuitable for any integration efforts because of the uncertainties surrounding payment systems and valuation of assets.

The existing derogations have not helped the country in any way because macroeconomic conditions have not improved to have a knock-on effect on regional competitiveness. In actual fact, the country continues to miss out on all macroeconomic targets. The transitional stabilisation policy reports significant shortfalls in achieving its intended objectives save for the recent currency and exchange rate stability. Capacity utilisation in manufacturing sector is likely to reduce further according to the 2019 CZI manufacturing sector survey, disinvestment in the mining sector continues as evidenced by the Karo resources platinum project stagnation, supply side constraints remain a serious threat to company survival and national debt is at its all time high. The country will potentially seek a further extension due to lack of preparedness.

The Zimbabwe economy is not as complexly diversified. Drivers of growth are few, with mining sector occupying the lead position in the last financial year. Trade in services is driven by tourism for which product has been negatively affected by the covid19 pandemic. No New growth nodes potential currently exists. It therefore translates to potential negative growth beyond 2021. Any future attempts to reintegration beyond the current derogation period will not give any positive results unless wholesome changes are undertaken to improve national competitiveness.

Bold reforms are needed in African integration. African countries dislike the concept of rules based economic engagements. Committing to economic integration agreements remains academic particularly where their rhetoric of protecting national interest. Zimbabwe falls in the same category and risks other countries invoking reciprocity to counter the effects of bad domestic economic policy. Use of statutory instruments in the last two financial years has seen the removal of a number of products from the Open General Import Licencing, affecting most products in SADC FTA protocol. Belonging to a number of different trade blocs complicates implementation of trade requirements. WTO rules on most favoured nation (MFN) unlocks market access in all bilateral and multilateral arrangements by Zimbabwe. This has

likelihood to weaken the fluidity of regional integration. Cherry-picking preferred and favourable trading regimes in either COMESA, SADC and the EU among others, may induce instability in complying with trade requirements particularly when Zimbabwe continues to undergo inherent macroeconomic challenges as a consequence of bad economic governance. The paper has managed to provide an in-depth evaluation of Integration Derogation, rules-based trade relations, reciprocation and national sovereignty as they relate to regional and continental integration.

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# Crime Prediction and Analysis System

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**Abstract** - Crimes are one of the major threats to society and also for civilization. The traditional crime solving techniques are unable to live up to the requirement of existing crime scenarios. Crime analysis is one of the most important activities of the majority of the intelligent and law enforcement organizations all over the world. The purpose of this study is to build a solution to support the criminal investigation process by providing a technological analysis in justifying criminal cases. This study gives guidelines to crime pattern detection, crime predictions and crime judgement suggestion processes. The feasibility of using machine learning techniques to build such platforms has been explored before. The vast geographical diversity and the complexity of crime patterns have made the analyzing and recording of crime data more difficult. Data mining is a powerful tool that can be used effectively for analyzing large databases and deriving important analytical results. The implemented system is a solution to be used in intelligent crime analysis, predictions systems which is designed to overcome the above-mentioned problems. The goal was to analyze the past crime data and past text case summaries and build applications to analyze which will support the investigation process in a wide range of angles to decision making.

**Keywords-** Machine Learning, Lstm, Data Mining, PowerBI, Firebase, Real time Analytics, Visual Analytics, Visualization, Criminal Cases

## I. INTRODUCTION

Introducing a 'CCMiner' which includes Crime predictions, Crime pattern analysis along with analysis of case documents in identifying patterns from past case summaries to support in making judgements. This can be approached in a more analytical point of view where a technological solution would help to find solutions for unsolved investigations, and support in decision making for the upcoming cases filed. Since Sri Lanka is a country that used outdated investigation methods and faces frequent problems, this system can be used to minimize certain circumstances. The final system is specially targeted to be used by a responsible person who carries out criminal investigations. This can be used as a package for criminal investigators which help their investigation process.

One of the most unfair situations is giving incorrect judgment for criminals and other legal matters. The average of grave crimes recorded from 2010 to 2018 in Sri Lanka, according to crime statistics reports released by Sri Lankan Police, is 45962. Percentage of crime increase in the past 3 years is 47.46%. Since, advanced technologies are used for

crimes presently, investigation of crimes is not an easy task as in the 20th century. Sri Lankan crime statistics show that many of the crimes are pending on investigation. This gives us some bad impression of the investigation system of our country. The average of pending investigations from 2010 to 2018 is 31798. It is 70.31% of the average of recorded grave crimes with pending cases.

The remainder of this research paper will describe the requirements of the implemented crime prediction and analysis system overall description of them and their perspectives and functionalities. Furthermore, it will discuss performance requirements, design constraints, technological approach and Methodology of the component. Crime pattern detection and Crime judgment suggestions. This research paper also gives a detailed description of the implemented system and it will explain background information and overview of previous work based on literature survey, identification and significance of the problem, research questions, objectives, hardware and software requirements, detailed research methodology, sources for test data analysis, anticipated benefits, what the system will do the constraints under which it must operate in order to obtain optimal results and how the system will interact with the external factors.

## II. RELATED WORK

High or increased crime-levels make communities decline, as crimes reduce house prices, neighborhood satisfaction, and the desire to move in a negative manner [1]. To reduce and prevent crimes it is important to identify the reasons behind crimes, predict crimes, and prescribe solutions. Due to large volumes of data and the number of algorithms needed to be applied to crime data, it is unrealistic to do manual analysis. Therefore, it is necessary to have a platform which is capable of applying any algorithm required to do a descriptive, predictive, and prescriptive analysis on a large volume of crime data. Through those three methodologies, law-enforcement authorities will be able to take suitable actions to prevent crimes. Moreover, by predicting the highly likely targets to be attacked, during a specific period of time and specific geographical location, police will be able to identify better ways to deploy the limited resources and also to find and fix the problems leading to crimes.

Regional crime analysis program and law enforcement data management systems are already developed for crime analysis [2] [3]. Most of these tools are developed to help the police to identify different crime patterns and even to predict criminal activities. They are complex software which

needs a lot of training before use. Designing a tool which is easy to use with minimal training would help law-enforcing bodies all around the world to reduce crimes.

Hence humans are incapable of comprehending with millions of data Hazwani et al. came up with a powerful computer-based system [4] which are able to predict crimes. This research identifies current implementations of crime prediction methods and the possibility to enhance it for future work. This is implemented using a support vector machine, fuzzy theory, artificial neural network and also multivariate time series. By using these models, the prototype got able to find out some helpful information but unfortunately there is no standard model that can solve the problems in different data sets. At the end of their finding Hazwani et al. report on results of an extensive comparison of crime prediction models. This got able to compare different crimes and show the capabilities of different crime prediction models but unfortunately Hazwani et al. didn't get able to develop this as an application level outcome.

In India Yadav et al. came up with a Crime Pattern Detection, Analysis & Prediction system with the capability of crime pattern detection, analysis and prediction [5]. The system is trained by feeding different crime records within 14 years in India. With the implementation of this regression model Yadav et al. got able to predict the crime rates in some selected areas. They used supervised semi-supervised and unsupervised learning techniques on crime records to knowledge discovery and increase predictive accuracy. Yadav et al. used some techniques such as Association mining, Clustering, Classification techniques and Correlation & regression. Authorities got able to depict results graphically and also the developed model will reduce crime by helping crime detection fields if implemented. Major disadvantage of this work is the developers didn't use any type of software metrics to check the Accuracy.

Sivaranjani et al. came up with a crime prediction and forecasting using clustering Approaches [6]. They used various clustering approaches of data mining to analyze the crime data of *Tamilnadu*. Three major clustering techniques are used in this K-Mean clustering, Agglomerative clustering and Density-Based spatial clustering. Sivaranjani et al. compared the clustering models and selected the best technique based on the result. K-Mean clustering is visualized using Google maps and the K-nearest neighbor algorithm is used for crime prediction. Each performance of clustering algorithms are evaluated using metrics such as Precision, Recall, F-mean and the results are compared. With the use of this system Sivaranjani et al. got able to visualize crime hotspots using google maps. But Sivaranjani et al. failed to implement a crime pattern recognition function.

Sivanagaleela et al. implemented a Crime Analysis and Predicting system by using Fuzzy C- Mean Algorithm for crime analysis and prediction [7]. This system mainly focused on which area will the crime occur rather than the criminal identification. *Naïve Bayes* classification was used to classify the data and Fuzzy C-Means algorithm is used to

cluster the crime data. This system predicted outputs by region and crime types which will occur frequently. States that using Fuzzy c-means algorithm crime-prone areas can identify with less time. The results were able to map by using a chart. One of the major cons the system had is it showed some low accuracy outcomes.

Gandotra et al. came up with an innovative idea which made them implement a text mining method to support criminal case judgment Referential prison term generation for the judge's sentence [8]. The major idea of this paper is used for police investigation document of criminal case send from district police office, parse this document into keyword table, then match this data with the trained database in the form of keyword table format of court's judgment. This paper tries to use a text mining approach to solve problems faced by judges. The system is programmed to use the police's investigation document of criminal cases sent from the district police office, parse this document into a keywords table, then match with a trained database. With the use of Cosine similarity algorithm of text mining technology to calculate the coefficient of similarity, based on the highest coefficient. The model reached nearly 87.5% of accuracy.

Keyvanpour et al. came up with a general crime matching framework which is able to detect and investigate the crime by means of data mining [9]. This research mainly focuses on using crime matching with behavioral burglary crime variables by identifying crime characteristics. Crime matching process is used for assigning the previously unsolved crimes to the arrested offenders. The system itself compares the clustering models and selects the best technique based on the result. SOM neural networks are used for clustering and the MLP neural network is used for classification. In this research, some of the most significant capabilities of data mining techniques were leveraged through a multi-purpose framework for intelligent crime investigation. But this system still got unable to recognize crime patterns

Investigating Crimes using Text Mining and Network Analysis is introduced by Elyezzy et al. [10]. This paper has been presented to the Crime Detection System, which has developed to discover a new relationship between offenders and communities using Arabic investigation documents and visualize the results to assist crime data analysis. Also a system is developed to extract useful information in the Arabic crime domain from unstructured investigation data in order to mine. The major approach of their research is basically based on building a predefined dictionary that contains some important keywords that can be used to classify the crime domain. Using a *Dracula* Graph Library for data visualization the Elyezzy et al. implemented a JAPE rule-based algorithm using the GATE tool to improve nominating the correct names from unstructured text.

A crime pattern detection is invented for investigations by Jain et al. [11]. The major objective of this research is to predict the probable suspects for the unsolved cases or test cases from the past criminal record, criminal record, and crime over past years' records. Subdividing the data into

different types of crime allowing the user to get information about those crimes easily. The system core is implemented using K-means clustering and HYB algorithm. This system has advantages such as providing a single all-embracing database in which all the data has been extracted, linked, cleaned and augmented and the system works like an interactive analytical instrument in which every part of the results is clickable to 'zoom in'. In this way, the user can simply embark on an analytical journey without the need to first design the process. As pros this system had some cons such as it is typically hard to extract data from police source systems because of old and diverse database systems with data models based on transactions instead of analysis. Also the existing systems usually generate static reports that do not allow interaction. They cannot be used to find the explanations behind the numbers they present.

### III. METHODOLOGY

The crime prediction and analysis system is implemented by integrating three major components. They are Crime prediction, Crime case suggestion and Real time crime case pattern analysis. Each component plays a major role for the final accurate outcome. The implementation of this product is done by using agile software development methodology. For the prototyping model the developers used the evolutionary prototype model.

#### Crime Prediction

Crime prediction function is implemented to predict crimes division wise. *Jupyter* notebook and Visual studio code are the main developing Ids used for this function. The developers gathered data from police stations from the relevant division. These data are saved on *csv* format for further data processing. Before saving these data all the data is converted to float variable type. Then the developer normalized the data manually to stop more duplicate iterations. The normalized data set is divided into two data sets as training data set and test data set. These sets of data are converted an array of values into a data matrix. This matrix is reshaped into  $X = t$  and  $Y = t+1$ . After this transformation the reshape input looked as  $3D$  ( $num\_samples, num\_timesteps, num\_features$ ).

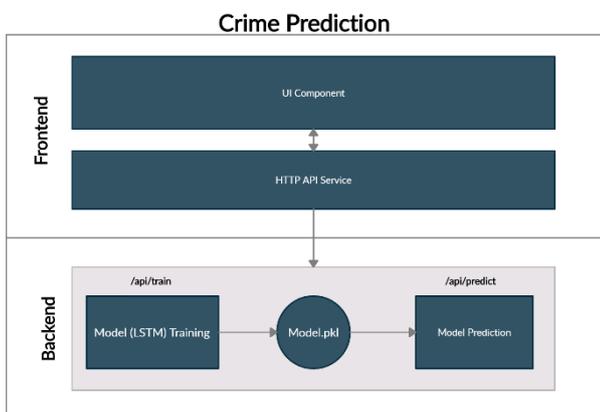


Figure 1. Architecture Diagram of crime prediction

After the data pre-processing these data are used to construct the LSTM model. The LSTM is defined with hundred neurons in the first hidden layer and with one neuron in the output layer to predict the pending and crime cases. The input shape is formed as a once time step with thirty features. This process is having a 20% of dropout rate. The MSE loss function and efficient Adam version of stochastic gradient descent is used to configure the model architecture. The implemented model was able to fit 20 training epochs with a batch size of 70. The model output is passed to the frontend by using HTTP API services.

#### Crime case suggestion

This component is implemented on focusing court judges as the target users. Previous case document details are extracted from the *supremecourt.lk* and the *courtfofappeal.lk* websites.

In the initial stage of this function keywords, terms and cluster similar case summaries are extracted from the dataset using *Python Natural Language Toolkit Library*. The clustered term frequency table is stored for future references.

Once a new case summary is fed to the system the similarity algorithm is used to match the new case summary with the existing data storage in the form of key word table format to find the similar cases from the stored past case documents. The cosine similarity algorithm of text mining is used to calculate coefficient of similarity and based on the highest coefficients value the researcher finds out the closest past criminal cases for a particular given case.

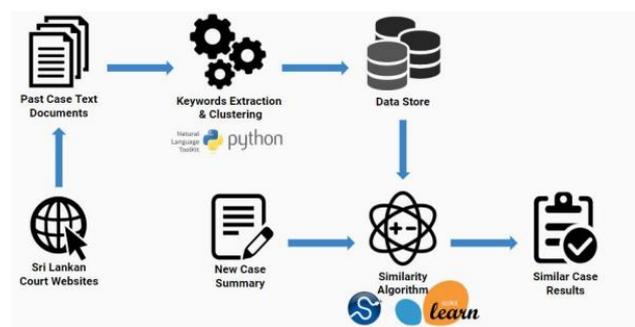


Figure 2. Architecture Diagram of crime case suggestion

Text analytics plays a huge role in this scenario. Text analysis process is based on linguistic, statistical and machine learning techniques. Information are retrieved from the unstructured data and the process of structuring the input text to derive patterns and trends to evaluate and interpret the output data.

The cases are clustered using the keywords included in it. Keywords are extracted from the data set stored in clustered term frequency table. When a unique case is pushed to the system cosine similarity is used to calculate a statistical score for the comparison between the case summaries which are having a high similarity for the given unique case.

#### Real time crime case pattern analysis

This function does the major visualization parts in the user interfaces. This functions are implemented to gather real

time data from island wide police officers. These data are displayed real time in the power BI tool.

Backend is fully implemented on firebase and the front end implementation is done in visual studio code Id.

When the data is entered in the front end text field these data is posted to the backend using the HTTP API services. Then these data are saved in the *firebase* data collection. The data written in the *firebase* is pulled back using get methods to read and visualize data in the power BI tool.

In the front end user interface the power BI tool is called as an *I-frame*. The developers have implemented the firebase call through the power BI tool.

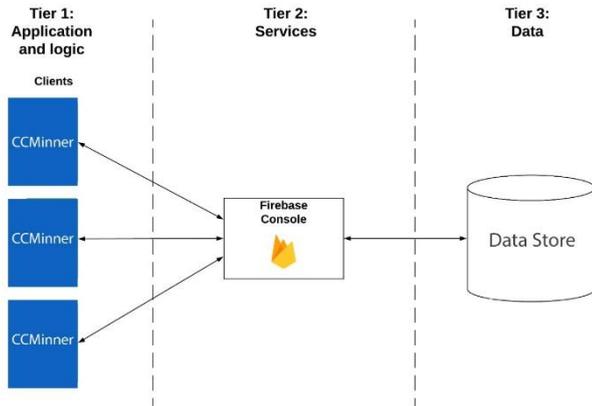


Figure 3. 3-tier-architecture diagram

3-tier-architecture diagram figure gives the brief idea of the 3-tier-architecture of the real time crime case pattern analysis functionality.

#### IV. EXPERIMENTS AND RESULTS

As mentioned before the implemented system contains three major components. Crime prediction, Crime case suggestion and Real time crime case pattern analysis. Below session widely explains the results of the system components.

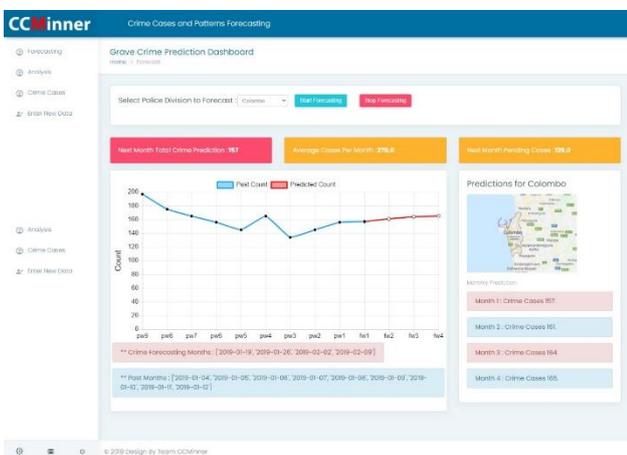


Figure 4. BI tool crime prediction Dashboard

BI tool crime prediction dashboard interface (Figure 4) shows the crime case prediction interface. In the drop down there are police divisions for some specific regions. There are data sets related to each division. Once the user clicks on the start forecasting button a graph will be generated. The blue line shows the past data count and the red line shows the prediction count. this also shows a summary of how many crimes may happen in the next month, Average cases per month, Pending cases etc.

The root mean square error rate is in a low amount such as 0.14545373.

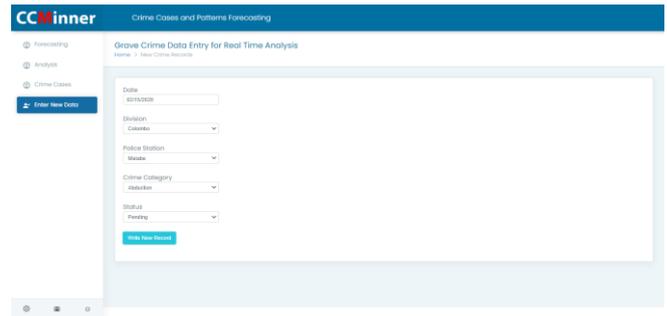


Figure 5. Crime case data input UI

In the crime case and pattern analysis function users can input date, division, police station, crime category and pending status (Figure 5). when the user input these data all of these data will be displayed in the below dashboard (Figure 6). It will graphically show the location, and how it happens. all of these things are shown in the power BI. BI tool represent 100% of accuracy real time data.



Figure 6. Real time data display Dashboard

In the crime case suggestion functionality there is also a trained machine learning model, which is training by using many crime cases. Once a user input keywords in the interface (Figure 7) these words are extracted from the text box for the text mining procedure. then these mined texts are analyzed and all the related crime scenes which include these keywords in its documents will be displayed in the interface. All of these are displayed after being sorted according to the related score point. The score rate depends on the type of query length.

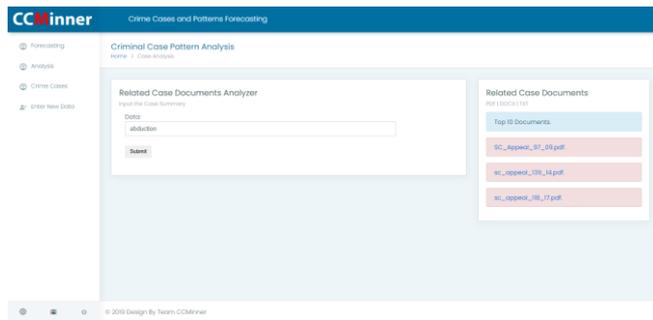


Figure 7. Crime case suggestion UI

## V. CONCLUSION

The major objective of this research is to identify the patterns from past case summaries to give support and guidance in decision making for the users. Altogether the major three functional components have successfully brought the research objective into the reality.

The crime prediction and analysis system has passed through several test case criteria to make sure that the probability of accuracy is above 0.85 rate. All the generated outputs are compared and tested using real data to certify the accuracy of the relevant outputs. In the future developers are planning to add more data for its data stream to make the crime prediction and analysis system more accuracy.

There is some limitation with the crime prediction and analysis system. There are some limitations with the user session handling. The crime prediction and analysis system cannot handle an extreme amount of user loggings in a certain time so the system itself cancel some session to make more availability for some users.

## ACKNOWLEDGEMENT

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# Phenolic Content, Polyphenol Oxidase Activity And Antioxidant Scavenging Activity In Three Species Of Plantain In Ghana

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**Abstract-** Plantains and Bananas (*Musa* spp.) are grown in more than 120 countries in the tropical and subtropical regions of the world. In Ghana, plantain is used like a starchy food similar to yams. Plantain (*Musa paradisiaca*) is found to contain some phenolic compounds. Polyphenols are a large group of non-nutrient compounds that are found in plants and they have antioxidant properties. Consumers have developed interest in organic foods that have this property due to their perceived health benefits. Three cultivars, Apantu, Oniaba and Apem at three stages of ripeness; unripe, firm ripe and fully ripe were used. Phenolic compounds were extracted with 70% Ethanol. Standard methods were employed in determining the PPO (Polyphenol Oxidase) activity. The results showed that the total phenolic content was highest in unripe Apem ( $448 \pm 18.45$ mg GAE/g DW) and Apantu had the least value of  $117.70 \pm 4.35$ mg GAE/g DW. Oniaba had  $169.1 \pm 11.25$ mg GAE/g DW. Apart from Apantu that recorded a decrease in the total phenolic content at the fully ripe stage, Oniaba and Apem recorded increases in their total phenolic content. Processing (boiling, drying and milling) had an effect on the total phenolic content of the studied samples. Apantu and Oniaba had increases in their total phenolic content but Apem had a decrease in the total phenolic content. The polyphenol oxidase activity was dependent on the stage of ripeness and the cultivar of plantain studied. The highest PPO activity was observed in the fully ripe Apem and the least was in unripe Apem. The fully ripened samples recorded the highest PPO activity followed by the firm ripe sample with unripe sample having the least. Phenolic compounds determined in the pulp and peels were Gallic acid, Catechol, Dopamine hydrochloride and Catechin. The concentrations of these phenolic compounds were found in varying concentrations in the pulp and the peels and also in the cultivars. The antioxidant scavenging activity affected by senescence of the pulp with fully ripe 'Oniaba' having the highest ( $51.40 \pm 0.68$ ) percent antioxidant scavenging activity.

**Index Terms-** Polyphenol, Polyphenol oxidase, Polyphenol oxidase activity, Antioxidant scavenging activity

## I. INTRODUCTION

Plantain (*Musa paradisiaca*), a plant of the banana family (Musaceae) is closely related to the common banana (*M.*

*sapientum*). The botanical classification of plantains and bananas is so complicated that plantain is variously viewed as a subspecies of banana, and the banana as a subspecies of plantain (Oke *et al.*, 1998). Plantain has a maximum of starch before it ripens, it is usually cooked green, either boiled, roasted or fried. It may also be dried for later use in cooking or ground for use as a meal (FAO document repository). The plantain meal can be further refined into flour. In some parts of East Africa plantain is a staple food and beer-making crop, notably in Central and Eastern Uganda and Tanzania (formerly Tanganyika). The plant is believed to have originated from South-East Asia. (Encyclopædia Britannica, Inc. 2011).

Phytochemicals are a large group of non-nutrient substances present in plants. They are biologically active and they play an important role in the interaction of plants with their environment as well as having some health promoting impacts (Schreiner *et al.*, 2006).

Natural resources such as fruits, herbs, vegetables, cereals and other plant materials rich in phenolics are increasingly of interest to consumers and in the food industry because of their perceived benefits beyond basic nutrition. Such food sources have been shown to retard oxidative degradation of lipids and thereby improving and enhancing the quality of food beyond its nutritional value (Javanraedi *et al.*, 2003). Therefore, the study of non-nutrient compounds such as phenolic acids, flavonoids and high molecular tannins as natural antioxidants have greatly increased (Siddhuraju and Becker, 2007).

In recent times, attempts are being made to produce convenience foods from starchy foods such as corn flour, cassava flour, yam flour and plantain flour. However, processed plantain flour has been observed to darken upon storage, probably due to the interactions of polyphenols and polyphenol oxidases or non-enzymatic factors. To be able to solve the browning problem of plantain flour during storage, it is important to characterize the polyphenols present in plantains, their stability during processing into precooked flours, as well as the polyphenol oxidase activity of plantains.

The aim of the study is to determine the phenolic contents of the three species of plantain in Ghana.

## II. MATERIALS AND METHODS

### Collection of Plant Materials

Three cultivars of Plantain, namely false horn plantain, intermediate plantain and French plantain with the local names *Apantu*, *Oniaba* and *Apem* respectively were obtained from the Agricultural Research Center of the University of Ghana, Legon at Kade in the Eastern Region of Ghana.

### Sample Preparation

The matured samples were harvested from the same field and transported immediately to the laboratory. The samples were cleaned and washed with distilled water.

### Laboratory Analysis

#### Extraction of Phenolic Compounds from the Freshly Harvested Plantain Pulp.

The extraction procedure used was that by Alothman *et al.*, (2008) with slight modification. The samples were washed in distilled water and peeled using a stainless-steel kitchen knife. 100 g of plantain pulps were diced into small sizes and blended for 3 minutes and then extracted with 200 ml of 70% Ethanol while shaking (GALLENKAMP orbital shaker, United Kingdom) at 100 rpm for 20 minutes at room temperature ( $25 \pm 1^\circ\text{C}$ ). The extract was then filtered using a clean muslin cloth and centrifuged (DENLEY BS 400 Centrifuge, England) at 4750 g for 15 minutes. The supernatant was concentrated at  $60^\circ\text{C}$  using a rotary evaporator (BÜCHI ROTAVAPOR R-114). The crude extracts were collected after 3 hours and stored at  $4^\circ\text{C}$  in the dark. Light exposure was avoided throughout the extraction process. The extracts were stored in a dark container at refrigeration temperature ( $6^\circ\text{C}$ ) until further analysis. The extraction process was carried out in triplicate

#### Extraction of Phenolic compounds from the firm ripe plantain

The pulp of the firm ripe plantain varieties were cleaned and washed with distilled water. 100g of the pulp was weighed and taken through the extraction procedure.

### Effect of Processing on the Phenolic Compounds

#### Extraction of Phenolic compounds from unripe Plantain flour

The pulp of the freshly harvested plantain varieties were oven dried (Wagtech, Model; GP/150/SS/250/HYD, DB THERMAL systems Ltd) at  $60^\circ\text{C}$  for 48 hours. The dried pulp was milled into flour using a hammer mill (Christy and Norris Ltd, Chelmsford England, equipped with sieve size  $5\mu\text{m}$ ). 50g of the flour was weighed and 150ml of 70% ethanol used for the extraction.

#### Extraction of Phenolic Compounds from Unripe Pre- Cooked Plantain Pulp Flour

The fresh unpeeled plantain varieties were boiled for 7 minutes. The pre-cooked plantain was allowed to cool after which the peels were removed and the pulp oven dried (Wagtech, Model; GP/150/SS/250/HYD, DB THERMAL systems Ltd) at  $60^\circ\text{C}$  for 48 hours. The dried pulp was milled into flour using a hammer mill (Christy and Norris Ltd, Chelmsford England, equipped with sieve size  $5\mu\text{m}$ ). 50g of the flour was weighed and taken through the procedure of extraction.

#### Extraction of Phenolic Compounds from Fully Ripe Plantain Pulp

The plantain was stored in an airy room for 14 days and allowed to ripen. The ripe plantain was peeled and 100g of the pulp weighed. It was then taken through the extraction procedure.

#### Determination of Total Phenolic Contents in the Plantain Samples

The total phenolic compound contents were determined by using Folin–Ciocalteu reagent assay (Singleton and Rossi, 1965). 0.1 ml extract (contains 0.1 mg extract) was mixed with water (46 ml). 1 ml of Folin–Ciocalteu reagent was added and mixed thoroughly. 3 ml of  $\text{Na}_2\text{CO}_3$  (7%) was added to the mixture. The absorbance was measured at 760 nm using Cecil 3042 spectrophotometer. A standard curve was prepared using gallic acid in ethanol to cover a range of 0–100  $\mu\text{g}/\text{ml}$ . The concentration of total phenolic compounds in the extracts was determined as mg gallic acid equivalent. The data were presented as the average of triplicate analyses.

#### Total antioxidant activity of the extracts (Radical scavenging activity)

##### DPPH (2, 2 –diphenyl-1- picrylhydrazyl) assay

The effect of the extracts and standard antioxidants on DPPH radical was estimated according to the method of Blois (1958) with slight modification wherein the bleaching rate of a stable free radical DPPH is monitored at a characteristic wavelength in the presence of samples.

An amount of 0.5ml of 0.1mM ethanolic solution of DPPH was added to 3.0ml of all the extract samples or standard antioxidants solution (50–500 $\mu\text{g}/\text{ml}$ ) in water. The mixture was shaken vigorously and kept standing at room temperature for 30minutes in the dark, the absorbance of the mixture was measured at 517nm using Cecil 3042 spectrophotometer. The decrease in absorbance indicates an increase in DPPH radical scavenging activity. This activity was calculated by using the equation below;

$$\text{DPPH scavenging Effect (\%)} = [(A_0 - A_1)/A_0] * 100$$

Where  $A_0$  is the absorbance of control and  $A_1$  is the absorbance of the extract or standard.

#### Standard Mixture Preparation

A standard mixture of Catechin, Epicatechin, Gallic acid, Chlorogenic acid, Catechol, Caffeic acid, Dopamine HCl, P-Cresol, was prepared into a stock solution of 200 $\mu\text{g}/\text{ml}$  using the mobile phase. The stock solution was diluted to 100 $\mu\text{g}/\text{ml}$  and 50 $\mu\text{g}/\text{ml}$  for the calibration graph.

#### Sample Preparation

One ml of the Rotary evaporated extracts was filtered through a sterile 0.45 $\mu\text{m}$  cellulose membrane filter (Nalgene, Nalg Nunc International Corporation U.S.A).

#### Polyphenol Oxidase (PPO) Activity

The method adopted by Montgomery and Sgarbieri (1975) was employed. Five grams of plantain pulp were homogenized with 0.6 g of Polyvinylpyrrolidone (PVPP) and 20 ml of 50mM

(pH 7) phosphate buffer. This was then filtered and centrifuged at  $10,000\times g$  at  $4\text{ }^{\circ}\text{C}$  for 15 min. The activity was measured with 2.85 ml of 0.2mM (pH 7) phosphate buffer, 50  $\mu\text{l}$  of Catechol (60 mM) as a substrate and 100 $\mu\text{l}$  of enzymatic extract. The mixture was maintained at  $25\text{ }^{\circ}\text{C}$  and the change in absorbance was read over 3 min at 420 nm. Activity was expressed as units of activity (UA) in which one unit of PPO was defined as the change in one unit of absorbance per second.

### III. RESULTS AND DISCUSSION

#### Total Phenolic Content in Plantain Pulp

The total phenolic content in the plantain cultivars are shown in Figure 1. Results for the unripe plantain samples showed that Apem had the highest total phenolic content (440 mg GAE/g DW) and Apantu had the least value of 120 mg GAE/g DW.

In the firm ripe plantain samples, Apem recorded the highest total phenolic content (280 mg GAE/g DW) with Oniaba having the least value of 250 mg GAE/g DW in Figure 4.1. When the unripe samples were compared with the firm ripe samples, Apantu had an increase of 150 mg GAE/g DW in the total phenolic content and Oniaba (85 mg GAE/g DW) but Apem recorded a decrease of 150 mg GAE/g DW in the total phenolic content. Romani *et al.* (2002) have indicated that a quantitative variation in phenolic compound content could be due to variety, different agronomic conditions, and tissue type.

Analysis of variance for the total phenolic content of the various cultivars indicated that the total phenolic content of the samples were significantly ( $p<0.05$ ) affected by the interaction of the cultivar type and the stage of ripeness of the plantain varieties. The difference might be due to their genomic variation because all the plants were exposed to the same agronomic conditions.

The total phenolic content of the unripe samples were compared with their peels to find out whether the peels will also

show a similar result but from figure 4.2, the results were different. Apantu recorded the highest phenolic content of about 3000 mg GAE/g DW and this was followed by Oniaba (2000 mg GAE/g DW) and finally Apem (1000 mg GAE/g DW).

#### The Effect of Maturity and Ripening on The Phenolic Content of The Plantain Pulp

The results in Figure 1 showed that Apem had the highest (220 mg GAE/g DW) total phenolic content among the fully ripened samples and the least was Oniaba (160 mg GAE/g DW). There was a general decrease in total phenolic content from the unripe and/or firm ripe stage to the fully ripe stage. Ngoh-Newilah *et al.*, (2010) reported a decrease in total phenolic content in some ripe Musa hybrids ('CRBP755' and 'DS11') in Cameroun and an increase in other cultivars ('Bita3', 'CRBP39' and 'FHIA21') from the unripe stage through the ripe stage to the fully ripe stage. It was explained that the postharvest metabolisms either enhance some metabolites synthesis for a determined period according to the environment and the genotype, or stimulate degradation of existing/synthesized substances leading to many secondary compounds found in fruits such as bananas and plantains (Robards *et al.*, 1999). The decrease in total phenolic content with fruit ripening was also reported in banana (Ibrahim *et al.*, 1994), mango (Abu-Goukh and Abu-Sarra, 1993) and date (Al-Ogaidi and Mutlak, 1986).

According to Taylor (1993), the decrease in polyphenol content of guava fruit causes a loss in astringency during ripening of the fruit. The increase in antioxidant activity as the fruit matured was due to the breakdown of starch to glucose which was used in the biosynthesis of ascorbic acid. The difference between the maximum and the minimum total phenolic content was about 50 mg GAE/g DW. There is a possibility that as the pulp ripens, polyphenol oxidase gets gradual access to the phenolic compounds and this causes a decrease in the total phenolic content.

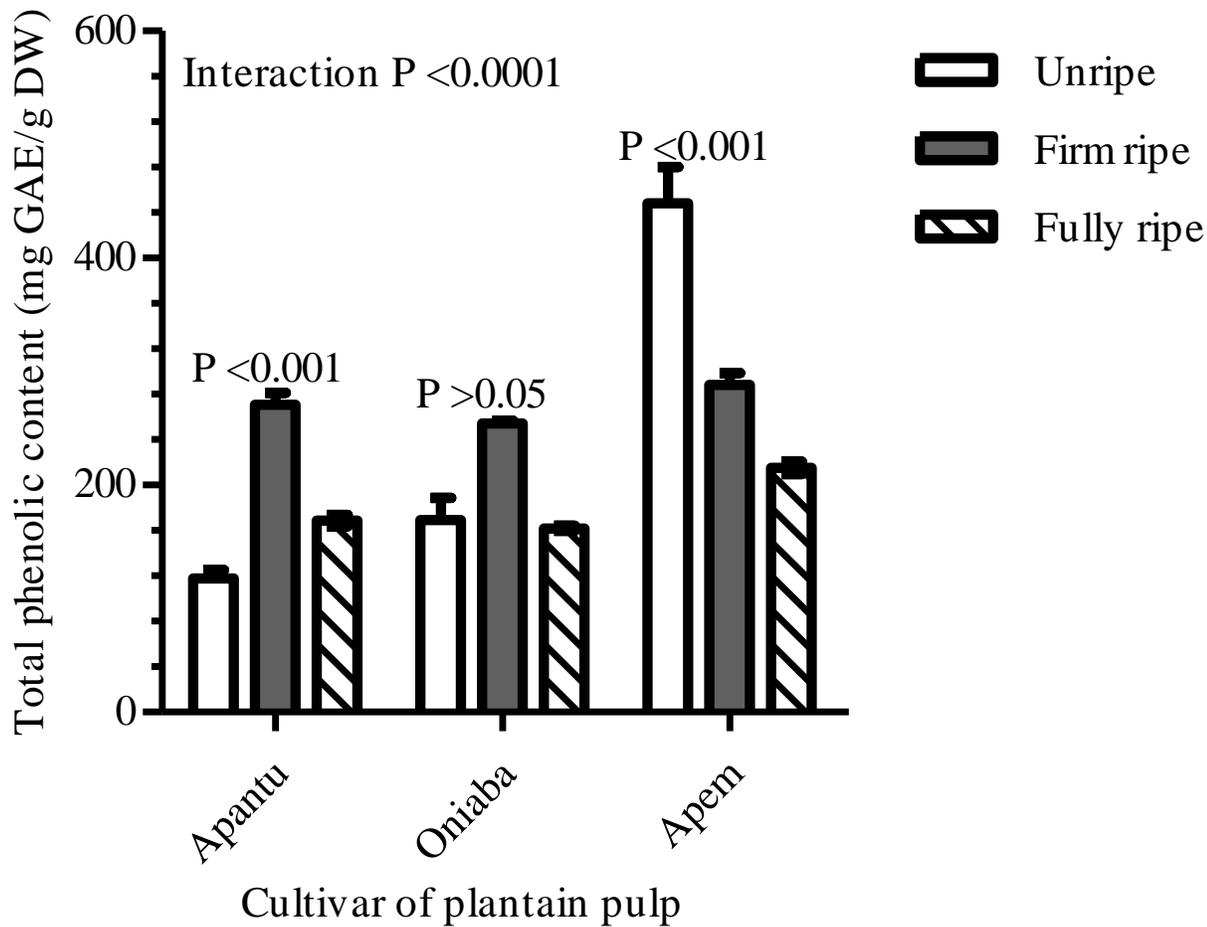


Figure 1:

Total Phenolic Content in Different Cultivars Of Plantain

**The Effect of Processing (Boiling and Drying) on the Phenolic Content of Plantain Flour.**

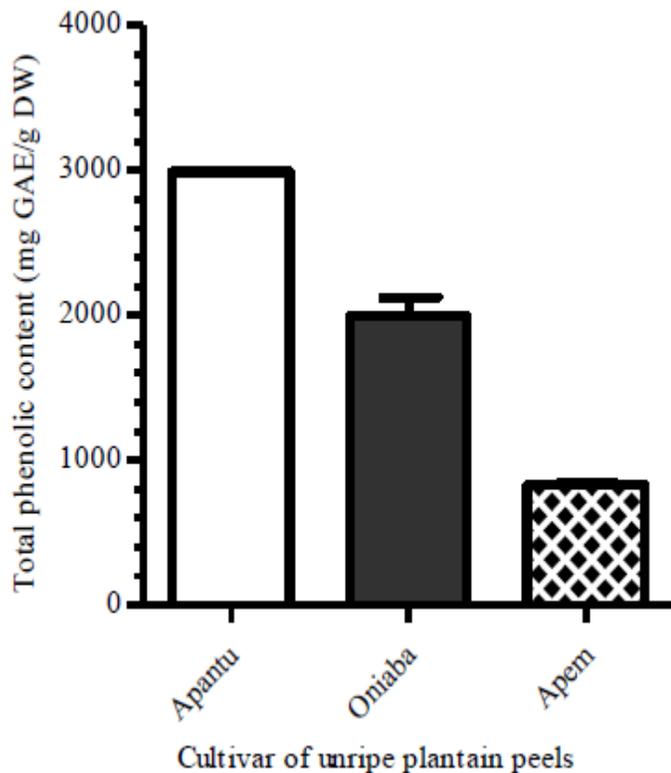
The data in Table 1 showed that processing had an effect on the phenolic content of the plantain cultivars. In the raw, dried and milled plantain into flour termed as (FDM) process, there were increases in the total phenolic content of Apantu (80 mg GAE/g DW) and Oniaba (47 mg GAE/g DW) with the exception of Apem which recorded a decrease of 107 mg GAE/g DW in the total phenolic content. Within the FDM there were significant differences ( $P < 0.05$ ) between Apantu and Apem and also Oniaba and Apem. Apantu had the least ( $199.00 \pm 2.11$  mg GAE/g DW) total phenolic content with Apem having the highest ( $341.00 \pm 34.6$  mg GAE/g DW) total phenolic content although not as high as that of the unripe Apem (440 mg GAE/g DW).

The boiled, dried and milled plantain termed as (FBDM) process, recorded higher values when compared with that of the unripe plantain cultivars. Oniaba had the highest phenolic content of  $187.2 \pm 3.66$  mg GAE/g DW and Apantu with the least  $166.9 \pm 0.96$  mg GAE/g DW.

Table 1: Total Phenolic Content of the Extract of Plantain Flour from Pulp

Cultivar	Total phenolic content (mg GAE/g DW)	
	FDM + Mean $\pm$ SE	FBDM # Mean $\pm$ SE
Apantu	$199.00 \pm 2.11^a$	$166.90 \pm 0.96^a$
Oniaba	$216.00 \pm 3.10^a$	$187.20 \pm 3.66^b$
Apem	$341.00 \pm 34.6^b$	

GAE- Gallic Acid Equivalent, DW- Dry Weight. FDM-fresh, dried and milled plantain pulp, FBDM-fresh, boiled, dried and milled. Values in the same column with different letters are significantly different at  $P < 0.05$ . +- analysis was done using one-way ANOVA, #- analysis was done using unpaired t-test. (n=3)

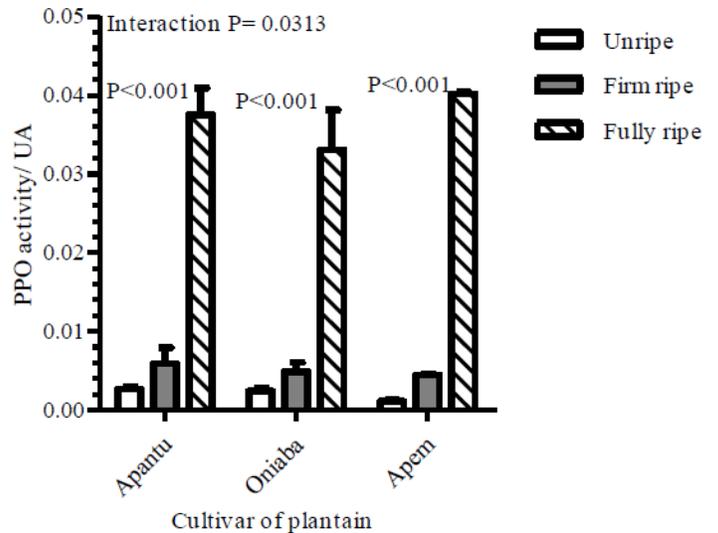


**Figure 3: Total phenolic content in unripe plantain peels.**

**Polyphenol Oxidase Activity**

The results shown in figure 4 show the Polyphenol Oxidase activity of the three plantain cultivars in accordance with the methods used. The Polyphenol Oxidase (PPO) activity of the Plantain was determined during various stages of ripening. Activity was expressed as units of activity (UA) in which one unit of PPO was defined as the change in one unit of absorbance per second.

In general, there was an increase in the PPO activity within the same cultivar from the unripe state to the fully ripe state. Similar findings have been reported for a local variety of plantain, 'Ogbutu', by Omuaru *et al.* (1990) and some banana varieties by Jayaraman and Ramanujao (1987). Within the fully ripe stage, Apem recorded the highest PPO activity (0.0402 UA) with Oniaba being the least (0.00244 UA).



**Figure 4: Polyphenol Oxidase Activity of Plantain Extract.**

From Apantu to Apem, there was a decrease in the PPO activity within the unripe stage and within the Firm ripe stage in figure 4. This observation was different in the fully ripe stage. The Polyphenol Oxidase activity in the firm ripe samples was intermediate between the PPO of the unripe and the fully ripe samples. The PPO activity was highest in the fully ripe stage because during ripening and senescence, there is a break down in the cell compartmentation and therefore the PPO get in contact with the substrate (polyphenols) and thus act on the polyphenols but in the unripe samples, the cell compartmentation is intact and this prevent the direct contact of the enzymes with the polyphenols (substrate). The enzyme activity is reduced and this was observed in figure 4.

**Free radical-scavenging activity of Plantain extracts using DPPH (Antioxidant activity assay)**

In table 2, the percentage scavenging activity of the fresh samples ranged from about 16% to about 51% for the unripe samples. Antioxidants are known to interrupt the free radical chain of oxidation by donating hydrogen from phenolic hydroxyl groups and to form stable products, which do not initiate or propagate further oxidation of lipids. DPPH radical is often used as an indicator in testing hydrogen-donation capacity and thus antioxidant activity (Dorman *et al.*, 2003).

**Table 2: Antioxidant activity of pulp extract of Plantain samples**

Cultivar	% Scavenging Activity		
	Unripe Mean ± SE	Firm ripe Mean ± SE	Fully ripe Mean ± SE
Apantu	46.60 ± 4.11 <sup>a</sup>	20.50 ± 4.11 <sup>a</sup>	39.70 ± 4.11 <sup>a</sup>
Oniaba	34.20 ± 0.00 <sup>b</sup>	28.80 ± 1.37 <sup>b</sup>	51.40 ± 0.68 <sup>b</sup>
Apem	15.80 ± 2.05 <sup>c</sup>	24.00 ± 2.05 <sup>a</sup>	43.80 ± 1.37 <sup>a</sup>

Post hoc test was by Tukey's. Values in the same column with different letters are significantly different at P < 0.05. Values are reported as Mean ± SE (n=3).

Apantu had the highest ( $46.60 \pm 4.11$ ) percentage scavenging activity followed by Oniaba ( $34.20 \pm 0.00$ ) with Apem recording the least value ( $15.80 \pm 2.05$ ). The difference in the percentage scavenging activity was due to the different cultivars used and this is in line with Prior *et al.*, 1998, since they all had different polyphenol contents.

There was a decrease in the percentage scavenging activity of the Firm ripe plantain samples of Apantu (26.1) and Oniaba (5.4) in comparison with the fresh and raw samples but that of Apem recorded a percentage increase of 8.2.

There was a general increase in the percentage scavenging activity of the fully ripe plantain samples of Apantu, Oniaba and Apem and the percentage rise were 19.20, 22.60 and 19.8 respectively. Although there were increases in percentage scavenging activity from the Firm ripe samples to the fully ripe samples, there were no significant differences ( $P < 0.05$ ) among the means of the fully ripe plantain cultivars. Free radicals are thought to play an essential role in fruit ripening and senescence, especially those derived from oxygen, and a higher relative concentration of phenolics in the older leaves in relation with the young ones has been revealed (Torrás-Claveria L. *et al.*, 2011; Ivanova D.G., Singh B.R., 2003), indicating that phenolic derivatives play a prominent role in tissue senescence (Tamagnone L., *et al.*, 1998).

When the fresh unripe samples were compared with the fully ripe samples, it was noticed that apart from Apantu (6.9) which had a reduction in the percentage scavenging activity Oniaba (17.2) and Apem (28) recorded an increase in their percentage scavenging activity. The increase in percentage scavenging activity after storage was due to several reasons. After harvest, ascorbic acid is still being synthesized in the living fruit tissues and it also acts as antioxidant. It is known that fruit ripening continues after harvest and this process leads to significant changes in the contents of the antioxidants.

Yan *et al.*, (2006) reported a lower antioxidant scavenging activity for banana when compared with other fruits like guava, dragon fruit, star fruit, orange and sugar apple but among the fruits studied banana had the highest chelating power.

In figure 1, unripe Apem recorded the highest total phenolic content but this did not commensurate with the percentage scavenging activity. The percentage scavenging activity of the unripe plantain showed a reverse of what was observed in the total phenolic content. A similar observation was made by Barros, *et al.*, 2009. It was suggested that other compounds different than phenolic acids are present and react with the Folin–Ciocalteu reagent and also contribute to their antioxidant properties.

#### IV. CONCLUSION

The main conclusions from this study include that, the total phenolic contents were highest in the pulp of the unripe samples with Apem recording the highest followed by Oniaba and Apantu. In the processed pulp flour, Apantu FDM ( $341.00 \pm 34.6$  mg GAE/g DW) was highest and the least was Apantu FBDM ( $166.9 \pm 0.96$  mg GAE/g DW). The peels of the samples recorded the highest total content and this was determined in Apantu, Oniaba and Apem (figure 2). PPO activity was also highest in the fully ripe samples. The following phenolic compounds were found in the samples studied; Gallic acid, Catechin, Catechol, Dopamine

in varying concentrations. The antioxidant scavenging activity affected by senescence of the pulp with fully ripe ‘Oniaba’ having the highest ( $51.40 \pm 0.68$ ) percent antioxidant scavenging activity.

#### V. RECOMMENDATION FOR FURTHER WORK

Further study should be done to fully characterize the polyphenols and identify those with high percentage scavenging activity.

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# Preparation of Poverty Strategy Documents in South Tapanuli District, North Sumatra Province, Indonesia

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**Abstract-** Poverty alleviation is carried out in a sustainable, on target, comprehensive, coordinative, systematic, integrated manner. Various programs have been carried out by the local government of South Tapanuli District to alleviate population poverty. However, this program has not been optimal in increasing and economically independent of the poor. This is due to the unavailability of data on the poor that is more comprehensive, detailed, accurate, and up to date. The availability of data on the poor can be used for control, monitoring, and evaluation of population poverty policies that are right on target and sustainable. The research objective was to formulate a population poverty reduction strategy document based on 5 database classifications. This type of research is descriptive and the population in this study is 14 County districts. This study used a survey method and the sampling method was cluster sampling. The results showed that the number of poor people based on welfare was 17,592 people or 6.56% of the total population of 268,095 people. There were 5,209 people or 1.94% who belonged to Decile 1. A total of 6,860 people or 2.56% belonged to Decile 2. A total of 5,523 people or 2.06% belonged to Decile 3. The number of poor people based on gender was 17,592 people consisted of 15,694 people or 89.21% of the poor men and 1,898 people or 10.79% of the poor women. Based on the results of the research that has been obtained, it is necessary to create commitments and policies so that each agency, service, and office must produce programs and activities to reduce population poverty in South Tapanuli District.

**Index Terms:** document preparation, North Sumatra, poverty reduction strategy, South Tapanuli District

## I. INTRODUCTION

Poverty is a major problem in a country, therefore the central, provincial, district, and city governments work together to overcome it. Poverty is a multi-dimensional phenomenon where the level of poverty is measured based on income and consumption. The deprivation approach states that poverty is not only a matter of actual income but an inability to obtain a certain minimum capacity (Singh and Cudhrama, 2020). Poverty is defined as the inability to meet the necessities of life, such as food, housing, clothing, education, health, and so on (Ginanjar et al., 2018). Poverty alleviation is carried out in a sustainable, on target, comprehensive, coordinative, systematic, integrated manner. Poverty reduction is a very complex problem. This is caused by various factors, such as geography, culture, causes of poverty, people's way of thinking, people's desire to get out of poverty. Poverty alleviation for the population can be carried out if there is support from the business world, non-governmental organizations, and the government. The target of poverty reduction is to increase the income, standard of living, and health of the population through comprehensive poverty reduction measures (Dai et al., 2020).

The Indonesian government has carried out a comprehensive poverty reduction. Various programs are made, such as the provision of poor rice, the family hope program, community health insurance, empowerment of independent communities, capital assistance for micro-economic businesses, and so on. However, the program has not been optimal in increasing and economically independent of the poor. This is due to the unavailability of more comprehensive, detailed, accurate, and up-to-date data on the poor. The availability of data on the poor can be used for control, monitoring, and evaluation of population poverty policies that are right on target and sustainable.

Based on the above problems, the Government of South Tapanuli District, North Sumatra, Indonesia has carried out a Medium-Term Development Plan by surveying to compile a poverty database for the regional population. There are 5 database classifications used during the survey, including 1) the poor based on welfare, 2) the poor by gender, 3) the poor by education level, 4) the poor by business field, and 5) the poor by position in work. These five databases can be used as material for consideration in the formulation and determination of population poverty reduction strategy policies. The research objective was to formulate a population poverty reduction strategy document based on 5 database classifications. Issues Poverty alleviation for the population must be carried out comprehensively, systematically, directed, right on target, justice, and sustainability.

## II. METHOD

This research was conducted in South Tapanuli District, North Sumatra Province, Indonesia. This type of research is descriptive and the population in this study is 14 county districts. This study used a survey method and the sampling method was cluster sampling. The cluster sample method is determined as follows:

- (1) The number of respondents or samples in the survey was 1000 respondents from 14 County districts in South Tapanuli district.
- (2) The number of samples for each County district is determined by dividing the total population of each sub-district by the total population of South Tapanuli District, then multiplying by 1000 samples.

To determine the number of samples from village X and sub-district X, this is done by dividing the number of villages X by the sum of villages X plus village Y and multiplying by the number of samples for District X, namely the following formula:

$$SB = \frac{\sum X}{n} \times SKT$$

Information:

SB = Survey of South Tapanuli district regional government work units

SKT = Total Cluster Sample

SD = Village Sample

SK = Village Sample

### II. 1. Data Collection

Survey data (primary data) was obtained by distributing questionnaires and secondary data (document data) was obtained through existing documents. There are 5 database classifications used during the survey, including 1) the poor based on welfare, 2) the poor by gender, 3) the poor by education level, 4) the poor by business, and 5) the poor by position in work. This research is limited to two databases, namely the first and second databases. Secondary data were obtained through the Integrated Data document from the National Team for the Acceleration of Poverty Reduction of the Republic of Indonesia. Based on this data, the poverty of the Indonesian population is grouped into 4 levels of population welfare status, namely Decile, 1) the welfare of the very poor, Decile 2) the welfare of the poor, Decile 3) the welfare of the near-poor, and Decile 4) the welfare of the vulnerable to poor.

### II. 2. Data Analysis

Survey data (primary data) were analyzed descriptively so that it could be described to describe population poverty in a systematic and detailed manner based on 5 main indicators of poverty. Secondary data (document data) were analyzed qualitatively to match the survey results. The results obtained are in the form of accurate data to create a poverty reduction strategy document in the South Tapanuli district, North Sumatra, Indonesia.

## III. RESULT AND DISCUSSION

### III. 1. Result

Based on the results of the research that has been done, it is obtained data on the poor in the South Tapanuli District, North Sumatra, Indonesia.

#### A. The poor are based on welfare

The results of data analysis showed that the number of poor people was 17,592 people or 6.56% of the total population of 268,095 people. There were 5,209 people or 1.94% belonging to Decile 1. A total of 6,860 people or 2.56% were classified into Decile 2. A total of 5,523 people or 2.06% belonged to Decile 3 (Tables 1, 2, and 3).

Table 1. Population Poverty Data in South Tapanuli District based on the welfare level of the population in Decile 1 (D1)

County District	Number Population	The Poor Population	
		D1	%
Batang Angkola	32.666	538	1,65
Sipirok	30.775	610	1,98
Batang Toru	29.517	244	0,83
Angkola Selatan	27.177	808	2,97
Angkola Barat	24.414	382	1,56
Sayur Matinggi	23.659	401	1,69
Angkola Timur	18.801	343	1,82
Angkola Sangkununur	18.315	383	2,09
Tano Tomb. Angkola	14.556	327	2.25
Saipar Dolok Hole	12.802	441	3,44
Muara Batang Toru	11.571	283	2,45
Marancar	9.446	161	1,70
Arse	7.946	162	2,04
Aek Bilah	645	126	19,53
Total	268.095	5.209	1,94

Table 2. Population Poverty Data in South Tapanuli District based on the welfare level of the population in Decile 2 (D2)

County District	Number Population	The Poor Population	
		D2	%
Batang Angkola	32.666	843	2.58
Sipirok	30.775	679	2.21
Batang Toru	29.517	437	1.48
Angkola Selatan	27.177	872	3.21
Angkola Barat	24.414	572	2.34
Sayur Matinggi	23.659	604	2.55
Angkola Timur	18.801	498	2.65
Angkola Sangku-nur	18.315	534	2.92
Tano Tomb. Angkola	14.556	356	2.45
Saipar Dolok Hole	12.802	433	3.38
Muara Batang Toru	11.571	403	3.48
Marancar	9.446	263	2.78
Arse	7.946	196	2.47
Aek Bilah	645	170	26.36
Total	268.095	6860	2.56

Table 3. Population Poverty Data in South Tapanuli District Based on The Welfare Level of The Population in Decile 3 (D3)

County District	Number Population	The Poor Population	
		D3	%
Batang Angkola	32.666	799	2.45
Sipirok	30.775	513	1.67
Batang Toru	29.517	406	1.38
Angkola Selatan	27.177	616	2.27
Angkola Barat	24.414	494	2.02
Sayur Matinggi	23.659	576	2.43
Angkola Timur	18.801	385	2.05
Angkola Sangkunur	18.315	400	2.18
Tano Tomb. Angkola	14.556	259	1.78
Saipar Dolok Hole	12.802	308	2.41
Muara Batang Toru	11.571	255	2.20
Marancar	9.446	208	2.20
Arse	7.946	171	2.15
Aek Bilah	645	133	20.62
Total	268.095	5523	2.06

Table 4. Population Poverty Data in South Tapanuli District Based on the Welfare Level if The Population in Decile 1, Decile 2, and Decile 3

County District	Number Population	The Poor Population	
		Total D1, D2, D3	%
Batang Angkola	32.666	2180	6.67
Sipirok	30.775	1802	5.86
Batang Toru	29.517	1087	3.68
Angkola Selatan	27.177	2296	8.46
Angkola Barat	24.414	1448	5.93
Sayur Matinggi	23.659	1581	6.68
Angkola Timur	18.801	1226	6.52
Angkola Sangkunur	18.315	1317	7.19
Tano Tomb. Angkola	14.556	942	6.47
Saipar Dolok Hole	12.802	1182	9.23
Muara Batang Toru	11.571	941	8.13
Marancar	9.446	632	6.69

Arse	7.946	529	6.66
Aek Bilah	645	429	66.51
Total	268.095	17592	6.56

Based on Tables 1, 2, 3, and 4, it is known that the number of poor people in 14 County districts in the South Tapanuli District is between 3.68% and 9.23% of the total population in each County district, except in Aek Bilah County district poor people 66.51% of the total population in the sub-district.

### B. Poor Population Based on Gender

The number of poor people in South Tapanuli District based on gender is 17,592 people consisting of 15,694 people or 89.21% of the poor men and 1,898 people or 10.79% of the poor women. If it is compared to the number of the male population with the number of the male population and the number of the poor female population with the number of the female population. It is known that among the 133,140 male population, there are 15,694 people or 11.79% are poor men. Among the 134,955 women, there are 1,898 women or 10.79% poor women. For more details, see Table 5 below.

Table 5. Poor People in South Tapanuli District by Gender

Village Name /County District	Number Population	Number of Poor Residents	Number of Poor Residents (%)
Batang Angkola	32666	2180	6,67
Sipirok	30775	1802	5.86
Batang Toru	29517	1087	3,68
Angkola Selatan	27177	2296	8,45
Angkola Barat	24414	1448	5,93
Sayur Matinggi	23659	1581	6,68
Angkola Timur	18801	1226	6,52
Angkola Sangkunar	18315	1317	7,19
Tano Tomb. Angkola	14556	942	6,47
Saipar Dolok Hole	12802	1182	9,23
Muara Batang Toru	11571	941	8,13
Marancar	9446	632	6,69
Aarse	7946	529	6,66
Aek bilah	6450	429	6,65
Total	268095	17592	6,56

Table 6. The Male Population of The Poor In South Tapanuli District

Village Name /County District	Number Population	Number of Poor Population	Number Poor Population Male	Number Poor Population Male/ Poor County District (%)
Batang Angkola	15902	1915	12.04	87.84
Sipirok	15183	1616	10.64	89.68
Batang Toru	14671	977	6.66	89.88

Angkola Selatan	13971	2094	14.99	91.20
Angkola Barat	11948	1274	10.66	87.98
Sayur Matinggi	11493	1386	12.06	87.67
Angkola Timur	9387	1097	11.69	89.48
Angkola Sangkunar	9266	1220	13.17	92.63
Tano Tomb. Angkola	6981	802	11.49	85.14
Saipar Dolok Hole	6403	1074	16.77	90.86
Muara Batang Toru	5966	838	14.05	89.05
Marancar	4720	563	11.93	89.08
Arse	3912	448	11.45	84.69
Aek Bilah	3337	390	11.69	90.91
Total	133140	15694	11.79	89.21

Table 7. Poor women Population in South Tapanuli District

Village Name /County District	Number population	Number of Poor Population	Number Poor Population Women / Village / Village Residents Male	Number of Poor Population Women / Population Poor Village of sub-district(%)
Batang Angkola	15902	1915	12.04	87.84
Sipirok	15183	1616	10.64	89.68
Batang Toru	14671	977	6.66	89.88
Angkola Selatan	13971	2094	14.99	91.20
Angkola Barat	11948	1274	10.66	87.98
Sayur Matinggi	11493	1386	12.06	87.67
Angkola Timur	9387	1097	11.69	89.48
Angkola Sangkunar	9266	1220	13.17	92.63
Tano Tomb. Angkola	6981	802	11.49	85.14
Saipar Dolok Hole	6403	1074	16.77	90.86
Muara Batang Toru	5966	838	14.05	89.05
Marancar	4720	563	11.93	89.08
Arse	3912	448	11.45	84.69
Aek Bilah	3337	390	11.69	90.91
Total	133140	15694	11.79	89.21

Based on Tables 6 and 7 it is known that the difference between the number of poor men and the number of poor women in South Tapanuli District is very high, namely 15,694 poor men and 1,898 poor women. The development strategy developed by the South Tapanuli District government is to increase the population's high economic growth. Economic growth is considered high if it is not followed by an equal distribution of income for all groups of society, there will be a trade-off between growth and equity (Prawoto, 2009). Poverty can be grouped into 3 parts, namely absolute poverty, relative poverty, and cultural poverty. Based on the

data in the Table 7, if someone is classified as absolutely poor, if their income is below the poverty line, it is not sufficient for them to meet the minimum needs of life, such as food, clothing, health, housing, education. A person is classified as relatively poor if he can live above the poverty line but is still below the capacity of the surrounding community. Cultural poverty is when the attitude of a person or group of people who does not want to improve their level of life despite efforts from other parties to help them. The poverty line is a measure of the average capacity of the community to meet the minimum living needs. Through the social approach, it is still difficult to measure the poverty line of the community, but from the theoretical economic indicators, it can be calculated using three approaches, namely the production, income, and expenditure approach.

The success of development can be seen from the increase in people's lives. The willingness of the community to develop is the key to preserving and developing development results. The government has issued Presidential Regulation of the Republic of Indonesia Number 54 of 2005, concerning the Program for the Acceleration of Poverty Reduction. These programs include poverty alleviation in rural/urban areas, public health insurance, subsidies and family hope, People's Business Credit, and cheap housing procurement (Djafar and Sune, 2019). Population poverty reduction program through empowerment is a good strategy because it uses a process approach that involves the community. So the community is not only a consumer of the program but also a producer because they have been involved in the poverty reduction process (Yoseph, 2014). The government plays a role in implementing community welfare. Government as an agent of development and reform of the poor. The government plays a role in regulating, allocating, distributing, serving, and empowering the community. The role of the government must be carried to achieve justice and equitable distribution of community welfare. The poverty of the population is still present in various regions because the government has not learned from the community, the government has not maximized the companion as a facilitator, the government has not shared experiences.

According to Foster et al (1984) population poverty is divided into 3 categories, namely the poverty rate index, the poverty depth index, and the poverty severity index. Poverty rates are higher in geographically isolated areas, with resources, lack of employment opportunities, low rainfall, and other hostile climatic conditions (Nargis, 2019). Astuti (2018) states that there is no significant difference between poor households headed by men and those headed by women. The results of research by Sarjono et al., (2017) show that the factors that influence the occurrence of poverty in households in East Jakarta City are gender, a number of household members, and the number of household members who work. Education and gender inequality have a significant and negative effect on poverty. Unemployment has a significant and positive effect on poverty in North Sumatra (Amalia, 2018).

#### IV. CONCLUSION

Based on the results of the research that has been obtained, it is necessary to create commitments and policies so that each agency, service, and office must produce programs and activities to reduce population poverty in South Tapanuli District.

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# Mixed Geographically and Temporally Weighted Regression with Cluster in West Java's Poverty Cases

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**Abstract-** Geographically and temporally weighted regression (GTWR) is a method used when there is spatial and temporal diversity in an observation. GTWR model just consider the local influences of spatial-temporal independent variables on dependent variable. In some cases, the model is not only about local influences but there are the global influences of spatial-temporal variables too, so that mixed geographically and temporally weighted regression (MGTWR) model is more suitable to use. The smaller the regional approach used, the better the resulting solution. This study examines the effects of clustering on MGTWR modeling. The cluster approach is used to reduce the modeling area and make the objects in the same clusters are more similar to each other than objects in other clusters. This study aimed to determine the model to be used in West Java's poverty cases in 2012 to 2018. The result showed that the GRDP, the percentage of literacy, the percentage of expenditure per capita on food, and health index are global variables. Whereas the variable expected years of schooling and households buying rice for poor (*raskin*) are local variables. Furthermore, based on Root Mean Square Error (RMSE), Akaike Information Criterion (AIC), and  $R^2$  was showed that MGTWR with cluster (MGTWRC) better than MGTWR when it used in West Java's poverty cases.

**Index Terms-** Cluster, Global and Local, MGTWR, Poverty, West Java

## I. INTRODUCTION

Spatial regression is a regression model that considers the spatial effects of the data. Some spatial regression methods have been developed, such as the general spatial model (GSM), the spatial autoregressive model (SAR), the spatial error model (SEM) and the geographically weighted regression model (GWR). According to Anselin and Getis (1992), spatial effect among locations can be caused by spatial dependence and spatial heterogeneity. Spatial dependence is defined as the dependence between a location and its surrounding. Spatial heterogeneity, meanwhile, is the variation caused by the differences in the effect of explanatory variables on the response among different locations. One of the spatial regression approaches used to solve the issue of spatial heterogeneity is geographically weighted regression (GWR) (Fotheringham et al. 2002). For each observation, the GWR model produces local parameter estimates (Purhadi and Yasin 2012).

In its analysis, GWR model only considers spatial effect of the data without taking into account the effect of time. In fact, some variables are not only observed based on its geographical location, but also based on its time. Temporal data can be used to provide information about the dynamics of spatial processes and to allow more relevant parameter estimates. Geographically and temporally weighted regression (GTWR) is the advancement of the GWR model that takes into account the effect of location and time. For each location and time, the GTWR model generates a local model (Huang et al. 2010). GTWR modeling utilizes a weight matrix  $W$  whose magnitude depends on the proximity of the location and time. The closer the location and time, the greater the weight is.

Not all explanatory variables used in GWR and GTWR have a spatial effect. The effects of certain explanatory variables are global and those of others are local. Therefore, the GWR model was developed into the mixed geographically weighted regression (MGWR) (Fotheringham et al. 2002). The MGWR model produces parameter estimates that are partly global and partly local according to the location. It also applies to the GTWR model that can be developed into the mixed geographically and temporally weighted regression model (MGTWR).

Poverty is one of the fundamental problems that has become the subject of government attention, especially in Indonesia. The government has made numerous attempts to minimize poverty rates. One of those is to recognize the factors that influence Indonesia's poverty rates. Moreover, the government also plays a role in classifying the needs of each regions according to their characteristics, especially in areas with high poverty rates. From year to year, the rate of poverty is changing. Therefore, it is important to study the poverty pattern in each region and to study the clusters of poverty year by year (Dewi 2011). Cluster analysis and regression analysis involving spatial and temporal aspects are quite relevant to be used in this case.

According to Dhiyaa'ulhaq (2017), the smaller the regional approach used, the better the resulting solution will be. Clustering, in this study, was used to decrease the modeling area and make the objects in the data have a high degree of similarity. A research conducted by Nuramaliyah (2019) noted that the MGTWR model was a better model than the GTWR model for estimating the percentage of poverty in the province of North Sumatra. The analysis by Andrytiarandy (2017) examined the methods of geographically weighted regression fuzzy cluster (GWRFC) and GWR. In overcoming problems in malaria prevalence cases, the

GWRFC method was better than GWR method. Therefore, the effect of clustering on MGTWR model was discussed in this study. Modeling in a smaller area, such as modeling on the clustered data, was expected to produce a better model. The best model would be selected based on the comparison of the RMSE, AIC, and  $R^2$  values.

## II. MATERIALS AND METHOD

### 2.1 DATA

The data used in this analysis was secondary data from the Central Bureau of Statistics 2012-2018 publication (BPS, 2018a, 2018b, 2018c). The data consisted of percentage of poverty as the response variable and six explanatory variables that were thought to affect the percentage of poverty. The selection of explanatory variables was based on previous studies. The variables used in this study are presented in Table 1. The districts and cities in the West Java Province, which consists of 17 districts and 9 cities, were the scope of this study.

Table 1: The variables used this the study

Variables	Note
$Y$	Poverty rate (%)
$X_1$	Gross regional domestic product (Billion Rupiah)
$X_2$	Literacy rate
$X_3$	Expenditure per capita on food (%)
$X_4$	Households buying rice for poor (%)
$X_5$	Expected years of schooling (Years)
$X_6$	Health index

### 2.2 ANALYSIS PROCEDURE

Steps of data analysis using R Studio are carried out as follows:

1. Explore the percentage of poverty in West Java in 2012–2018 using descriptive statistics.
2. Calculate pearson correlation coefficient to evaluate the relationship pattern of the explanatory variables that are thought to affect the response variable.
3. Conducting global regression modeling which includes:
  - a. Parameter estimation
  - b. Simultaneous and partial testing of regression parameters
  - c. Assumption testing
4. Performing multicollinearity test between explanatory variables using VIF value. If  $VIF > 10$ , then multicollinearity was present between variables.
5. Identifying the spatial and time heterogeneity in the data using Breusch-Pagan (BP) test. The hypothesis used was as follows:

$H_0: \sigma_1^2 = \sigma_2^2 = \dots = \sigma_p^2 = \sigma = 0$  (homoscedastic disturbances)

$H_1: \text{At least there is one } i \text{ where } \sigma_i^2 \neq 0$  (heteroscedastic disturbances)

Breusch and Pagan (1979) formulated the heterogeneity test statistics for cross-section data by deriving the lagrange multiplier (LM) formula. The Breusch-Pagan test statistics are:

$$BP = \frac{1}{2} \mathbf{f}' \mathbf{Z} (\mathbf{Z}' \mathbf{Z})^{-1} \mathbf{Z}' \mathbf{f} \sim \chi_p^2 \text{ with } f_i = \left( \frac{\varepsilon_i^2}{\sigma^2} - 1 \right)$$

Test criteria:  $BP = \begin{cases} \leq \chi_{(p-1)}^2, \text{ accept } H_0 \\ > \chi_{(p-1)}^2, \text{ reject } H_0 \end{cases}$

6. Performing cluster analysis.
  - a. Conducting cluster analysis with k-means method based on location coordinates for each year.
  - b. Using elbow method to determine the best number of clusters.
7. Performing MGTWR modeling on the overall data and the clustered data which includes the following stages:
  - a. Determine global and local variables using BP test
  - b. Calculate spatial-temporal distance ( $d_{ij}^{ST}$ ) on coordinates ( $u_i, v_i, t_i$ ).
  - c. Determine parameter estimates of spatial-temporal ratio ( $\tau$ ), spatial ( $\lambda$ ), temporal ( $\mu$ ), and bandwidth of spatial-temporal distance ( $h_{ST}$ ) using the minimum CV.
  - d. Calculate weight matrix

- e. Calculate the estimated value of global and local parameter.
- f. Test the global and local parameters model.
8. Comparing the goodness of the model based on the values of RMSE, AIC, and  $R^2$ .
9. Interpret the results by making a map based on explanatory variables that significantly affected the percentage of poverty in West Java's Province.

### III. RESULTS

#### 3.1 DATA EXPLORATION

Poverty is characterized as an economic inability to meet basic food and non-food needs, as measured in terms of expenditure, according to the Central Bureau of Statistics (2018). The percentage of poverty is one of the indicators that can be used to define the state of poverty in a region. Figure 1 shows the distribution map of poverty in West Java during 2012-2018.

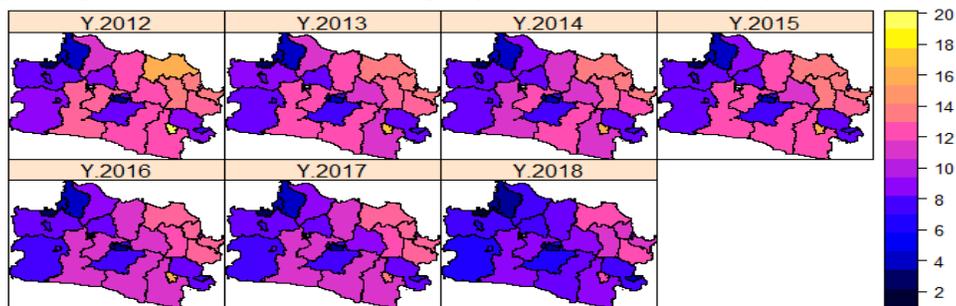


Figure 1: Distribution map of the West Java's poverty rate in 2012-2018

There are 26 regencies/cities consisting of 17 districts and 9 cities in West Java. In terms of location, each region in the same year had different percentages of poverty. Figure 1 indicates that there was a decline in the percentage of poverty that existed in many regions in the period from 2012 to 2018. It can be seen from the increasing number of blue and purple areas on the map. Figure 1 indicates that regions with about the same percentage of poverty tend to be in groups or have close proximity. This shows that the proximity between regions could affect poverty. Poverty in a region was affected not only by the factors in that particular region, but also by factors in other regions.

The linear relationship between each explanatory variable and the response variable was measured using Pearson correlation coefficient. The correlation coefficient of each explanatory variable and the response variable are shown in Table 2.  $X_3$  and  $X_4$  had a positive linear relationship with the Y variable. This meant that the higher the percentage of expenditure per capita on food ( $X_3$ ) and the percentage of households that have bought *raskin* ( $X_4$ ) in a region in West Java, the higher the percentage of poverty in that region.  $X_1$ ,  $X_2$ ,  $X_5$  and  $X_6$  had a negative linear relationship with the Y variable. This meant that the higher the gross regional domestic product ( $X_1$ ), the literacy rate ( $X_2$ ), the expected number of years of schooling ( $X_5$ ), and the health index ( $X_6$ ) in a region in West Java, the lower the percentage of poverty in the region.

Table 2: The correlation coefficient

Variables	Pearson correlation
Y and $X_1$	-0.3921
Y and $X_2$	-0.2689
Y and $X_3$	0.6752
Y and $X_4$	0.5911
Y and $X_5$	-0.5183
Y and $X_6$	-0.6030

One of the statistical tests used to see an indication of a risky linear correlation between explanatory variables is multicollinearity test. Multicollinearity test between variables was carried out based on the VIF (Variance Inflation Factor) value. Larger VIF value indicates a more risky linear correlation between explanatory variables. If the corresponding VIF value is greater than ten ( $VIF > 10$ ), the explanatory variables are multicollinear. Table 3 shows that all the explanatory variables' VIF values were below 10, so it was presumed that there was no multicollinearity between the explanatory variables. This indicated that the linear association between explanatory variables had a low risk.

Table 3: The explanatory variables VIF values

Variables	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$
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VIF	1.2603	1.2556	2.5252	1.6217	1.8605	2.3404
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### 3.2 SPATIAL HETEROGENEITY ANALYSIS

Testing for spatial heteroscedastic using the Breusch-Pagan (BP) test. This test was carried out on 26 regions in West Java in the period of 2012 to 2018 with an error rate of 10%. The results shown in Table 4 show that simultaneous test of the data in the period of 2012 to 2018 had p-values that was less than the error rate, so it could be inferred that the percentage of poverty in each area in West Java was spatially heterogeneous. Thus, the spatial regression method using geographically weighted regression is more appropriate for the poverty rate in West Java.

Table 4: Breusch-Pagan test

Year	Breusch-Pagan statistic value	P-value
2012-2018	12.1152	0.0594*

Note: \*) significant at  $\alpha = 10\%$

### 3.3 CLUSTER ANALYSIS

Elbow method was used to find the optimal k value in cluster analysis. Figure 2 shows the plot of the elbow method. The x-axis is the number of clusters and the y-axis is the sum of squares within the cluster. The optimum number of clusters was four since the plot shows that in the 4<sup>th</sup> cluster there was no longer a dramatic decline in the sum of squares within the cluster.

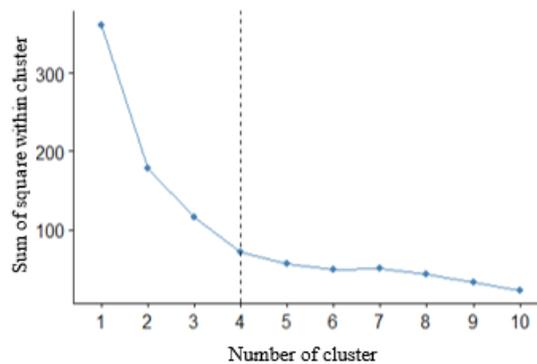


Figure 1: Elbow method based on the location coordinates

The results of clustering based on the location coordinates can be seen in Table 4. Based on the table, it can be seen that cluster 1 and cluster 2 each consisted of 5 regions, while cluster 3 and cluster 4 each consisted of 8 regions. The size of clustered data used in modeling was equal to the number of cluster members times the number of time.

Table 5: The results of clustering based on the location coordinates

Cluster	Cluster members	Number of members
1	Purwakarta, Karawang, Bekasi, Bekasi City, Depok City	5
2	Bogor, Sukabumi, Cianjur, Bogor City, Sukabumi City	5
3	Tasikmalaya, Ciamis, Kuningan, Cirebon, Majalengka, Cirebon City, Tasikmalaya City, Banjar City	8
4	Bandung, Garut, Sumedang, Indramayu, Subang, Bandung Barat, Bandung City, Cimahi City	8

### 3.4 MIXED GEOGRAPHICALLY AND TEMPORALLY WEIGHTED REGRESSION (MGTWR)

The model produced a total of 26 locations  $\times$  7 times = 182 models. This implied that each location had 7 models that were differentiated by year, starting from 2012 to 2018. The MGTWR model consisted of two kinds of variables, namely global and local variables. The determination of the variables was based on Breusch-Pagan test between the response variable (Y) and all the explanatory variables (X). Table 6 reveals that the variables  $X_1$ ,  $X_2$ ,  $X_3$ , and  $X_6$  had p-values that were more than the error rate, so it could be inferred that these variables were global variables. The variables  $X_4$  and  $X_5$  respectively, had p-values that were smaller than the error rate, so that these variables were local variables.

Table 6: The Breusch-Pagan test for the determination of variables

Peubah	BP test value	P-value	Note
Y and $X_1$	1.5246	0.2169	Global
Y and $X_2$	1.8023	0.1794	Global

Y and $X_3$	0.9599	0.3272	Global
Y and $X_4$	2.8246	0.0928*	Lokal
Y and $X_5$	3.1404	0.0764*	Lokal
Y and $X_6$	0.2751	0.5999	Global

Note: \*) significant at  $\alpha = 10\%$

A weight matrix constructed from a euclidean distance matrix using the best kernel function was needed for MGTWR modeling. Exponential kernel function had the smallest Cross-Validation (CV) value, so it could be concluded that the exponential kernel function was the best kernel function to be used in the weight matrix. The distance matrix in the modeling used the interaction between spatial distance and temporal distance. In order to resolve the unit difference between spatial distance, temporal distance, and spatial-temporal distance, a balancing parameter between spatial distance and temporal distance was required. The balancing parameters used were spatial distance ( $\lambda$ ), temporal distance ( $\mu$ ), and spatial-temporal distance ratio ( $\tau$ ) parameters. These parameters were obtained based on the smallest CV value. Based on the exponential kernel function, the parameter values for each data can be seen in Table 7.

Table 7: The parameters value of each data

	$h_s$	$\tau$	$\lambda$	$\mu$	$h_{ST}$
Overall	0.057330	0.000541	1.763584	0.000954	0.013410
Cluster 1	0.039304	0.000191	0.716689	0.000137	0.031625
Cluster 2	0.201451	0.003086	0.985350	0.002937	0.064279
Cluster 3	0.055421	0.000253	1.051998	0.000267	0.013865
Cluster 4	0.134703	0.000345	1.243425	0.000429	0.122321

Table 8 shows the results of MGTWR model's global parameters estimation. The parameter estimates of the gross regional domestic product (GRDP) ( $X_1$ ) of the overall data and each clustered data, were negatives. This indicated that if the GRDP in a region increased, the percentage of poverty would decrease. The estimated literacy rate ( $X_2$ ) and health index ( $X_6$ ) parameters in the cluster 1 data were positive, while those from the other clusters were negative. This illustrated that if the literacy rate and the health index in the Cluster 1 regions increased, the percentage of poverty would also increase. Meanwhile, in the other clusters, if the literacy rate and the health index in a region increased, the percentage of poverty in that region would decrease. The estimated parameter of the percentage of expenditure per capita on food ( $X_3$ ) was positive in the overall data. This meant that if the percentage of expenditure per capita in region increased, the percentage of poverty would also increase.

Table 8: Global estimated parameter of the MGTWR model of each data

	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_6$
Overall	-0.0746	-0.0648	0.0338	-1.7548
Cluster 1	-0.0858	0.1359	-0.0042	0.0981
Cluster 2	-0.1657	-0.0235	-0.0616	-0.2786
Cluster 3	-0.1019	-0.0502	-0.0116	-0.9233
Cluster 4	-0.0217	-0.0141	-0.0807	-2.1259

Table 9 shows the summary of the estimated local parameters of the MGTWR model in the overall data.  $\hat{\beta}_4$  and  $\hat{\beta}_5$  were the estimated parameters for the percentage of households buying *raskin* ( $X_4$ ) and the expected number of years of schooling ( $X_5$ ), each of which were local variables. Based on the results,  $X_4$  and  $X_5$  had a significant effect on the percentage of poverty among districts and cities in West Java

Table 9: Summary of Local estimated parameter in MGTWR model in overall data

Parameter	Minimum	Maximum	Average	Standard Deviation
$\hat{\beta}_0$	31.2100	682.3433	160.8183	67.5522
$\hat{\beta}_4$	-0.1502	0.0742	-0.0249	0.0352
$\hat{\beta}_5$	-45.2483	9.6022	-0.3153	5.5053

Based on Figure 3 and Table 9, the estimated parameter for the percentage of households buying *raskin* ( $X_4$ ) and the expected number of years of schooling ( $X_5$ ) had different values. In the overall data and in each cluster data, the estimated parameters for the percentage of households buying *raskin* ( $X_4$ ) had a negative mean. The estimated parameters for the expected number of years of schooling ( $X_5$ ) had a positive mean in cluster 2, while the other clusters had a negative mean.

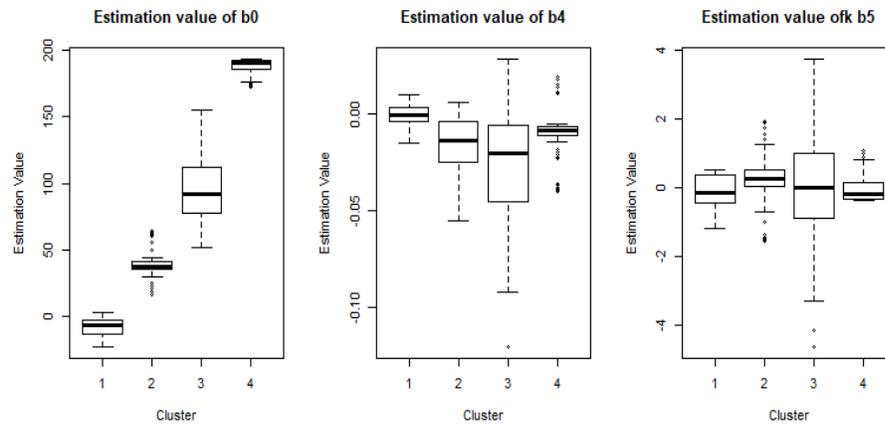


Figure 2: Boxplot of estimated local parameters of the MGTWR model in cluster data

Partial test for the global and local variables was carried out using t-test. The partial test on the global variables with an error rate ( $\alpha$ ) of 5% indicated that the gross regional domestic product (GRDP) ( $X_1$ ) had a significant effect on the percentage of poverty in the 1<sup>st</sup>, 2<sup>nd</sup>, and 4<sup>th</sup> clusters. In each clusters, the literacy rate ( $X_2$ ) had no significant effect on the percentage of poverty. The percentage of expenditure per capita on food ( $X_3$ ) and health index ( $X_6$ ) only had a significant effect on the percentage of the poverty in the cluster 4 data. The results of partial test of the local variables in the clustered data are presented in the form of distribution maps which can be seen in Figure 4.

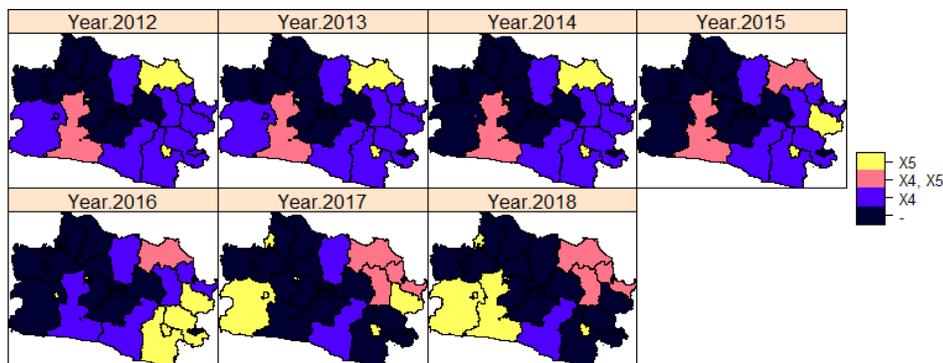


Figure 3: The distribution map of significant local variables in MGTWRC

### 3.5 COMPARISON GOODNESS OF MODEL

Based on Table 10, it can be seen that the MGTWRC model had the smallest RMSE value. The small RMSE value in the model indicated that the variance of the MGTWRC model was close to the variance in the observed data. The MGTWRC model also had a lower AIC value as compared to the MGTWR model. In other words, the MGTWRC model was more precise than the former MGTWR model.

Model	RMSE	AIC	$R^2$
MGTWR	0.3187	1156.9910	0.9952
MGTWRC	0.2464	810.2995	0.9923

The MGTWR with cluster model had an  $R^2$  value of 0.9923. Based on the value of  $R^2$ , the model's explanatory variables could explain the response variable by 99.23%, while other factors that were not included in the model explained the rest. Based on the resulting RMSE, AIC, and  $R^2$  values, it could be concluded that the MGTWRC model was better than the other models.

#### IV. CONCLUSION

The percentage of poverty varied spatially and temporally so that geographically and temporally weighted regression (GTWR) modeling could be carried out. The gross regional domestic product (GRDP) ( $X_1$ ), literacy rate ( $X_2$ ), percentage of per capita expenditure on food ( $X_3$ ), and health index ( $X_6$ ) had a global effect. Meanwhile, the percentage of households that bought *raskin* ( $X_4$ ) and the expected number of years of schooling ( $X_5$ ) had a local effect.

The MGTWR with cluster (MGTWRC) model was a better model than the former MGTWR model for estimating the percentage of poverty in West Java. The smaller the regional approach used, the better the resulting solution. In this study, clustering was used to decrease the modeling area and make the objects in the data have a high degree of similarity. Based on the resulting RMSE, AIC, and  $R^2$  values, it could be concluded that the MGTWR with cluster model was better than the other models. Therefore, the MGTWR with cluster model was the best model in modeling the percentage of poverty in West Java in 2012-2018.

The partial test on the global variables showed that the gross regional domestic product (GRDP) ( $X_1$ ) had a significant effect on the percentage of poverty in the 1<sup>st</sup>, 2<sup>nd</sup>, and 4<sup>th</sup> clusters. Overall, the literacy rate ( $X_2$ ) had no significant effect on the percentage of poverty. The percentage of expenditure per capita on food ( $X_3$ ) and health index ( $X_6$ ) only had a significant effect on the percentage of the poverty in the cluster 4 data. In addition, the partial test on the local variables showed that the effect of the percentage of households buying *raskin* ( $X_4$ ) and the expected number of years of schooling ( $X_5$ ) on the percentage of poverty varied in each cluster in West Java.

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# Impact Of Social Media On General Health Of Adolescent

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**ABSTRACT-** Social media has strong impact on all ages but adolescent are more vulnerable to its effect, as this is the changing phase from childhood to adolescent. To analyze the effect of social media on general health of adolescent the questioner study was designed and by using simple sampling of 100 students were selected from different schools from Karachi Pakistan. By the result we analyzed that social media play a vital impact on health of adolescent.

**Keyword-** Health of Adolescent, Social Media Impact on Health, Social Media and Adolescent.

## I. INTRODUCTION

Adolescence is the period of developmental transition between childhood and adulthood. It involves changes in the personality, as well as in physical health, intellectual and social development. During this time of changes teens are faced with many issues, so they must be physically mentally and socially fit. Since last era, social media found to be a power full addiction to the health care communicators. Intensity of online world is thought to be a factor or that trigger depression in some adolescent which may lead to social isolation. Various physical issues have also been reported.

Many researches have conducted researches to evaluate the impact of social media on youth but adolescent is a crucial age to adopt any kind of positive as well as negative changes. Previous researchers used random sampling methods that covers all age group and could not focused on teenagers only. They collaborate with their peers whether for study purpose or for entertainment through social media. Millenials are expose to all type of technologies in many aspects of their life's (Browning Gerlich and Wester Mann 2011). Internet allurements can embrace the young population and persuade them to spend excessive time. This can lead to internet addiction. Although internet is not an addiction but attractive online applications can be addictive (Young 1998).

Researchers have discovered that teens are showing certain change in their life style behavior and which may have major concerned for their parents, teachers and future growth, for example they have opted sedentary life style, reduce out door physical activities, distraction from social circles, studies and their parents. They also exhibit signs of loneliness depression, anxiety etc.

They rely more on internet friends rather making true relationship or friends. This is the age when person wants to make his personality present able to all and want appraisal through likes and good comments some time, they lose self-stem when they could not get desired level of appreciation.

Our study is focused on adolescent or teen agers age from 12 to 18. We design our study to figure out the core changes such as mental health (social anxiety, sleeping disorders, behavioral changes etc.), physical health changes and also to evaluate inability to acquire social skills for example creating healthy interaction with people, self-esteem etc.

To evaluate the desired outcomes a questioner base survey among senior students of school and asked the question relevant to their changes in behavior, thinking, habits and physical fitness after using social media.

We kept the privacy maintained so that children could fairly disclosed the information about themselves we asked twenty-two questions of different aspects. We believe our study disclose the positive and negative effect occurring at this stage in teenagers so that teachers, parents, pedagogic and health policy makers can understand the intensity of the outcomes and make a proper awareness programs and policies to mediate the situation.

We are researching to evaluate the effects of social media on their quality of life. We will discover to what extent teens are exhibiting physical, behavioral, mental and social issues. Our study will also focus on impacts of social media usage on their studies.

**BACKGROUND-** Since two decades, social media continue to grow in popularity as it promises a lot for the modern youth. Since 1990 rapid use of internet caught the attention of researchers (Rotsztein 2003) and many researchers have conducted researches exploring positive and negative impact of social media on peoples personal, social, physical and mental health<sup>(1)</sup>. Till 2000's, the Web(internet) became essential part in developing skills to match the pace of modern technological world. It also provides everyone chance to connect to one another in this vast network generated by the Internet. Social media has also been widely adopted, with high enthusiasm around the world. Internet technology today shows a quick progress, and social networks

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increase their number of users on each day. Social networking is one of the main indicators of the technology era, attracts people of all ages while the virtual world goes beyond the real life via the applications it offers. It also has been described as an important part of a young person's life and a platform for experimentation, creative self-expression and identity formation. Informal learning opportunities, interest-based groups, development and maintenance of friendships<sup>(2)</sup> and fun but it can be dangerous when comes in wrong hands. In many studies Youth stand out to be the highest users among the web users. The adolescents found to be more involved in using different social networking sites and are more vulnerable to its negative outcomes. A study conducted on effect of social media on youth in University of Sargodha upon 380 students which have randomly selected for collection of primary data. In these 380 students, 53% students are 19 to 20 years old, 27% are 17 to 18 years old and remaining 20% are above 20. From these respondents, 49% are Male and remaining 51% are Female<sup>(3)</sup>.

This research seeks to find out what use social media are in the lives of the youth. With the advent of information Technology (IT) almost everywhere, there has been a dramatic adjustment in the way we live. IT tools such as computers, Tablets and mobile phones have become valued elements in the lives of youths merely because it aids them to interact and communicate freely. School going teens spend more time on mobile gaming texting watching videos, sharing personal pictures etc, and this addiction has transformed their mental physical and social status Web-based technologies now encompass the socializing features of virtual spaces that have emerged as zones for information sharing, collaboration, and community formation and extension (Suter, Alexander, & Kaplan, 2005).

**OBJECTIVE OF STUDY-** The objective of the study is to explore the impact of social media on health of adolescents.

**Null Hypothesis-** There are no effect of social media on general health of adolescent.

**Alternate Hypothesis-** There are effects of social media on general health of adolescent.

## II. LITERATURE REVIEW

Evidences shoes that there is a relationship between social media and its impacts on the behavior of youth. Therefore, peoples and target audience receive messages in real time and develop changes and tendencies. Tapscott (1998) Currently youth grow up with large number of contacts using different types of social media. They are conveniently adopting digital literacy and live in digital world in which elderly peoples are only naturalized citizens. Children had trust on internet. Those counties who have ICT (Information Communication Technology), social media furnish chances to contribute with those countries. Livingstone and Bober (2003) the main cause of generation gap in different ways such as lack of awareness, recognition of domestic rules, and in what children were really acting and what were parent's views about their children's activities, is social media. Social media made people forgot their rituals and traditions.

Berson and Berson (2005) present that high risk is associated with excessive use of internet, and with simple use of internet there is no risk. Early in childhood, they need guidance of someone as they did not have awareness about the risks. During teenage, they are not able to make life's decisions.

Elola and Oskoz (2008) said, Social media was very beneficial in establishing business relationship with other countries and social media has positive results in establishing and understanding cultural relationship.

Brady, Holcomb, and Smith (2010) said that efficient ways for education is provided by social media. Social media for E-learning is used by students.

Lusk (2010) stated that, students use social media for academic purpose. Social media helps students to learn and improve their communication skills. Student increase their learning skills by using new web tools provided by social media.

In views of Jacobsen and Forste (2011), while doing home work or in class two third of the students use social media which has negative impacts on grades.

According to Kalpidou, Costin, and Morris, grades and social media has a relationship, according to Ohio state University those students who spent time on social media has low grades comparative to those students who did not spent time on social media.

Waddington (2011) stated that, youth believe that social media is an important component of their culture; not a craze. It could improve their capabilities and they used it as an educational tool (4).

## III. METHODOLOGY

**Sample Size and Study Design-** Our research-based survey study includes structured questionnaire to collect data from desired sample we collected data from students studying in schools of different socio-economic groups such as lower class, middle class and upper class. We collected data from all private sector schools of Karachi. We distributed 120 survey questionnaires in different schools of Karachi and received 110 questionnaires back from respondents, out of which 10 questionnaires were not completely filled so we receive complete response from 100 respondents.

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We use random sampling technique to collect data from respondents aged between 12-18.

**Measures-** We distributed questionnaires in different private schools of Karachi and used dichotomous scale in which there are only YES or NO options so that students can choose 1 suitable option easily. We use internet effect scale to determine the effect of excessive use of social media on their health. We designed our questions to identify the different health issues which includes physical, mental, social and behavioral health issues, these questions were based on the Internet Scale IES (Internet Effect Scale). Out of 27 questions 5 were demographic questions which gives demographic details of respondents for e.g., age, gender, socio-economic status, siblings and family system. 123 were mental health questions to evaluate effect of social media on mental health of adolescent, 123 were behavioral health questions to observe changes in behavior of adolescent due to excessive use of social media, 123 were physical health questions to evaluate the negative impact on the physical health and 123 were social health question to check impact on social media on their social interactions in daily life, there are few questions which helps to evaluate the impact of excessive use of social media on academic performance of student.

#### IV. RESULTS

**AGE-** Out of 100 respondents 62 were between the age of 12 to 15 and 38 were between 16 to 19 and 100% students responded to the questioner as shown in table in table and graph

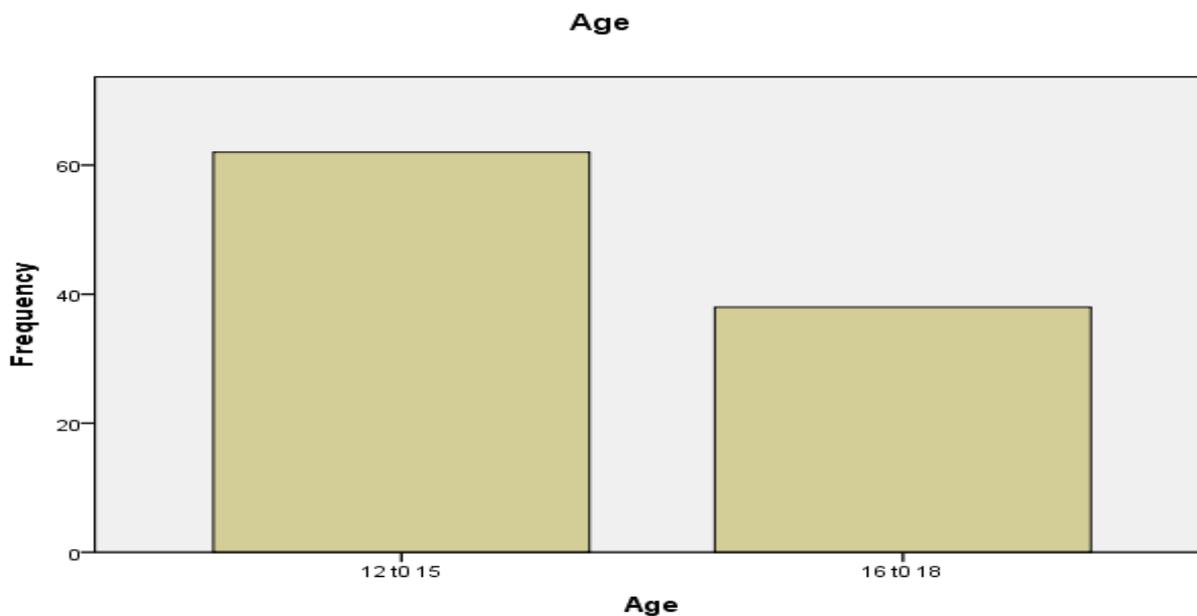
#### Statistics

Age

N	Valid	100
	Missing	0
Mean		1.3800
Median		1.0000
Mode		1.00
Std. Deviation		.48783

#### Age

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 12 to 15	62	62.0	62.0	62.0
16 to 18	38	38.0	38.0	100.0
Total	100	100.0	100.0	



**GENDER-** out of 100, 48 were male and 52 were female and 100% responded to the questioner

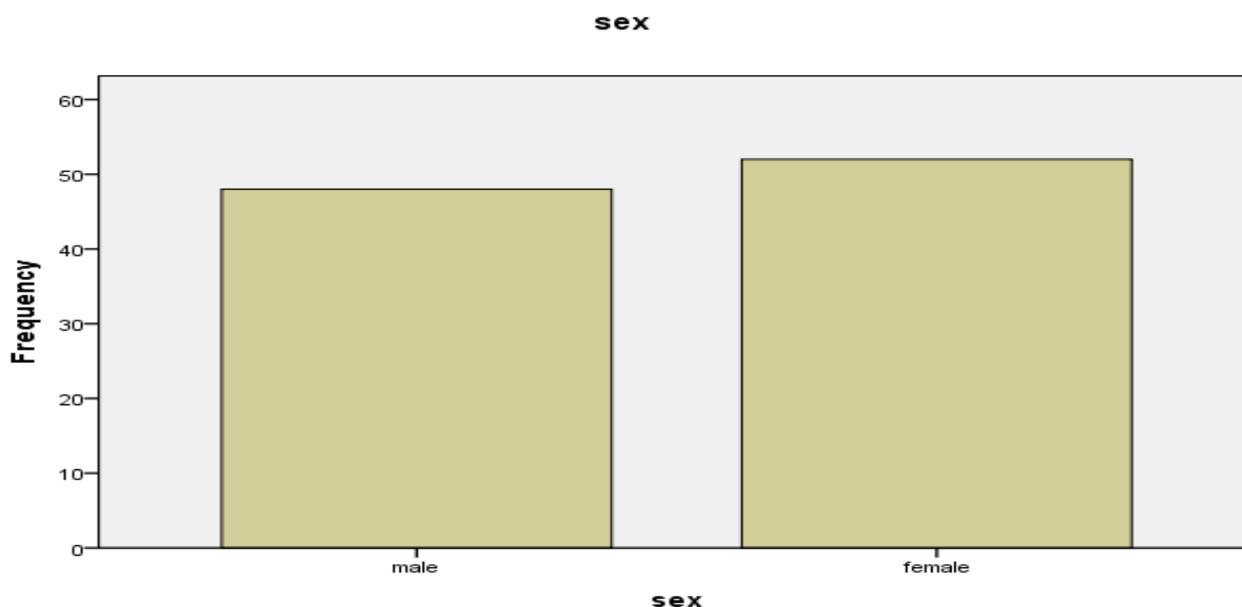
**Statistics**

SEX

N	Valid	100
	Missing	0
Mean		1.5200
Median		2.0000
Mode		2.00
Std. Deviation		.50212

**SEX**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid male	48	48.0	48.0	48.0
female	52	52.0	52.0	100.0
Total	100	100.0	100.0	



**CLASS-** we took three socioeconomic classes upper class ,middle class ,and lower class .most of the students belonged to middle class about 81 in number as shown in table and graph.

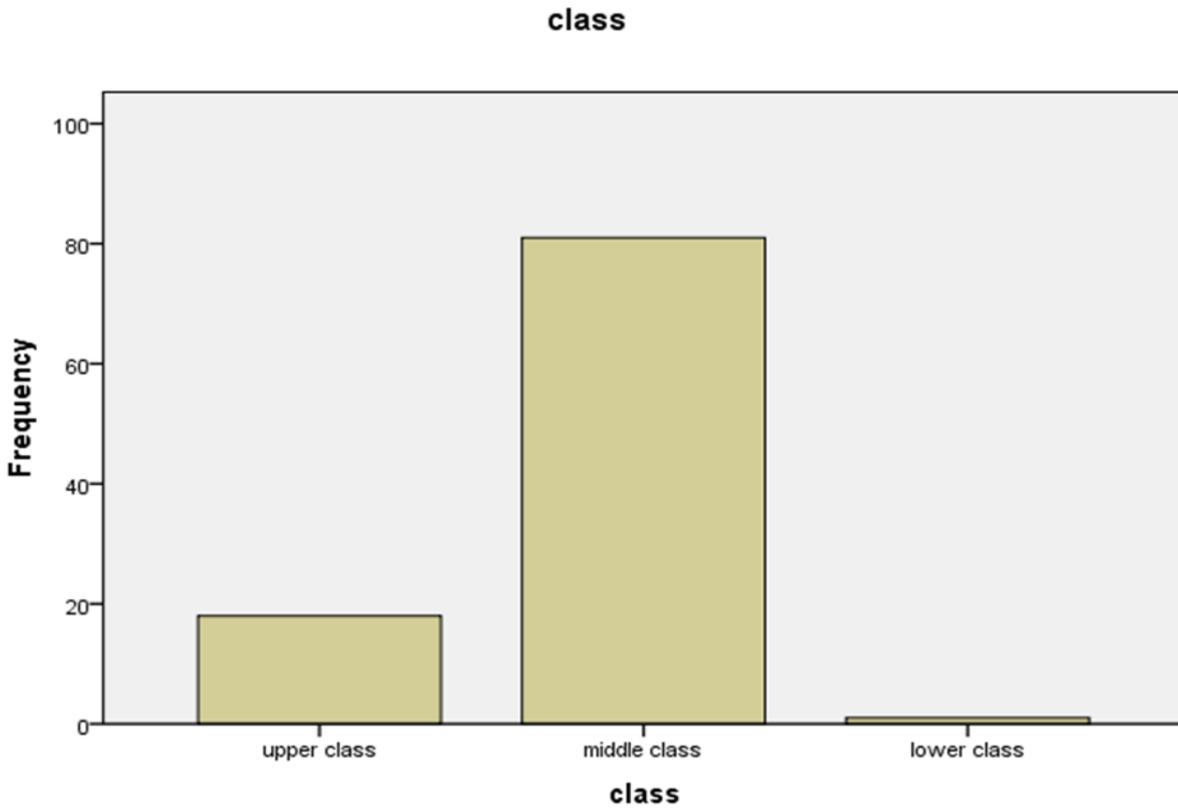
### Statistics

Class

N	Valid	100
	Missing	0
Mean		1.8300
Median		2.0000
Mode		2.00
Std. Deviation		.40339

Class

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid upper class	18	18.0	18.0	18.0
middle class	81	81.0	81.0	99.0
lower class	1	1.0	1.0	100.0
Total	100	100.0	100.0	



**NO.OF SIBLING-** out of 100 students ,students inform that only 6 don't have any sibling other 14 have One and 22 have 2 ,31 have 3 and 15 have 4 and 4 have 5 and 6 have 6 siblings as shown in graph and table below.

Statistics

no.of siblings

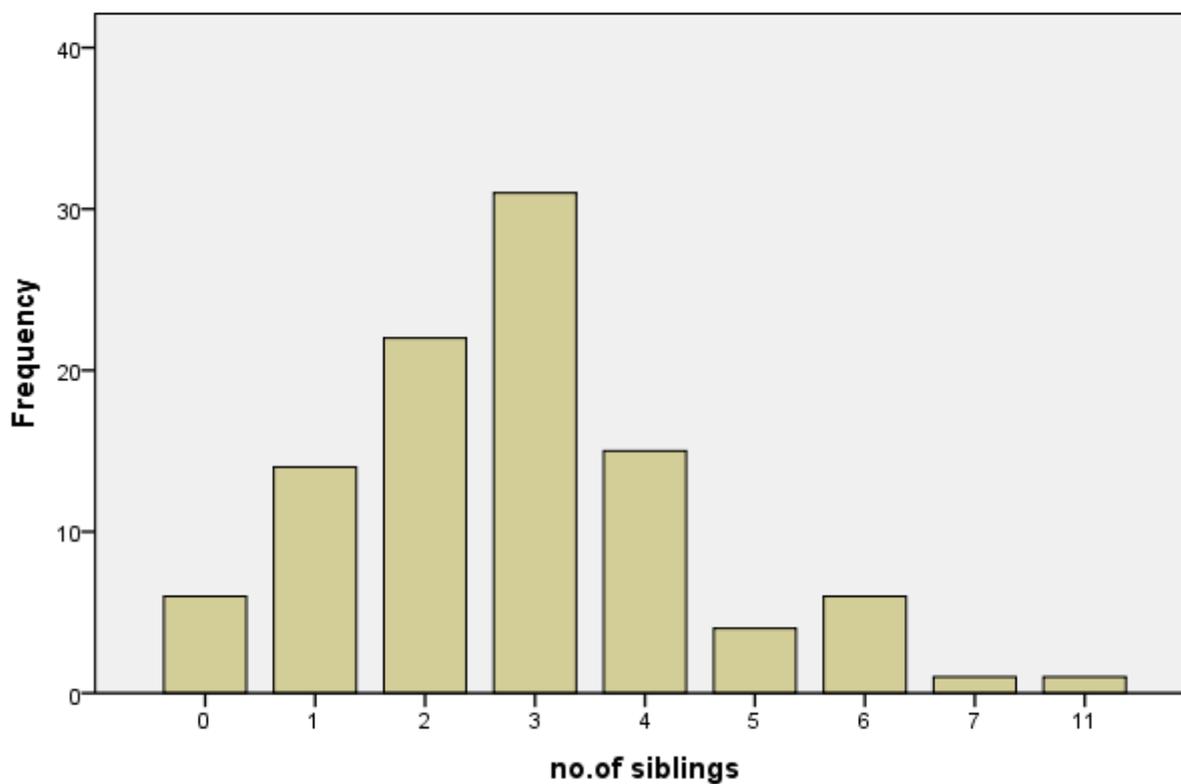
N	Valid	100
	Missing	0
Mean		3.8500
Median		4.0000
Mode		4.00
Std. Deviation		1.72548

no. of siblings

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 0	6	6.0	6.0	6.0
1	14	14.0	14.0	20.0

2	22	22.0	22.0	42.0
3	31	31.0	31.0	73.0
4	15	15.0	15.0	88.0
5	4	4.0	4.0	92.0
6	6	6.0	6.0	98.0
7	1	1.0	1.0	99.0
11	1	1.0	1.0	100.0
Total	100	100.0	100.0	

no.of siblings



Statistics

**FAMILY SYSTEM-** out of 100 students 61 belonged to nuclear family system and 39 were belonged to extended family system as shown below.

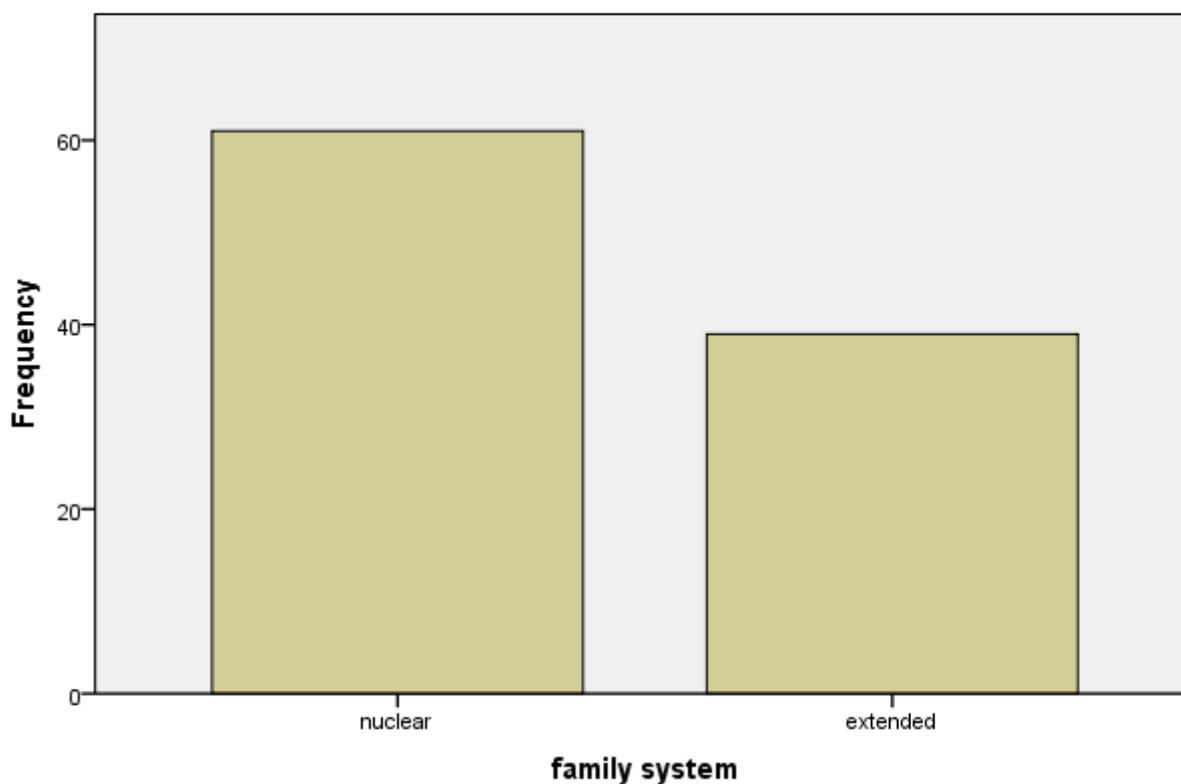
Family system

N	Valid	100
	Missing	0
Mean		1.3900
Median		1.0000
Mode		1.00
Std. Deviation		.49021

family system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Nuclear	61	61.0	61.0	61.0
	Extended	39	39.0	39.0	100.0
Total		100	100.0	100.0	

family system



**IMPACT ON GENERAL HEALTH-** This study shows that there are negative impacts of social media on the health of adolescent. Out of 100 respondents, most respondent have social problem (mean=10.7500) followed by mental problems (mean=8.90) then physical problem (mean=7.500) respondent also has educational problems (mean=3.34) and shows behavioral problem (mean=3.07). This shows that social media has impact on adolescence mental health, reduced their social interaction and outdoor activities but at the same time study shows that their education and learning abilities are not effected as their social behavior.

**Descriptive Statistics**

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
social problem	100	7.00	7.00	14.00	10.7500	1.39534	1.947
physical problem	100	5.00	5.00	10.00	7.5500	1.55294	2.412
mental problem	100	6.00	6.00	12.00	8.9000	1.32192	1.747
Behaviouralproblem	100	2.00	2.00	4.00	3.0700	.78180	.611
educational problem	100	2.00	2.00	4.00	3.3400	.76831	.590
Valid N (listwise)	100						

**Descriptive Statistics**

	Std. Deviation	Variance
social problem	1.39534	1.947
physical problem	1.55294	2.412
mental problem	1.32192	1.747
Behavioral problem	.78180	.611
educational problem	.76831	.590
Valid N (list wise)		

**V. CONCLUSION**

This descriptive study shows that excessive use of internet has strong negative influence on the health of adolescent. It has influence on the social, mental, physical and behavioral factors of health of adolescent, academic performance has also been affected by the massive use of social media. Above result shows that adolescent mostly have social problems after intrusion of internet as they prefer having online relationships rather than interacting with peoples for example interacting with friends and relatives etc. Second most common health issue identified in our result is mental disturbance, they face mood swings, depressive and anxiety due to long hours usage of internet. Adolescent found to have detrimental effect on physical health such as vision, headache, migraine, fatigue and backache. Adolescent also face different behavioral issues. Other health issues excessive use of internet also declines the educational performance of students such as lack of interest in homework and bad grades.

**DISCUSSION-** As we know health is the name of mental, physical and social wellbeing. By introduction of social media in our society the health of the people is facing devastating effect and teen agers who are at the stage of transformation from childhood to adulthood cannot maintain appropriate usage of internet. Youth is depriving of social interaction by which they can share ideas acquire information also be exposed to many opportunities in vicinity, but the internet is unregulated world it has no form of morals and laws and relationship constrain that are essential to healthy behavior. Adolescent are exposed to variety of content for example aggressive gaming videos verbal outburst that can lead to serious mental breakdown, they may have anxiety attach and depression. In education internet usage can be advantageous but inability of young people to evaluate the contents and

staying online for long deteriorate their performance in school and colleges so there is utter need to spread awareness to adolescent about the appropriate use of internet in order to improve quality of health.

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# A new efficient encryption and decryption method using a Lossless Data Compression Scheme

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**Abstract**—With the advancement in internet technologies, data communication via the internet has been increasing day by day. Everybody, who is on the global network, may anguish about the safety of their sensitive data, information security, and privacy. Therefore, security threat has become the global complication in the world and this complication is increased continuously. The previous researcher proposed algorithm was not much efficient and time saving that's why we proposed a time saving a little bit more reliable algorithm. Cryptography is the component of information security that is used for message authentication, privacy, and certification. In this paper, we have described a new symmetric technique using shuffling, High-frequency latter, forward & backward function, and also old methods of cryptography which are already defined. The combination of all these makes the algorithm efficient and also time-saving

**Keywords**—Encryption; decryption; mean; cryptography

## INTRODUCTION

Our world such as our lifestyle, way of thinking, way of working each and everything has changed due to digitalization. Every person who wants to send, receive information, data, service and it's all communication must have to require security, privacy, and protection. Network security plays a vital role in data protection and security from hacking. [1].

When hacking has become a big complication, the requirement of a cryptography mechanism to avoid threats of integrity, confidentiality, and availability is increased. The cryptography mechanism is a combination of several techniques that helps to control security problems. It also

makes secure communication and provides high protection to data from the reach of hackers[2].

In cryptography, one thing that is mostly being used for both encryption and decryption is the symmetric key. It means that the same key is used for decryption and encryption. This key helps you to shared information between the two parties over the internet that is possible when the sender and receiver know the secret key. The main deficiency in the symmetric key is shared among the people publicly on the second-hand asymmetric key used different keys for encryption and decryption[3].

Cryptography depends upon some other factors such as Plain text, ciphertext, secret key. Plain text is the form of text or information that every person can understand easily. This information is a combination of characters, symbols, etc. The secret key performs a vital role in the cryptographic algorithm, it is used for encryption and decryption.

Encryption is the process, which is used for the translation of the simple text into un-understandable text and increase the security of a message or text. The Ciphertext is the result of an encryption process that is difficult to understand and read.it. Decryption is the reverse of the encryption which is used for converting cipher text into original text [4][5][6].

This paper is categorized into different sections. The first section is related to the basic knowledge of network security and cryptography analysis. In the second section, we describe the related work that has been already defined by many

researchers and scholars in the field of network security. The third portion contains a complete description of an algorithm that is being proposed in this paper. The next and last portion of this paper is related to the future work that we will cover in the future.

**RELATED WORK**

The following proposed algorithm that is defined in this paper is the mixture of different already proposed techniques and some cryptography information. This portion defines some early proposed techniques.[2].

Chachapara, K. et al [7] performed protected sharing with cryptography in encrypted cloud computing is also meant the architecture used uses the algorithm like RSA, along with AES which is the most secure algorithm in the field of cryptography. The Cloud controllers created keys for each user to have related privileges to access their files.

Orman, H. [8] describe several techniques on the development of cryptography, according to the author that the hash function plays an important internal role in cryptography, providing almost any data number, and in the MD5 drawbacks became known, it directed toward undoubted influences how the hash function is calculated.

Gennaro R. [9] defined the classification of cryptography and described that the randomness was the outcome of the unfamiliar steps, said to be the cause of why the important is cryptography. The attacker could not find or predict about original information.

Preneel, B. [10] clarifies cryptographic techniques and in the environment of the Snowden period where he talked about the crowds, it also studies the implementation and security of IT systems such as knowledge of the methods of attack where assassins can cross or unreasonably withdraws.

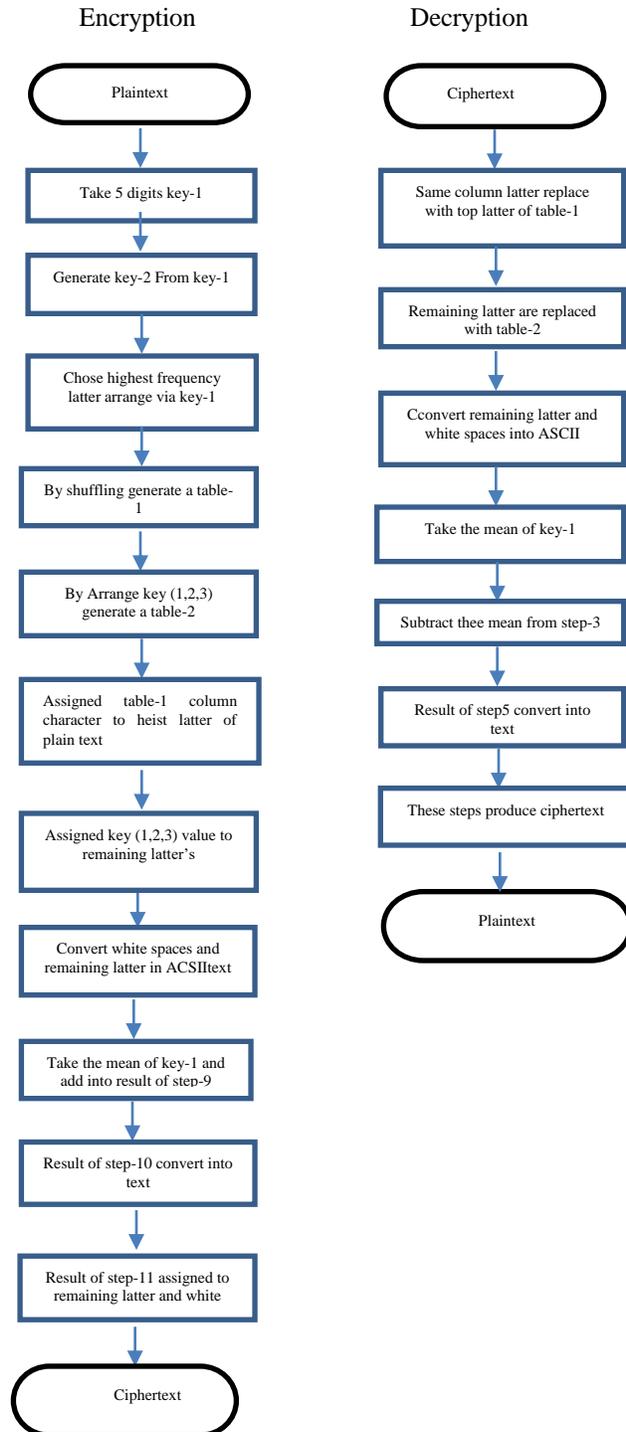
Sadkhan, S. B. [11] demonstrates the principles and procedures in cryptography where Julius Cesar describing the current situation of Arab industrial and efforts for education in this region and is about a review for a new filtering system for information security.

Muhammad Azhar Mushtaq, Abid Sultan .et all[12] defined a new coin-flipping-based algorithm. the proposed technique is based on coin flipping and ASCII values. CFA is a more efficient technique that was used in this algorithm because ciphertext is difficult to break than other proposed techniques. Moreover, the randomly key created is equal to the size of the plaintext block due to growing security.

In this paper, Muhammad Azhar Mushtaq, Abid Sultan .et all[13] developed a cryptographic algorithm that was based on ASCII value and gray code. Before Gray code is not used in any cryptography techniques. AGS is a strong algorithm because the size of encrypted text is less than then original text. The shifting operation is performed on both randomly key generated and plain text. The Block size of plain text is equal to the key therefore increasing the level of security.

**PROPOSED WORK**

This paperer aims to define a more effective and complex algorithm. The proposed algorithm has a little bit more reliable encryption and decryption process than the previously proposed algorithms. The previous algorithm was much time-consuming so we proposed a time-saving algorithm.



Flowchart.1 Ecrption and Decryption

A. Encryption

The proposed algorithm is divided into two parts.

The first part is related to the keys.

Step1:

Take a 5-dights key from the user.

Step2:

Generate a new 5-dights key from key-1 with forward and back shuffling called key-2.

Step3:

Chose the highest frequency latter from alphabets and arrange via key-1. The resultant is called key-3.

The second part is related to creating a table and generating a ciphertext.

Step4:

By Shuffling of the highest frequency latter, we generate a table called table-1.

Step5:

Assigned keys (key-1-2-3) values respectively to table-1 characters which are a result as a table-2.

Step6:

Chose the highest frequency latter from plain text and assigned the column characters of table-1 to the highest frequency latter of plain text in forwarding manner first column latter to the first occurrence then move on.

Step7:

Repeat Step6 for the top 5highest frequency latter of plain text.

Step8:

Assigned keys (key-1-2-3) value to the remaining latter's which Belongs to table-2.

Step9:

Convert white spaces and remaining latter into ASCII.

Step10:

Take the mean of key-1 and add to the ASCII value of the existing white spaces and remaining latter.

Step11:

The result of step 10 converts into text.

Step12:

The result of step 11 is assigned to the existing white spaces and remaining latter of plain text.

Step13:

These steps 1 to 12produces a ciphertext.

B. Decryption

Step1:

Replace the same column characters with their top latter of table-1.

Step2:

The remaining chipper text latter's is replaced according to table-2 latter.

Step3:

Convert remaining latter and white spaces of ciphertext into ASCII.

Step4:

Take the mean of key-1.

Step5:

Subtract the mean from the result of step 3.

Step6:

The result of step5 converts into text.

Step7:

These steps produce plain text.

EXAMPLE

C. Encryption

The proposed algorithm is divided into two parts. The first part is related to keys

Key: 53142F1B3

Plain text: "I am happy because All is well in my life"

Step1:

Take a 5-dights key from the user with forward and back.

Key: 53142F1B3

Step2:

Generate a new 5-dights key from key-1 with forward and back shuffling called key-2.

F=1 & B=3

5+1-3=3

3+1-3=1

1+1-3=-1+9=8

4+1-3=2

2+1-3=0+9=9

KEY-2=31829

Step3:

Chose the highest frequency letter from alphabets and arrange it via key-1. The resultant is called key-3.  
 “E, U, A, O, N”

I	J	K	P	Q
R	T	V	W	Y
R	T	V	W	Y

Arranged form: “N, A, E, O, U”

The second part is related to creating a table an generating a ciphertext.

Step4:

After the Shuffling of the highest frequency letter table-1 is generated.

TABLE-I SHUFFLING OF THE HIGHEST FREQUENCY

E	U	A	O	N
B	D	F	G	H

Step 5:

Assigned keys (key-1-2-3) values respectively to table-I characters which are the result as a table-II.

TABLE II. (assigned keys to table-1)

B	D	F	G	H	I	J	K	P	Q	R	T	V	W	Y
5	3	1	4	2	3	1	8	2	9	N	A	E	O	U

Step 6,7:

Chose the highest frequency letter from plain text and assigned the column characters of table-1 to the highest frequency letter of plain text in a forwarding manner (first column letter to the first occurrence then move on). Repeat this step for the top 5 letters of plain text.

TABLE III(assigned frequency letter to plain text)

I	A	m	h	a	p	p	y		b	e	c	a	u	s	E	a	L	l	I	s	w	e	l	l	I	n	m	y	l	I	f	e	
	F		k						b	v	d	I	F									r					h						b

Step 8:

Assigned keys (key-1-2-3) value to the remaining letter’s which Belongs to table II.

TABLE IV (assigned keys value to remaining plain text letter)

I	A	m	h	a	p	p	y		b	e	c	a	u	s	e	a	L	l	I	s	w	e	l	l	I	n	m	y	l	I	f	e
3			2	2	2	u	5												3		O				3			u		3	1	

STEP 9:

Convert white spaces and remaining letter into ASCII.

Character	ASCII
M	77
C	67
S	83
L	76
Space	32

Step10:

Take the mean of key-1 and add to the ASCII value of the existing white spaces and remaining letter.

$$m = \frac{\text{sum of the terms}}{\text{number of the terms}}$$

$$m = \frac{5 + 3 + 1 + 4 + 2}{5}$$

m=3

Character	ASCII+mean
M	77+3=80
C	67+3=70
S	83+3=86
L	76+3=79
Space	32+3=35

ASCII+mean	Character
77+3=80	P
67+3=70	F
83+3=86	V
76+3=79	O
32+3=35	#

Step11:  
 The result of step 10  
 converts into text.

Step12:

The result of step 11 is assigned to the existing white spaces and remaining letter of plain text.

TABLE V (existing white spaces converting)

I		a	m		h	a	p	P	y		b	e	c	a	U	s	e		A	L	L		I	s		w	e	l	l		I	n		m	y		l	I	f	e		
	#		p	#						#		f			v	#			o	o	#		v	#			o	o	#		#	p	#									

Step13:

These steps 1 to 12 produces a ciphertext.

TABLE VI (ciphertext)

I		a	m		h	a	p	p	y		b	e	c	a	u	s	e		A	L		l		I	s		w	e	l	l		I	n		m	y		l	I	f	e
3	#	f	p	#	2	k	2	2	u	#	5	b	f	v	d	v	I	#	F	o	#	o	#	3	v	#	o	r	o	o	#	3	h	#	p	u	#	o	3	l	b

Ciphertext: “**3#fp#2k22u#5bfvdvi#fo#o#3v#oroo#3h#pu#o31b**”

D. Decryption

Ciphertext: **3#fp#2k22u#5bfvdvi#fo#o#3v#oroo#3h#pu#o31b**

Step1:

Replace the same column characters with the top letter of table1.

TABLE VIII. RESULT OF DECRYPTION STEP 1

		f			k						b		v	d		I	F									r					h								b		
I		a	m		h	a	p	p	y		b	e	c	a	u	s	e		A	L		l		I	s		w	e	l	l		I	n		m	y		l	I	f	e

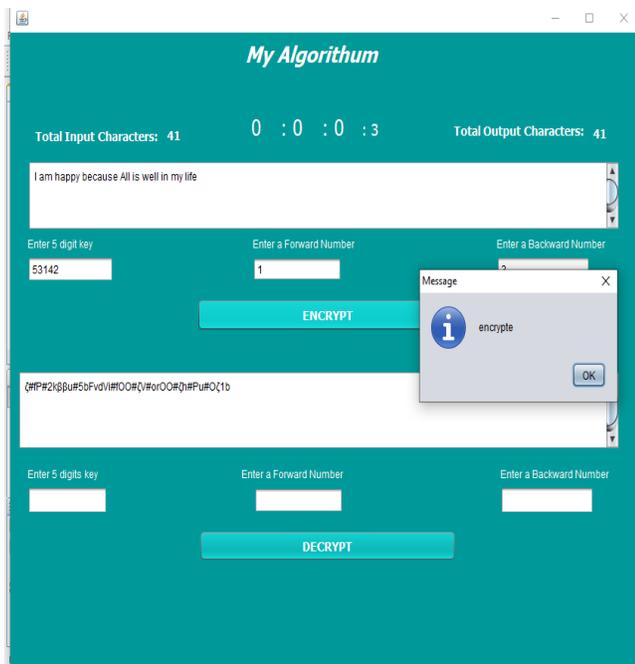
Step2:



**“I am happy because All is well in my life”**

**IMPLEMENTATION & CALCULATING EXECUTION TIME**

as highlighted in figure1 the implementation of the proposed algorithm is performed in java.net. This takes input from the user as a plain text and the secret key with forward and back shuffling to encrypt and decrypt the data. Finally this implementation also calculates the execution time of the algorithm in a microsecond.



**I. CONCLUSION**

In this paper after analyzing the disadvantages of multiple substitution techniques, we proposed a new method which is the mixture of existing algorithms. The currently proposed technique is secure than the previous methods and it produces relative ciphertext in less execution time. Our main focus is to improve security and decrease execution time as compared to already proposed methods. In the future, we will work on white spaces, character cases and utilization of memory

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Figure.1 Algorithm Interface

TABLE XIII. EXECUTION TIME

Characters	Execution time
41	0:0:0:3
280	0:0:0:30
560	0:0:0:60
1120	0:0:0:120

Table 13 represents the execution time of the proposed algorithm based on different length of plain text block.

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# A Cooks Distance Approach To Obtain Optimum Liquidus Temperature Of TIG Mild Steel Weld

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**Abstract-** The liquidus temperature factor is a very important parameter considered to determine the quality and strength of a welded joint, this study employs the cooks distance approach to optimize the temperature at which the weld joint is completely liquid. Twenty experimental runs was generated, which guided as an experimental layout , 10 mm thickness of low carbon steel was selected for the experiment which was welded with the TIG welding process. The RSM model was used to develop an optimal solution that can explain the behavior of the welded joint with respect to the liquidus temperature, different diagnostic techniques were employed which includes the normal probability plot, contour plot and the cooks distance plot. The model developed has sufficient merit as the results obtained shows that the cooks distance values is within the range of 0 and 1 indicating the absence of outlier in the data making the optimal result strongly acceptable.

**Keywords:** cooks distance ,optimum ,liquidus temperature ,mild steel weld, control

## Introduction

Optimization of most welding processes of mild steel should result in a significant reduction in the production cost and improve the quality of fabricated engineering structures. In the refining processes, optimizing the slag regimes [1,] thermal and chemical homogenization of the melt [2] or filtration of steel [3] is very important to solve. Works toward optimizing the process of solidification of heavy forging ingots [5] were implemented in the casting and solidification of steel. Finally, an attention is focused on the fluid flow behavior of steel flow in the tundish [5], The methods of study of metallurgical processes are also based on knowledge of thermodynamic properties of materials occurring in a given technology nodes.

Knowledge of liquidus temperatures of mild steels is one of the most important factors, especially in dealing with the processes involved in the casting and solidification. The liquidus temperature is a very important parameter to consider for proper adjustment of models (physical or numerical) or in the final stage of applied knowledge of the real process, it is significantly affecting the final quality of the fabricated product. The liquidus temperature of steel plays a very significant role in metallurgical production, accurate liquidus temperature of mild steel is required for scientific investigation of solidification processes of molten steel by numerical simulation.[6]Temperature is a significant parameter, not only for processes of melting and hot forming, but also for steel welding. For the sake of optimizing the existing processes of steel manufacturing, it is important to know phase transformation temperatures, or temperatures at which steel loses its plasticity or strength [7]. Knowledge of the liquidus and solidus temperatures are critical parameters necessary for the optimal production of steel products ,correct setting of physical or numerical models are equally important for achieving the best steel melting and fabrication processes. The correct determination of these temperatures significantly influences the quality and properties of semi-finished products [8].optimization processes today have integrated some statistical techniques to increase the reliability of the optimal solution, the cooks distance is one of the statistical diagnostics employed. Cook's Distance ( $D_i$ ) is used for assessing influential observations in regression models. The problem of outliers or influential data in the multiple or multivariate linear regression setting has been thoroughly discussed with reference to parametric regression models.[9] The kernel density estimation was presented as a type of Cook's distance [10],and later suggested a type of Cook's distance in local polynomial regression.[11]The classical cook's distance was modified with generalized Mahalanobis distance in the context of multivariate elliptical linear regression models and they also establish the exact distribution for identification of outlier data points. The exact distribution of Cook's distance was used to evaluate the influential observations in multiple linear regression analysis. The authors showed the derived density function of the cook's distance in terms of the series expression form. Moreover, the first two moments of the distribution are derived and the authors computed the critical points of Cook's distance at 5% and 1% significance level for different sample sizes based on no.of predictors. Finally ,the numerical example shows the identification of the influential

observations and the results extracted from the proposed approach is more scientific, systematic and its exactness outperforms the traditional rule of thumb approach.[12]

## 2. Research Methodology

In this section, the materials and response surface methodology and the TIG welding process is described and explained. Furthermore, the RSM diagnostics and cooks distance results are explained and interpreted .In this study an optimum experimentation to control the liquidus temperature was conducted. Gas tungsten arc welding process was used to join the weld specimen made of low carbon steel. The first step taken was design an experimental matrix ,using the design expert software ,five set of welded sample was made for each experimental run which amounted to a total of one hundred weld samples.

### 2.1 Material selection

The material chosen for the welding experiments was low carbon steel also known as mild steel, it was chosen because of its availability This grade has high corrosion resistance and can be operated at elevated temperature., the Tungsten inert gas welding technique wa selected because of its fine weld product quality . A matching filler wire having similar property of the base metal was selected .For good arc stability and low spatter, 8% CO2 mixed argon gas was chosen as a shielding gas.

### 2.2 Welding Process Parameters

The welding process parameters consists of current, voltage, gas flow rate, their range of values are shown in table 1

**Table 1: process parameters**

Factors	Unit	Symbol	Low (-1)	High (+1)
Welding Current	Ampere	I	130	170
Welding Voltage	Volts	V	20	24
Gas Flow Rate	Lit/min	GFR	13	17

### 2.3 Conducting the experiments using the design matrix

Weld experiments were conducted using a 10mm thick mild steel plate was welded with a 60° single V-groove with root face butt weld. Tor the welding current varying from 130 to 170 amps , gas flow rate 13 to 17 lit/min and voltage 20 to 24 voltsIn the present work, mild steel plates of 10mm thickness and 60 mm lengths were butt joined using the desired filler rod at varying levels of current voltage and gas flow rate t by manual TIG welding process. This three parameters were taken as variable for present study and their three levels were chosen for which responses were measured, and the central composite design was selected as the experimental design method. These parameters with their levels are shown in table 1 . The experimental data for the liquidus temperature is presented in table 2

**Table 2: experimental data**

Run	I	V	GFR	$\sigma_R$ (MPa) Residual stress	$T_L$ (°C) Liquidus temperature	$\eta$ (Kg/(m.s)) Viscosity
1	130.00	21.50	12.50	407.8	1650	0.007564
2	130.00	21.50	12.50	388.3	1655	0.007495
3	110.00	20.00	11.00	340.42	1631	0.007875
4	110.00	23.00	11.00	307	1645	0.007634
5	130.00	21.50	12.50	405.47	1650	0.007564
6	130.00	24.02	12.50	472.54	1680	0.007167
7	163.64	21.50	12.50	385.73	1736	0.006514
8	130.00	21.50	12.50	388.3	1655	0.007495
9	110.00	23.00	14.00	289	1624	0.007938
10	96.36	21.50	12.50	234.8	1645	0.007634
11	150.00	20.00	14.00	410.28	1700	0.006921
12	130.00	21.50	15.02	405.47	1650	0.00756
13	150.00	20.00	11.00	380	1660	0.00767
14	130.00	21.50	12.50	388.3	1655	0.007495
15	130.00	18.98	12.50	405.47	1650	0.007564
16	110.00	20.00	14.00	318	1624	0.007638
17	150.00	23.00	11.00	445.88	1706	0.006645
18	130.00	21.50	9.98	364.32	1632	0.00782
19	130.00	21.50	12.50	405.47	1650	0.007564
20	150.00	23.00	14.00	445.88	1724	0.006645

**3 Results and Discussion**

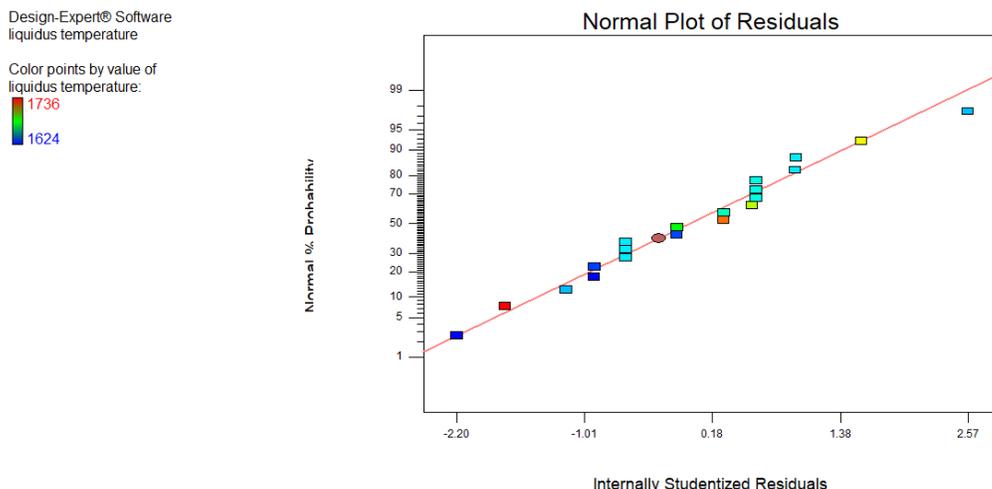
The diagnostics case statistics which shows the observed values of liquidus temperature against their predicted values is presented in table 3 The diagnostic case statistics actually give insight into the model strength and the adequacy of the optimal second order polynomial equation

**Table 3: Diagnostics case statistics report of liquidus temperature**

Standard	Actual	Predicted	Residual	Leverage	Internally Studentized	Externally Studentized	Influence on Fitted Value	Cook's	Run
1	1631.00	1633.37	-2.37	0.670	-0.917	-0.909	-1.294	0.170	3
2	1660.00	1659.24	0.76	0.670	0.294	0.280	0.399	0.018	13
3	1645.00	1648.06	-3.06	0.670	-1.183	-1.211	-1.724	0.284	4
4	1706.00	1701.93	4.07	0.670	1.573	1.720	1.45	0.502	17
5	1624.00	1629.70	-5.70	0.670	-2.202	-2.911	-1.15	0.984	16
6	1700.00	1698.57	1.43	0.670	0.554	0.534	0.761	0.062	11
7	1624.00	1626.39	-2.39	0.670	-0.923	-0.916	-1.304	0.173	9
8	1724.00	1723.26	0.74	0.670	0.288	0.274	0.390	0.017	20
9	1645.00	1637.75	7.25	0.607	2.571	1.19	1.21	* 1.02	10
10	1736.00	1740.95	-4.95	0.607	-1.755	-2.002	-1.49	0.476	7
11	1650.00	1647.29	2.71	0.607	0.960	0.956	1.188	0.142	15

12	1680.00	1680.41	-0.41	0.607	-0.144	-0.137	-0.170	0.003	6
13	1632.00	1632.43	-0.43	0.607	-0.151	-0.144	-0.179	0.004	18
14	1650.00	1647.27	2.73	0.607	0.967	0.964	1.198	0.145	12
15	1650.00	1652.57	-2.57	0.166	-0.624	-0.604	-0.270	0.008	1
16	1650.00	1652.57	-2.57	0.166	-0.624	-0.604	-0.270	0.008	19
17	1655.00	1652.57	2.43	0.166	0.592	0.572	0.255	0.007	14
18	1650.00	1652.57	-2.57	0.166	-0.624	-0.604	-0.270	0.008	5
19	1655.00	1652.57	2.43	0.166	0.592	0.572	0.255	0.007	2
20	1655.00	1652.57	2.43	0.166	0.592	0.572	0.255	0.007	8

To diagnose the statistical properties of the liquidus temperature response surface model, the normal probability plot of residual presented in Figure 1

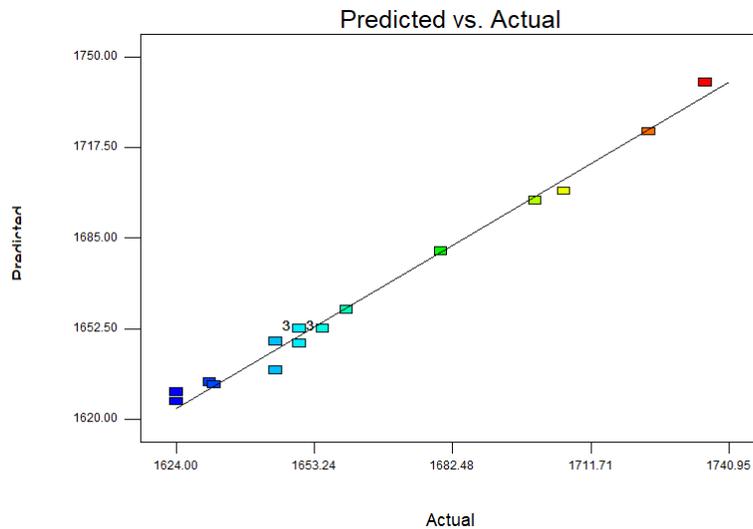


**Figure 1: Normal plot of residuals for liquidus temperature**

In order to detect a value or group of values that are not easily detected by the model, the predicted values is plotted against the actual values, for liquidus temperature which is shown in the figure 2

Design-Expert® Software  
 liquidus temperature

Color points by value of  
 liquidus temperature:  
 1736  
 1624

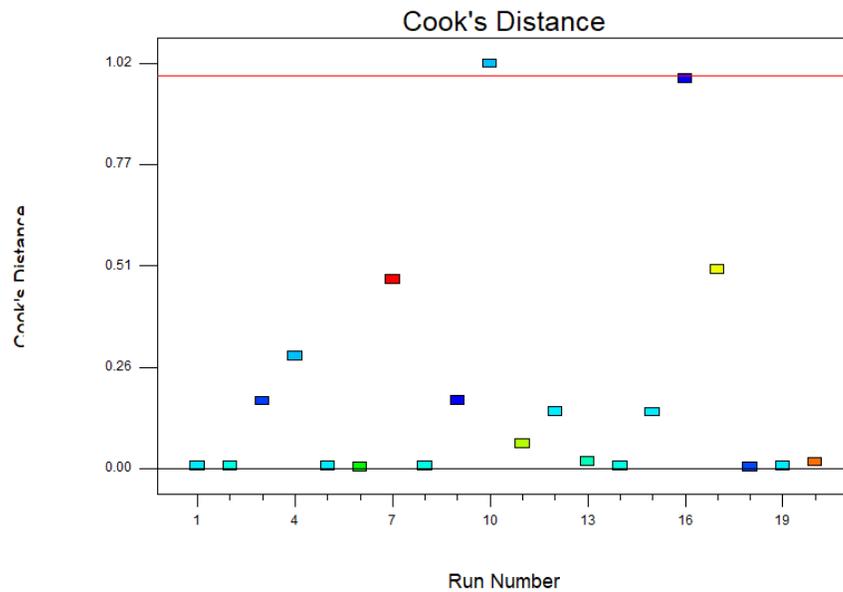


**Figure 2: Plot of Predicted Vs Actual for liquidus temperature**

As can be seen from the graph, the points are close to the line of fit. The model essentially is able to predict most of the data points. To determine the presence of a possible outlier in the experimental data, the cook’s distance plot was generated for the liquidus temperature response. The cook’s distance is a measure of how much the regression would change if the outlier is omitted from the analysis. A point that has a very high distance value relative to the other points may be an outlier and should be investigated. The generated cook’s distance for the liquidus temperature is presented in Figures 3

Design-Expert® Software  
 liquidus temperature

Color points by value of  
 liquidus temperature:  
 1736  
 1624

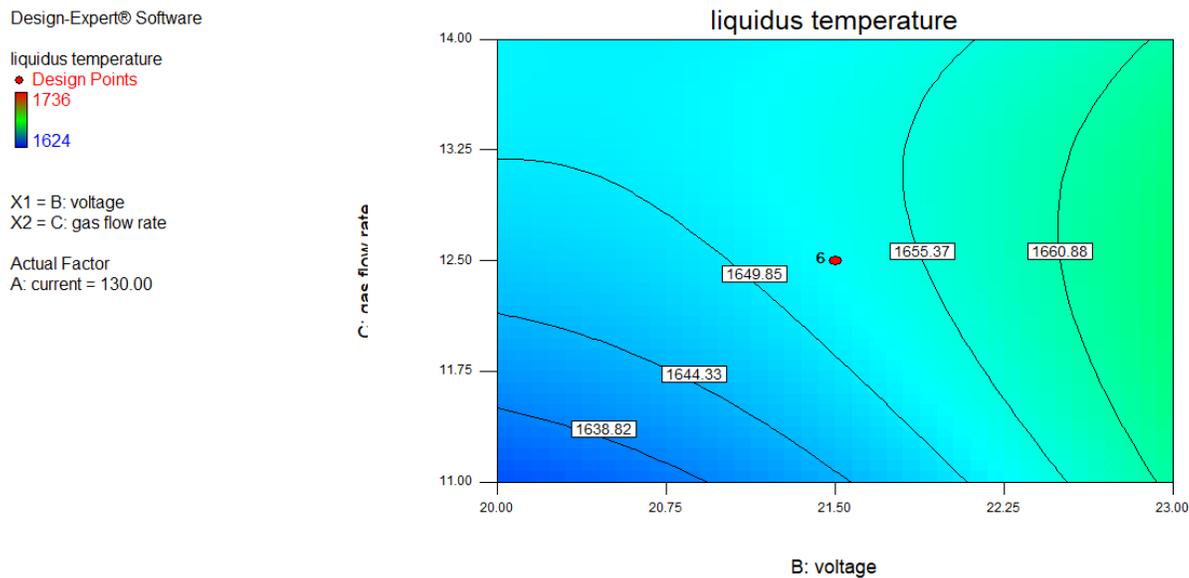


**Figure 3: Generated cook’s distance for liquidus temperature**

**Table 4: numerical optimal solutions**

Number	current	voltage	gas flow rate	residual stress	liquidus temperature	Viscosity	Desirability
<b>1</b>	<b>110.00</b>	<b>21.38</b>	<b>11.00</b>	<b>313.512</b>	<b>1636.15</b>	<b>0.00778952</b>	<b>0.824</b>
2	110.00	21.50	11.00	312.913	1636.73	0.00777898	0.824
3	110.03	21.22	11.00	314.687	1635.48	0.00780179	0.823
4	110.00	21.61	11.00	312.546	1637.29	0.00776914	0.823
5	110.00	21.35	11.02	313.721	1636.08	0.00779009	0.823
6	110.00	21.32	11.02	313.959	1635.95	0.00779222	0.823
7	110.00	20.95	11.00	316.841	1634.58	0.00781926	0.822
8	110.00	20.77	11.00	318.932	1634.09	0.0078294	0.819
9	110.00	20.70	11.00	319.789	1633.95	0.00783267	0.818
10	110.00	20.29	11.00	326.128	1633.4	0.00784758	0.808
11	110.00	20.77	11.17	319.937	1634.6	0.00780994	0.807
12	110.00	20.02	11.00	331.233	1633.36	0.00785263	0.798
13	110.00	22.75	11.00	316.64	1645.64	0.00762966	0.795
14	110.00	21.65	11.60	314.634	1637.66	0.00774297	0.793
15	110.00	22.73	14.00	302.079	1625.38	0.00793753	0.790

The contour plots showing liquidus temperature variable against the optimized value current and voltage is presented in Figure 4



**Figure 4: Predicting liquidus temperature using contour plot**

### 3.2 Discussion

The second order quadratic model was selected as the best model that can optimize the liquidus temperature in the TIG welding process, The diagnostics case statistics which shows the observed values of liquidus temperature against their predicted as presented

in table 3 The diagnostic case statistics actually give insight into the model strength and the adequacy of the optimal second order polynomial equation In order to detect a value or group of values that are not easily detected by the model, the predicted values is plotted against the actual values, for liquidus temperature which is shown in the figure 2 To determine the presence of a possible outlier in the experimental data, the cook's distance plot was generated for the liquidus temperature response. The cook's distance is a measure of how much the regression would change if the outlier is omitted from the analysis. A point that has a very high distance value relative to the other points may be an outlier and should be investigated. The model developed has sufficient merit to control the liquidus temperature optimally

#### 4. Conclusion

This study was carried out to develop models to optimize the liquidus temperature of mild steel joints using the TIG welding process. The RSM technique was employed to develop the models and the cooks distance was used to measure the integrity and reliability of the model. the diagnostic case statistics showed the residuals, predicted, actual and the cooks distance values for the liquidus temperature model. The cooks distance falls within the range of 0 and 1 indicating that there is no outlier in the data making the optimal solution strongly accepted

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# XAI-based Medical Decision Support System Model

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**Abstract-** The paper presents a model of the geriatric medical diagnostic support system (MDSS) developed in the context of artificial intelligence (AI) using elements of the explainable artificial intelligence (XAI) paradigm, such as computing with words (CWW), fuzzy SWOT analysis maps (FSM), possibility of verbal evaluation of sixteen symptoms, and estimates of the four interacting syndromes and their verbal interpretations. The functional organization of the model is presented mathematically using a vector description method and fuzzy reasoning operations. The viability and proper functioning of the implemented software model are confirmed by a pilot advisory practice in a geriatrics clinic. The paper concludes with a list of future further research.

**Index Terms-** Explainable artificial intelligence (XAI), Computing with words (CWW), Fuzzy SWOT maps (FSM), Fuzzy logic based reasoning, Verbalization, Degree of certainty, Membership function, Fuzzy logic terms, Geriatric syndromes, Geriatric symptoms, Medical decision support systems (MDSS), Interpretability, Functional organization, Knowledge - driven artificial intelligence.

## I. INTRODUCTION

Recently both in the world of science and in industry as well as in culture, much attention have been paid to the study of the possibilities of the development and application of so-called artificial intelligence (AI). Just ask in the GOOGLE system, for example, "artificial intelligence today: review" and the system provides data on 377 million links in 0.55 sec. The relevance of the issue of artificial intelligence research can also be felt from the material presented, for example, in the WCCI-2020 Congress reports [1-3] because "the IEEE WCCI 2020 is the world's largest technical event on computational intelligence, featuring the three flagship conferences of the IEEE Computational Intelligence Society (CIS) under one roof: The 2020 International Joint Conference on Neural Networks (IJCNN 2020); the 2020 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2020); and the 2020 IEEE Congress on Evolutionary Computation (IEEE CEC 2020)". 1,819 highest quality papers were accepted from over 73 countries and they confirm the highest interest in research and modern development of the artificial intelligence paradigm.

True, the issue of artificial intelligence is not new; it has just emerged with the birth of a computer, which by the way was not yet called a computer, but simply as an analytical Charles

Babbage engine [4]. Then the world's first programmer, Ada Augusta Lovelace (Byron), impressed by the capabilities of this device, asked if this device would really be smarter than a human. As we can see, the question remains open to this day and perhaps only philosophically supplemented by the question of whether we - humans need it and to what extent? [5].

Today no one doubts the great potential of artificial intelligence in practically every area of human life. But the successful spread of its applications often raises questions about trust in it, especially when the decisions and recommendations are about vital issues and questions under consideration. The successful use of methodologies and tools born of the artificial intelligence (AI) paradigm is based on trust issues: the reliability of the recommendations, advices and actions provided by the AI not only for the tool developer but also for its end user. It means that the AI success is based on the richness, validity, reliability, interpretability and explainability of all AI solutions.

Explainable artificial intelligence (XAI) has received a particularly strong systemic approach, with DARPA making its interest in the research field public and providing a number of its own potential case studies ([6, 7]), some of which are followed by a number of responsible studies, for example, [8-12] and other literature sources as it is seen in [1-3].

It should be emphasized that the analysis of already published papers on XAI research reveals priority areas for XAI applications. Among those areas, in addition to military-defense applications, medical diagnostic and medical decision support systems (MDSS) in general are clearly dominating. The current situation and the need and depth of MDSS research, as well as the scale and importance of the applications of such support systems, are well reflected in the publications examined, such as [13-18]. Interestingly, the authors [17] present their main conclusion that: "Based on our review, we found that XAI evaluation in medicine has not been adequately and formally practiced. ... Ample opportunities exist to advance XAI research in medicine". And so authors indicated the most sensitive direction of such necessary work.

According to various literature sources in the world, including the Republic of Lithuania, population aging is one of the problems in the field of health care that promotes the development of MDSS implementation for the diagnosis, treatment and care of diseases in the elderly ([19-24]). Clinical Department of Geriatrics of the Lithuanian University of Health Sciences has very clearly formulated the main statements concerning the situation. Although Lithuanian population is

aging and the number of older persons is increasing, the expectancy of autonomous life is one of the shortest in Europe. An increasing number of the elderly results not only in aging society, but in increasing morbidity as well. Reality of life is encouraging health care systems to take into account the needs of older patients and to seek for comprehensive assessment, which is not limited by physical assessment only but includes evaluation of functional state especially involving the MDSS tools based on XAI ([19], [20]).

For several years now, the Clinical Department of Geriatrics of the Lithuanian University of Health Sciences has united its researchers with scientists and computer engineering specialists of the Centre of Real Time Computer Systems of the Kaunas University of Technology for the joint project “Explainable Artificial Intelligence for Assessing the Health Risks of a Geriatric Patients”, and as a result the diagnostic XAI - based MDSS model was designed and is presented here. This research was funded by the Research and Innovation Fund of Kaunas University of Technology and the Research Fund of Lithuanian University of Health Sciences, project acronym GeRiMoDIs.

This paper is organized as follows: the preliminaries are presented in Section 2. The functional organization of the MDSS model is described in Section 3. Section 4 is devoted to present applications of the MDSS model to geriatric practice. And finally, the conclusions with a list of future further research are drawn in Section 5.

## II. PRELIMINARIES

The team of authors of the research and model realization conducted in this article are of the opinion that the object of computerized system analysis, design making processes and information processing shifts from raw data towards more sophisticated computing according to the following scheme: DATA → INFORMATION → KNOWLEDGE → WISDOM [25]. This is especially true of the possibilities and efforts to develop an XAI-based MDSS model, as in medicine the processing of tremendously huge data and the aggregation of information has already been done thanks to a huge number of medical practitioners, who are already a kind of accumulators of valuable knowledge.

Following these provisions of ours, which correlate well with DARPA insights ([6,7]), it is possible to symbolically represent and compare labor costs, the accuracy achieved, and the explainability obtained using the Data-Driven, Information-Driven, and Knowledge-Driven Artificial Intelligence for development of the MDSS model as it is shown in Fig.1.

Based on the analysis of all conceptual aspects of the use of artificial intelligence in medicine, it was decided to choose the application of Knowledge-Driven XAI as the most effective use of medical expert knowledge and the most flexible and easy interpretable explanations of the validity of its diagnostic and other solutions.

It is worth to emphasize that the Centre of Real Time Computer Systems of Kaunas University of Technology (CRTCS) has proposed a new universalized concept of a system using a dynamic SWOT analysis network for fuzzy control of risk in complex environments [26], whose philosophy fully includes the functioning of many real systems, including medical decision support systems (MDSS).

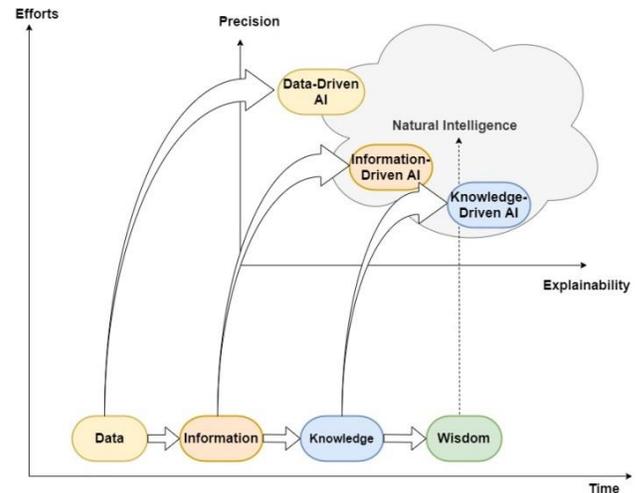


Fig. 1. Symbolic comparison of efforts, precision and explainability level obtained in case of different approaches to the base of AI source..

A generalized view of such an abstract system is shown in Fig.2. Each abstract complex environment in question is treated as a problem, characterized by a number of indicators and parameters, the analysis of which assesses the state of that medium.

The analysis of an environment E is entrusted to the fuzzy network of SWOT elements shown in Fig. 2 as the SWOTengine\_Net layer

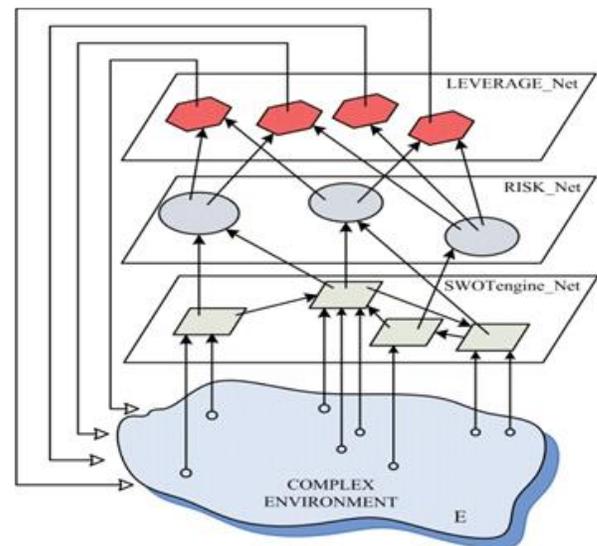


Fig. 2. A generalized view of an abstract system for risk control in the complex environment.

The RISK\_Net layer provides an assessment of the state of the environment and passes it to the LEVERAGE\_Net where recommendations, signals and/or actions to be formed. The latter layer, with the help of feedback, acts as complex of tools for optimizing possible states and managing risks in the complex environment E under investigation.

As for the SWOTengine\_Net layer, it is important to note on the one hand that it is covered by elements using the conventional SWOT methodology [27] and on the other - that those elements are enriched with computing with words (CWW) capabilities and can process both normal digital information as well as verbal information, i.e., words representing one or another linguistic

estimate of a parameter or indicator. Symbolically, such a SWOT element using a CWW based on fuzzy logic and a fuzzy reasoning mathematical apparatus is shown in Fig. 3 [28].

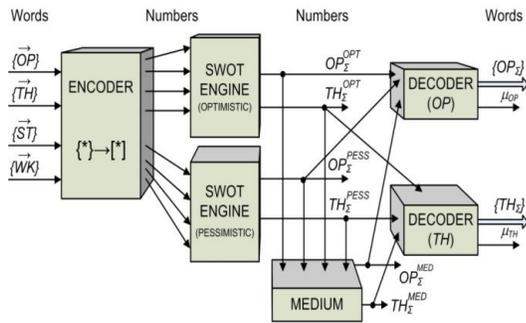


Fig. 3. SWOTengine enriched with computing with words (CWW) capabilities.

It is understood that the processing of vague verbal reasoning is related both to the vocabulary used and to the degree of certainty of each estimate. These characteristics and parameters will be discussed in the article as we move on to addressing specific medical geriatric problems.

The interactions between SWOTengines on the SWOT network level usually reflects the real interactions of phenomena in the complex environment E under study. The model of these interactions at the SWOTengine\_Net level (Fig. 2.) is implemented using the newly developed network of fuzzy SWOT maps (FSM) proposed at the CRTCS; the efficiency of those FSM has been tested and confirmed in other projects [29].

In the universalized structure concept (Fig.2), proposed for the management of the risks in the environment E ([26]), the cases of covering all other layers with the necessary elements are also provided. However, the practice of the Clinical Department of Geriatrics of the Lithuanian University of Health Sciences says that the most sensitive and most awaiting place for XAI-based MDSS is the first layer of the SWOTengines\_Net structure. In this case, environment E would correspond to the patient, each SWOT element would correspond / cover one syndrome, and the

inputs of the SWOT element (Fig. 3) ( $\vec{WK}$  and / or  $\vec{ST}$ ) would correspond to the symptoms and data accompanying the patient's illnesses and obtained using diagnostic tests and answers to certain questionnaires.  $\vec{OP}$ , and in particular  $\vec{TH}$ , would then be matched by diagnostic estimates characterizing the level of the syndrome / disease. Because cautious geriatric practice is more focused on the "pessimistic" version of SWOT analysis, these studies and model implementations focus more on aspects of SWOT analysis that assess patient weaknesses in  $\vec{WK}$  and reveal and highlight the level of disease threat  $\vec{TH}$  and / or risk.

### III. FUNCTIONAL ORGANIZATION OF THE MDSS MODEL

After thorough summarizing the listed geriatric needs and possibilities to develop an XAI-based MDSS model, it is important to formalize a description of its functional organization. The generalized approach to model functions is as follows: a geriatric patient is typically characterized by multiple symptoms, study data, and estimates of responses to specific questionnaires. It is desirable that the symptoms and data to be processed be available in both digital and verbal forms and that their assessment be performed using artificial intelligence techniques reminiscent of natural human specialist knowledge and intelligence, and that diagnostic results and recommendations be provided in verbal form. This requires special estimation matching dictionaries and methodologies for transferring estimates from digital to verbal form and vice versa with a certain degree of certainty.

It is convenient to start the formalization process itself by clearly defining the symbols of the variables used, the mathematical operations performed and explaining their real physical meaning. So, the Table 1 presents notations that are used in the formalization and description of the functional organization of the XAI-based medical diagnostics and decision support system (MDSS) model.

TABLE 1  
THE NOMENCLATURE FOR THE XAI-BASED MDSS MODEL.

SYMBOL	LITERAL DEFINITION (DESCRIPTION)	MATHEMATICAL DEFINITION OR FORMULA
$s$	Index of symptoms	$s = 1, 2, \dots, s, \dots, S$
$d$	Index of syndromes (diseases)	$d = 1, 2, \dots, d, \dots, D$
$q$	Index of questions	$q = 1, 2, \dots, q, \dots, Q$
$dq$	Index of answers to question $q$ of the $d$ -th questionnaire	$dq = d1, d2, \dots, dq, \dots, dQ$
$\vec{x}$	Generalized vector of symptoms	$\vec{x} = (x_1, x_2, \dots, x_s, \dots, x_S)$
$\vec{y}_d$	Generalized vector of answers to the $d$ -th questionnaire	$\vec{y}_d = (y_{d1}, y_{d2}, \dots, y_{dq}, \dots, y_{dQ})$
$W_{DS}$	Matrix of relations between syndromes $D$ and symptoms $S$	$W_{DS} = \begin{pmatrix} w_{11} & \dots & w_{1s} & \dots & w_{1S} \\ \vdots & & \vdots & & \vdots \\ w_{d1} & \dots & w_{ds} & \dots & w_{dS} \\ \vdots & & \vdots & & \vdots \\ w_{D1} & \dots & w_{Ds} & \dots & w_{DS} \end{pmatrix}$
$w_{ds}$	Strength of influence of symptom $s$ to syndrome $d$	An element of the $W_{DS}$ ( $s \rightarrow d$ )
$\vec{W}_d$	Vector of influence of the answer $y_{dq}$ , ( $q = 1, 2, \dots, Q$ ) to the questionnaire $d$	$\vec{W}_d = (w_{d1}, w_{d2}, \dots, w_{dq}, \dots, w_{dQ})$
$W_{DD}$	Matrix of relations between syndromes	$W_{DD} = \begin{pmatrix} 0, w_{12}, \dots, w_{1d}, \dots, w_{1D} \\ \vdots \\ 0 \\ \vdots \\ w_{D1}, w_{D2}, \dots, w_{Dd}, \dots, 0 \end{pmatrix}$
$\vec{z}$	Generalized vector of level of the syndromes	$\vec{z} = (z_1, z_2, \dots, z_d, \dots, z_D)$

As can be seen from Table 1, the model to be designed must assess the level of  $D$  interacting syndromes (or diseases) whose threat level can be judged from the  $S$  symptom estimates and the estimates of answers to the  $Q$  questions specific to each syndrome.

An important feature of the model is that estimates of the parameters or symptoms to be processed can be either numerical or verbal. For example, the overall estimate  $x_s$  for any  $s$  symptom can be given in numeric form as  $x_s = [x_s]$  or in verbal form as  $x_s = \{x_s\}$ . These notations  $[*]$  or  $\{*\}$  are used when it is necessary to emphasize the type of parameter estimate under processing; that is, in the absence of such a necessity, simply a generalized estimate notation  $x_s$  is used.

Since the model has to operate/process both numerical and verbal estimates of parameters and answers to questions, it is necessary to have some vocabulary of correspondences between digital and verbal estimates and fuzzy logic-based terms allowing the level of certainty  $\mu(x)$  of such compliance to be assessed [28]. An example of such vocabulary and fuzzy logic terms used in geriatric practice are given in Fig. 4.

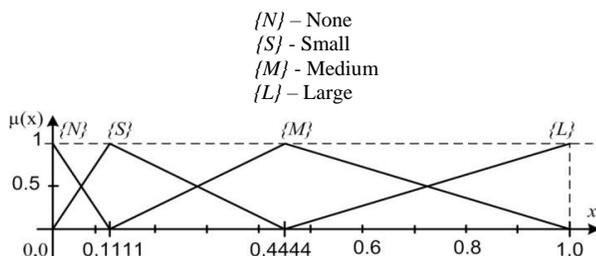


Fig. 4. An example of vocabulary and fuzzy logic terms

The verbalization (fuzzification) of the digital estimate can be conveniently explained by the example in Fig. 5. Here a digital INPUT estimate  $[x_1]$  is transformed into OUTPUT consisting of two words: the word  $\{M\}$  (Medium) with the certainty  $\mu(M) = 0,7$  and the word  $\{S\}$  (Small) with the certainty  $\mu(S) = 0,3$ .

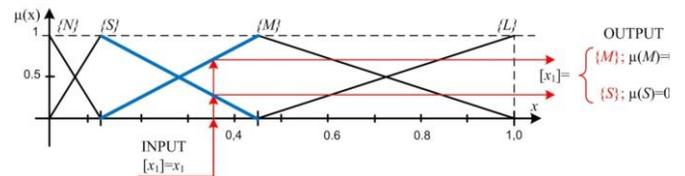


Fig. 5. An example of verbalization

The process of digitalization (defuzzification) of any verbal estimate is performed in analogues way and is demonstrated in Fig. 6.

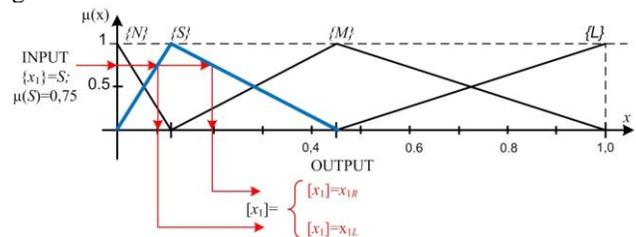


Fig. 6. An example of digitalization

In this case a verbal estimate  $\{x_1\} = \{S\}$  (Small) is presented at the INPUT together with the value of certainty of this statement let as say  $\mu(S) = 0,75$ .

The statement  $\{S\}$  with the proclaimed degree of certainty generates in the OUTPUT two possible digital estimates:  $[x_1] = x_{1L}$  and  $[x_1] = x_{1R}$  which denote the left and right points of the number interval. And the higher the certainty of the verbal estimate, the narrower the range of the output digital estimate.

According to the needs of geriatric practice presented here, XAI possibilities and using the described mathematical apparatus and its possible application details, it is possible to formally present the generalized structure of geriatric and functional organization of the XAI-based MDSS model (Fig. 7) and to describe it with a set of formulas and mathematical relations (1) – (6).

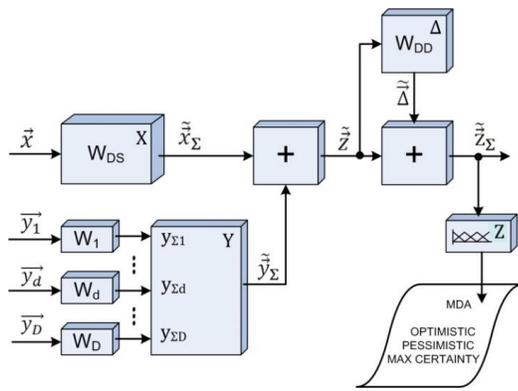


Fig. 7. A structural representation of functional organization of the XAI-based geriatric MDSS model.

Keeping in mind the fuzzy SWOT maps network (FSM) terminology and approach to the implementation of the XAI-based geriatric MDSS model, the first weaknesses ( $\overline{WK}$ ) that characterize the state of certain patient are symptoms  $S$ . Their influence to the threats ( $\overline{TH}$ ) of syndromes  $D$  can be evaluated in the block-box  $X$  by vector multiplication given in (1) where  $T$  stands for vector transposition operation:

$$\vec{x}_{\Sigma} = W_{DS} \cdot \vec{x}^T \quad (1)$$

An influence of the estimate  $\vec{y}_d$  of the answers to the questions of the questionnaire  $d$  is formed in a similar way in the corresponding block-box  $W_d$  as a scalar multiplication (2):

$$y_{\Sigma d} = \vec{y}_d \cdot W_d \quad (2)$$

Such an operation must be performed to answers of all questionnaires to be taken into account at this moment. So the block-box  $Y$  collects all available evaluations of the answers and forms a corresponding vector (3) for the following operations necessary to evaluate a current state of the threats of all interacting syndromes:

$$\vec{y}_{\Sigma} = (y_{\Sigma 1}, y_{\Sigma 2}, \dots, y_{\Sigma d}, \dots, y_{\Sigma D}) \quad (3)$$

Must be strongly emphasized that all results after each operation are normalized in each block-box to have summarized estimates in the range  $[0-1]$ . The normalization itself is performed by dividing the non-normalized result of the operation by the sum of all possible maximum input elements. In the formulas and structure (Fig. 7), the normalized values are denoted by additional tildes, for example, let us say the value  $\vec{y}_{\Sigma}$  after normalization looks like  $\vec{y}_{\Sigma}$ .

So, the results  $\vec{x}_{\Sigma}$  and  $\vec{y}_{\Sigma}$  obtained correspondingly in the block-boxes  $X$  and  $Y$  are conveyed after normalization as  $\vec{x}_{\Sigma}$  and  $\vec{y}_{\Sigma}$  for an evaluation of the summarized and normalized as well level of threats of the syndromes under consideration in the form of vector  $\vec{z}$ :

$$\vec{z} = \vec{x}_{\Sigma} + \vec{y}_{\Sigma} \quad (4)$$

As it is well known, geriatric syndromes often interact and strongly promote each other. The nature of such interactions is reflected in this description of the functional organization of the XAI-based MDSS model by the interaction strength matrix  $W_{DD}$ . That  $D \times D$  dimensional matrix is an important reflection of the expertise and knowledge of the geriatric clinic. This inter syndromic interaction is included in the functional organization of the model by calculating the estimate  $\vec{\Delta}$  of the strength of that influence according to (5) in the block-box  $\Delta$ :

$$\vec{\Delta} = W_{DD} \vec{z}^T \quad (5)$$

The final assessment of the threat and risk of all syndromes is obtained by summing and normalizing the estimates of the immediate threat and the threat of interactions (6).

$$\vec{z}_{\Sigma} = \vec{z} + \vec{\Delta} \quad (6)$$

After the transformation of  $\vec{z}_{\Sigma}$  into verbal form in the block-box  $Z$ , i.e. after each component of this vector of digital estimates of corresponding syndrome receives its verbal estimate and the digital estimate of the certainty, the model produces a medical decision answer (MDA) (Fig.7.), consisting of three statements: about OPTIMISTIC diagnose with its estimate of certainty, PESSIMISTIC one also with the estimate of its certainty, and the most RELIABLE diagnose with the highest estimate of its certainty.

#### IV. APPLICATION OF THE MDSS MODEL TO GERIATRIC PRACTICE

Based on the functional organization of the XAI-based MDSS model developed and described in the third section of the article, two versions of such a model were programmed for the Clinical Department of Geriatrics, Lithuanian University of Health Sciences to perform specific tasks of geriatric practice: for research and for training of junior medical staff and students as well. In both cases four ( $D = 4$ ) interacting syndromes were taken under consideration as to be diagnosed: MALNUTRITION (M), OROPHARYNGEAL DYSPHAGIA (OD), DEMENTIA (D), and DEHYDRATION (DH).

Their essential definitions and the implicit interactions according to the knowledge of experts are symbolically represented in Fig. 8 and in Table 2. The estimates of strength of this mutual influence were delivered by the team of experts of geriatric practice in a verbal form. Those verbal estimates were transformed into digital form using the fuzzy logic based mechanism described in the Fig. 6. Worth of mentioning the fact, that in practical implementation of the model the richer vocabulary was used and the correspondingly the number of fuzzy logic terms was higher.

The Fig. 9 represents the really used set of terms, and the formula (7) expresses the matrix  $W_{DD}$  (see Table 1) representing digital strength of influences obtained from verbal estimates delivered according to the experts' knowledge (Fig.10).

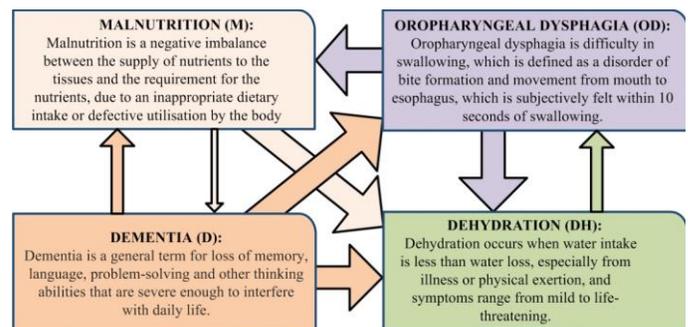


Fig. 8. Definitions and interactions among M, OD, D and DH

$$W_{DD} = \begin{pmatrix} 0,0000 & 0,0000 & 0,6250 & 0,5625 \\ 0,5625 & 0,0000 & 0,0000 & 0,5625 \\ 0,2500 & 0,5625 & 0,0000 & 0,5625 \\ 0,0000 & 0,2500 & 0,0000 & 0,0000 \end{pmatrix} \quad (7)$$

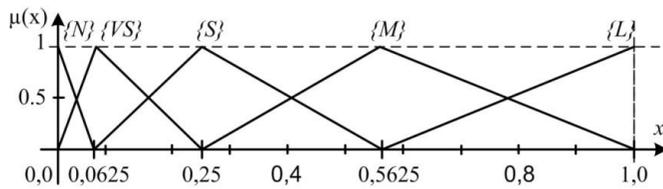


Fig. 9. Really used fuzzy logic terms in the model implementation for digitalization of experts' words.

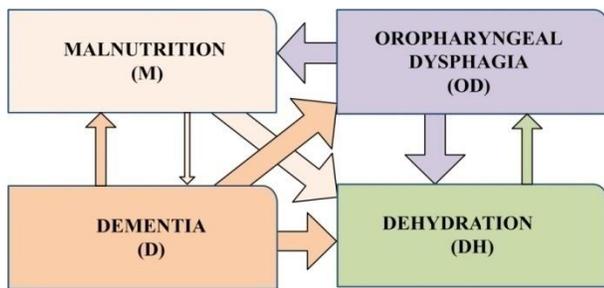


Fig. 10. Symbolic representation of estimates of syndromes' influences and the corresponding matrix  $W_{DD}$

This geriatric knowledge based matrix of relations between syndromes (Fig.10.) is covered in the programs of both models by the corresponding fuzzy SWOT map (FSM) on the SWOTEngine\_Net layer as it was provided in the functional organization description (Section 3) and in the structure of a general system for risk control (Fig. 2). Numerical and/or verbal symptom estimates and total estimates of the answers to the questions in each questionnaire serve as input data for the respective SWOT map elements. As mentioned above, models' implementations focus more on aspects of SWOT analysis that assess patient weaknesses in  $(\overline{WK})$ . The list of patient's weaknesses in the form of symptoms is presented in Fig. 11 (lines 13 – 30 and columns J, K, L, M), and the weaknesses in the form of answers to the questionnaires – in the same Fig. 11 (lines 31 – 34 of the same columns J, K, L, M). The list of symptoms and questionnaires as SWOTengines' input information sources shown in Fig. 11 are supplemented by information about possible interval of their estimates (the column N); another part of the Fig. 11 as an example is supplied by data from one practical diagnostic case (columns O and P)

After the patient is properly registered, as shown in Fig. 13, all available information about the symptoms, tests and answers to the relevant questionnaires is entered into the model, and an information/control window is formed (see Fig. 11).

The set of questionnaires was composed according to international geriatric practice adopted and supplemented by knowledge accumulated in the Department of Geriatrics of the LSMU [30-36].

Definitions of geriatric syndromes covered in this diagnostic model are presented in Table 2 and their maximal possible scores are depicted in Fig. 12 (Column E). Incidentally, the F and G columns are filled with diagnostic data from one particular

patient and serve as an example of the overall estimate (F) and the normalized estimate (G) in that particular case.

	J	K	L	M	N	O	P
13	Symptoms				Interval	Score	Estimate in the model
14	M	Decreased appetite;			(0-3)		0
15		Eat less;			(0-3)		0
16		Weight loss;			(0-3)		0
17		Clothes, shoes, rings became too big;			(0-3)		0
18	OD	Choke by drinking or eating;			(0-3)	3	1
19		Coughing while drinking or eating;			(0-3)		0
20		When you drink, the voice changes, the language;			(0-3)		0
21	D	It is difficult to swallow the pills;			(0-3)		0
22		Refuses to leave;			(0-3)		0
23		Food spills out of the mouth;			(0-3)		0
24	DH	Spits out food;			(0-3)		0
25		No longer able to eat;			(0-3)		0
26		Drink low fluids;			(0-3)	3	1
27	Questionnaire	Urine became darker in color;			(0-3)	3	1
28		Less urination;			(0-3)	3	1
29		Dry or dry mouth;			(0-3)	3	1
30		M			(0-14)	0	0,000
31		OD			(0-40)	0	0,000
32		D			(0-20)	0	0,000
33		DH			(0-40)	0	0,000
34							

Fig. 11. List of symptoms and questionnaires as SWOTengines input information sources.

	A	B	C	E	F	G
1				Total possible score	Total score entered	Normalized score in the model
2						
3	Symptoms	M		4x(0-3)		0
4		OD		4x(0-3)	1x3	0,25
5		D		4x(0-3)		0
6		DH		4x(0-3)	4x3	1
7	Questionnaire	M		(0-14)	8	1,000
8		OD		(0-40)		0,000
9		D		(0-20)		0,000
10		DH		(0-40)	7	0,250

Fig. 12. List of maximal scores of geriatric syndromes and questionnaires.

As mentioned above, the first step involves answering screening questions regarding four geriatric syndromes. Four characteristic questions are allocated to each syndrome (Table 3).

After receiving the prognostic answer from this tool, the specialist continues by filling out a questionnaire according to the syndrome. We would like to stress that high questionnaire scores signify the presence of a syndrome in this tool.

TABLE 2.  
DEFINITIONS OF GERIATRIC SYNDROMES

Geriatric syndrome	Definition
MALNUTRITION (M)	Malnutrition is a negative imbalance between the supply of nutrients to the tissues and the requirement for the nutrients, due to an inappropriate dietary intake or defective utilization by the body
OROPHARYNGEAL DYSPHAGIA (OD)	Oropharyngeal dysphagia is difficulty in swallowing, which is defined as a disorder of bite formation and movement from mouth to esophagus, and which is subjectively felt within 10 seconds of swallowing
DEMENTIA (D)	Dementia is a general term for loss of memory, language, problem-solving and other thinking abilities, which is severe enough to interfere with daily life
DEHYDRATION (DH)	Dehydration occurs when water intake is lower than water loss, especially due to illness or physical exertion, and symptoms range from mild to life-threatening

TABLE 3.  
SCREENING QUESTIONS FOR GERIATRIC SYNDROMES

Geriatric syndrome	Screening questions
MALNUTRITION	Decreased appetite Eating less Decreased weight Clothes, shoes, rings have become too large
OROPHARYNGEAL DYSPHAGIA)	Chokes while eating or drinking Coughing while eating or drinking Voice and speech changes after drinking Difficulty swallowing pills
DEMENTIA (eating disorders in dementia)	Refuses to open the mouth Foods pills out of the mouth Spits out the food No longer knows how to eat
DEHYDRATION	Drinks little amount of fluids Urine has become darker Urines less Dry mouth

DATE (YYYY.mm.dd)	CODE OF PATIENT CASE HISTORY							
2020.11.11 17:29	20CP 28754							
NAME	SURNAME	BIRTH DATE (YYYY.mm.dd)	AGE		GENDER	HEIGHT	WEIGHT	BMI
Ona	Ambrazevičienė	1935.05.31	Y	M	Moteris	m	kg	kg/m <sup>2</sup>
			85	6		1,75	66	21,551

Fig. 13. Patient's registration card.

For malnutrition, we used the MNA-SF scale [31] with the maximal score being 14. A good nutritional status is indicated by model (0-2 points), malnutrition risk by 0,5 (3-6 points), and malnutrition by 1 (7-17 points).

For oropharyngeal dysphagia, we used the EAT-10 dysphagia screening tool [24], with the maximal score being 40. In this model, suspected dysphagia is indicated by 0,5 (3-10 points) and dysphagia by 1 (11-40 points).

For dementia, we used the Edinburgh feeding evaluation in dementia scale [35], with the maximal score being 20. In this model, severe dementia, which is associated with other syndromes is indicated by 1, corresponding to a score of 11 20.

For dehydration, we used a set of questions formed using the ESPEN guidelines on clinical nutrition and hydration in geriatrics [36], with the maximal score being 40. Dehydration risk is indicated by 0,5 (6-10 points) and dehydration by 1 (11-40 points).

The maximal scores and interpretations of the questionnaires are presented in Table 4 and their maximal possible scores are depicted in Fig. 12 (Column E).

TABLE 4.  
MAXIMAL SCORE AND INTERPRETATION OF GERIATRIC SYNDROME QUESTIONNAIRES

Geriatric syndrome	Max points	0 – good	0.5 – it can be bad	1 – it is bad
MALNUTRITION	14	0-2	3-6	7-14
OROPHARYNGEAL DYSPHAGIA	40	0-2	3-10	11-40
DEMENTIA (eating disorders in dementia)	20	0-5	6-10	11-20
DEHYDRATION	40	0-5	6-10	11-40

If necessary, it is possible to track and verify all intermediate stages of information processing, which further highlights the application of the paradigm of explainable artificial intelligence in all stages of computation.

Examples of intermediate windows for one case are shown in Figure 14. Here it is possible to follow the formation of syndrome threats from the estimates of symptoms and answers to the questionnaires to the end of processing before the normalization of the results. Naturally, such a need rarely arises, and diagnostic advice information from this model of XAI-based MDSS is provided to medical staff in the form described in Section 3 after the normalization and verbalization procedures are performed.

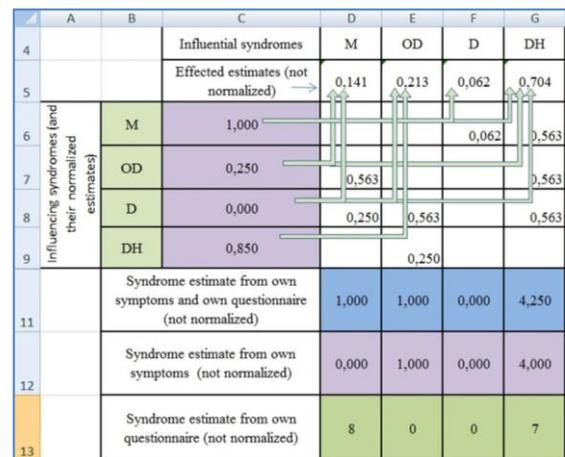


Fig. 14. Internal model information window demonstrating computational processes.

Therefore, this tool provides the specialist with a pessimistic, optimistic, or most probable prognosis of some geriatric syndromes, e.g. most probable prognosis for the patient: medium malnutrition prognosis with certainty 0,772, low oropharyngeal dysphagia prognosis with certainty 0.604, low dementia prognosis with certainty 0,560, and medium dehydration

prognosis with certainty 0.525. An example of such a case is shown in Fig. 15.

Examples of intermediate windows for one case are shown in Fig. 14. Here it is possible to follow the formation of syndrome threats from the estimates of symptoms and answers to the questionnaires to the final processing before the normalization of the results. Naturally, such a need rarely arises, and diagnostic advice information from this model of XAI-based MDSS is provided to medical staff in the form described in Section 3 after the normalization and verbalization procedures are performed. An example of such a case is shown in Fig. 15.

	A	B	C	D	E	F	G	H
27		<b>General threat of syndroms</b>						
28	PACIENT ...	<b>MALNUTRITION (M)</b>	<b>OROPHARYNGEAL DYSPHAGIA (OD)</b>	<b>DEMENTIA (D)</b>	<b>DEHYDRATION (DH)</b>			
30	<b>Pessimistic diagnosis</b>	LARGE with certainty	MEDIUM with certainty	SMALL with certainty	LARGE with certainty			
31		0,228	0,396	0,560	0,475			
32	<b>Optimistic diagnosis</b>	MEDIUM with certainty	SMALL with certainty	NOT with certainty	MEDIUM with certainty			
33		0,772	0,604	0,440	0,525			
34	<b>Reliable diagnosis</b>	MEDIUM with certainty	SMALL with certainty	SMALL with certainty	MEDIUM with certainty			
35		0,772	0,604	0,560	0,525			

Fig. 15. Diagnostic advice information from this model of XAI-based

Two models were programmed and tested according to the same functional organization of the XAI-based MDSS. The first one was programmed in Excel environment and was called GERI-VYRAI. In this case the end user's interface is Lithuanian. (Reference: GERI-VYRAI-G –Microsoft Excel \*\*\*\*; open access unavailable because of lasting process of commercialization). Another version of the similar model used Visual Studio 2019 Community Edition for programming. The bilingual English and Lithuanian user's interface is built as ASP.NET Core 3.1 Web Application, and the programmed. NET Standard 2.0 Class Library module was used to perform calculations. This version is more flexible for researchers and in general is more convenient for end users. (Reference: https://GERIMODIS- \*\*\*\* and the open access is unavailable for the reason mentioned above). Fig. 16 shows their initial user access windows for both versions of the model.

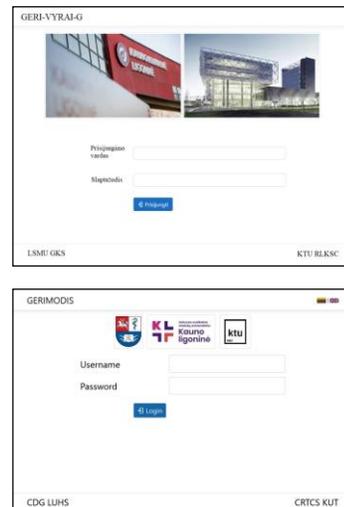


Fig. 16 User access windows of two XAI-based MDSS for geriatrics.

It is important to note that during the initial testing, the model was used by both: experienced professionals and trainees, as well as several students. The general opinion is that 1) the diagnoses presented by the model correlate well with the diagnoses of specialists, and 2) that it is convenient to work with such a tool. This suggests that the model deserves further practical research and development to be incorporated into geriatric practice and commercialized accordingly.

## V. COCCLUSION AND FUTURE WORKS

This article proposes a broader development of XAI-based medical diagnostic and decision support systems in geriatrics. To this end, a formal description of the functional organization of a possible structure for such an XAI-based MDSS was created and presented and two models of such a system were developed and tested.

The first preliminary experiments demonstrated and confirmed the viability of the idea, demonstrated a potential breakthrough in the implementation of artificial intelligence-based systems and tools in geriatric practice.

In the near future, the development of the model idea is expected in two directions: the first is research into the effectiveness of the tool model in assessing everyday individual cases, and the second is research into various aspects of the diagnostic methodology itself.

It is anticipated that the models already developed at this stage can be effectively used to train students and improve staff skills.

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# Behaviour Related Stigma Scale (BRSS): A tool to measure behaviour related stigma among key population groups

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**Abstract-** Key populations are identified as the groups having the highest risk of acquiring and transmitting HIV due to their behaviour. They face high level of stigma and discrimination as a result of belonging to a key population group.

The groups identified as key populations in this study are drug users, men who have sex with men, female sex workers and transgender community. Reducing stigma and discrimination is identified as one of the four critical enablers which help to overcome major barriers to service uptake, including social exclusion and marginalization, criminalization, stigma and inequity among KP.

Since there was not tool to assess the level of behaviour related stigma among key populations, the objective of the study was to develop and scientifically validate a tool to assess the behaviour related stigma among key population groups.

## Methods:

Development of the tools consisted of six steps. 1. Operationalizing the definition of stigma 2. Item generation, 3. Analysis of the content within each item and item reduction of the tool, 4. Formulating the draft instrument, 5. Finalizing the draft instrument to measure behaviour related stigma among key populations as BRSS. This was done through exploratory factor analysis and confirmatory factor analysis. The sample size was 183 and 180 respectively for the two components using respondent driven sampling method. The study was conducted in Galle district in Sri Lanka. The participant who were included for the exploratory factor analysis were excluded from the confirmatory factor analysis.

## Results:

A seventeen item tool with a three factor structure was developed and the Sinhalese version of it was validated to Sri Lankan context. It was named as behaviour related stigma scale.

## Conclusion:

Behavior related stigma scale can be used to assess the level of behaviour related stigma in any of the key population groups.

## I. INTRODUCTION

**K**ey Populations (KP) are the groups who have a high burden of acquiring Human immunodeficiency virus (HIV) in many

settings. Internationally the four KP groups considered are sex workers (SW), men who have sex with men (MSM), people who inject drugs (PWID) and transgender (TG) population (United Nations Programme on HIV/AIDS (UNAIDS, 2017).

Key populations are considered as a hidden population in both international and Sri Lankan setting. They possess the highest risk of contracting HIV, mainly due to their key behaviour.

Globally, KP are adversely affected by stigma and discrimination due to the fact that they belong to a key KP group. This leads to higher risk of acquiring HIV and limit access to HIV services (World Health Organization (WHO), 2014).

Stigma and discrimination adversely affect the social, psychological and medical aspects of the affected one's life. Since they get deserted from the families and get rejected from school, they become school drop outs without completing education. These factors lead them to a more vulnerable life. Additionally, multiple health complications also occur. They are anxiety, depression, self-harm, suicidal attempts, poor self-image, low self-esteem and addiction. Stigma and discrimination is identified as a key obstacle on universal access to HIV prevention, treatment and care. It lowers their access to health care services, and lowers HIV testing among these groups and necessary treatment. Finally, this will result in a hidden epidemic of HIV in the community.

Therefore, it is evident that it is essential to identify the key populations with high level of stigma due to their key behaviour. Since there is no comprehensive tool to assess behaviour related stigma among all KP groups, it was identified as important to develop a common tool to assess behaviour related stigma among KP.

The objective of the study was to develop and validate a tool to assess the behaviour related stigma among KPs.

## II. METHODS:

Development of the Behaviour related stigma scale was conducted in six steps.

### Step 1: Operationalizing the definition of stigma

A thorough literature review was carried out on medical sciences such as Psychiatry/Psychology, Behavioural Science and Sociology to identify different definitions of "stigma". A Delphi process was conducted to arrive at a new definition for stigma, to modify it to behavior related stigma and to identify its main

domains. A scale from zero (total disagreement) to four (total agreement) was used to rate the definitions for their appropriateness in the Sri Lankan context. This process was repeated in three rounds, selecting the definitions according to the score and finally arrived at one new definition. A definition for stigma was developed as “an attribute or behaviour which is discrediting”. As this study is on behaviour related self-stigma the definition was further modified as “an attribute possessed by an individual which is discrediting due to his or her identity or behaviour” (identity was taken into consideration among TG people and behaviour among FSW, MSM and DU).

### **Step 2: Item generation**

Items to be included within the multi-dimensional constructs of behavior related stigma were generated using a detailed literature review, key informants and in-depth interviews. Literature on instruments used in medical (Psychiatry, Psychology) and Sociology were searched. The selected items were adopted according to the cultural acceptability in generating items.

Key informant interviews were conducted among the main stakeholders from different categories who are directly and indirectly involved in decision making and service provision to KP such as Mental Health, Psychiatry, Psychology and human behaviour.

In-depth interviews were conducted to get an insight into different aspects that people of KP regard as important for behaviour related stigma. They were carried out among KP in the community in different settings; urban, semi urban and rural.

### **Step 3: Analysis of the content within each item and item reduction of the tool**

The items that were in duplicate were removed and a draft list of 32 items was prepared. The items were rated using a five point likert scale ranging from least important -1 to most important -5. There were 25 items with a mean score of three or more and mean score of seven items were less than three. Those seven items were excluded during the review. The list of 25 items was sent for the second round to the expert panel for clarifications, suggestions and rating. The results were reviewed as in the first round with special emphasis placed on the definition for behavior related stigma. Finally, a total of 18 items were retained after the non-statistical item reduction procedure.

### **Step 4: Formulating the draft instrument**

The selected items were developed into an instrument by writing them as statements that were to be used as interviewer administered questions as it was considered the most appropriate method for obtaining data which could be applied to the KP with varying education levels. A Likert scale was used as response choices.

Simple scoring of items was adopted in the absence of any research evidence for any benefit in weighting the items as opposed to weighted scoring, especially when there are many items in the pool (Chang, Brown, & Nitzke, 2008). Scores ranged from 1 to 5 for all 18 items. In 17 stems of the scale excluding item 8, the lowest value was one which indicated least likelihood of behavior related stigma and highest score of five indicated the most likelihood of behavior related stigma. In the stem no. 08, the

scoring was reverse; a score of 1 indicated a most likelihood of behavior related stigma and a score of 5 indicated least likelihood of behavior related stigma.

### **Step 5: Translation of the draft instrument**

The BRSS was translated into Sinhala from the original English version. The forward – backward translation methodology was employed in the translation of draft instrument.

### **Step 6: Finalizing the draft instrument to measure behaviour related stigma among key populations as BRSS**

The draft instrument was finalized as BRSS by carrying out the following procedures.

#### **a. Exploration of the underlying latent factors in the draft instrument**

An exploratory factor analysis using Principal Component Analysis (PCA) was carried out to assess how the selected 18 items were related to each other, and to see if there was any need for further reduction of items (Brown, 2006). The factorability of the 18 items was assessed.

A cross-sectional community-based study was carried out among 183 KP in Galle district in January 2018. As there were 18 items in the BRSS the ratio of participants per item was 1: 10.1.

#### **Study population:**

Four four KPs (female sex workers, men who have sex with men, drug users and transgender) were defined as below.

- Female sex worker is defined as any female who has sold sex in exchange of money or goods for the past six months. (NSACP, 2015).

- Men who have had sex with other men in the past six months as a matter of reference or practice, regardless of their sexual identity or sexual orientation and irrespective of whether they have sex with women or not are defined as MSM (NSACP, 2013).

- Drug users are defined as people who take psycho active (psychotropic) substances for non-medical purposes during the past six months excluding those who take only alcohol and tobacco (NSACP, 2013).

- Transgender people are defined as people who belong to the umbrella term as those who describe people whose gender identity and expression doesn't conform to the norms and expectations traditionally associated with their sex assigned at birth for the past six months (UNAIDS, 2015).

All FSW, MSM, DU and TG group who have completed 18 years and resided in Galle district for the past six months from the time of the study were included while any participant who belonged to the four KP, with a diagnosis of a mental disorder at the time of the study was excluded.

As this is a study on hard to reach populations, respondent driven sampling method was used.

Data was collected using an interviewer-administered-questionnaire (IAQ) including socio-demographic characteristics and the draft instrument translated to Sinhala Language.

Data collection was done by trained field investigators who were graduates in Sociology.

#### **Statistical analysis:**

All items in the draft instrument were subjected to PCA using the Statistical package for Social sciences (SPSS) version 22. Initially inter-correlation matrices of the 18 items were calculated and anti-image correlation matrix was carried out to measure the factorability for all the variables. Sampling adequacy of data was assessed. The factors were selected as relevant when the Eigen values were more than one. Scree plots were examined and factors were rotated to optimize the interpretability of the scale. After conducting the PCA, three factorable latent factors were identified. Promax rotation method was used. Seventeen items loaded well with a factor loading of more than 0.3 into three factors. Since item No 17 “**I feel that people think that I spread HIV merely because I belong to a key population**” was cross loading, it was dropped and re rotated. The three factors identified were negative self-image, disclosure concerns and public attitudes. Then item no 18 was renumbered as item no 17. Pre-testing of the draft instrument was carried out among 20 adults in the district of Kandy and modifications were done as appropriate. The scale developed was named Behaviour Related Stigma Scale (BRSS).

Assessment of validity and reliability of the BRSS This was conducted in two stages.

### **Stage 1: Assessment of judgmental validity**

Face, content and consensual validity were assessed in relation to judgmental validity. Each item in the instrument was assessed for its relevance, appropriateness and acceptability in the local context by the experts in different fields, by agreeing whether the conceptual definition of behaviour related stigma has been translated appropriately within the BRSS.

### **Stage 2: Validation study to ensure construct validity and reliability of BRSS (Sinhala version)**

A cross sectional study was conducted among 180 eligible study participants in Galle district, who were not included in PCA. Data was collected using the draft tool (BRSS) with 17 items which was developed in this study by the same field investigators. Considering the non-normal distribution of the items in the BRSS and according to the recommendations offered in LISREL 9.2, Robust Maximum Likelihood (RML) estimation method was used in the CFA. The CFA was performed on the covariance matrix of the items of BRSS. Assessment of the appropriateness of the model was based on several fit indices such as Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative fit index (CFI) and Non Normal Fit Index (NNFI). Judgements on how well the model fits data were made on the basis of RMSEA < 0.05, SRMR 0.9 and NNFI > 0.9 (Chang et al, 2008).

Internal consistency was assessed in the study using the Chronbach's Alpha, where it is estimated that values higher than 0.7 are satisfactory (Nunnally & Bernstein, 1994; Tavakol & Dennick, 2011). Test-retest reliability was assessed by administering the BRSS to a randomly selected sub-sample of 20 participants, following a time interval of two weeks. Value of 0.7 or above for the Spearman's r correlation coefficient was considered as having at least a moderate correlation between the scores (Mukaka, 2012).

## **III. RESULTS:**

The construct for behaviour related stigma was defined as “an attribute, behaviour or reputation which is socially discrediting on an individual and results in a feeling of shame and expectation of discrimination due to one's key behaviour or identity.”

A total of 32 items were generated for the construct on behaviour related stigma using three methods following thorough literature review and key informant interviews among eight individuals working with KP groups and in-depth interviews in 12 individuals. The majority of the key informants belonged to 30 – 39 age group (n= 07). Most of them (n= 08) had an educational qualification of G.C.E. (Advance level) or higher.

### **Analysis of the contents and item reduction**

Thirty-two items were generated at the initial stage. They were further reviewed by a panel of experts on the importance of measuring each item measuring behaviour related stigma. During this process, the number of items was reduced to 25 by deleting irrelevant and duplicate items. Finally, the number of items was reduced to 18 according to the expert rating and importance. These 18 items were retained in the draft instrument.

### **Latent Factors identified using PCA**

An exploratory factor analysis using PCA was carried out to identify the unknown latent factors in the draft instrument representing behaviour related stigma among KPs. The sample size for this component was 183 adults who belonged to the four KPs.

The majority of the study participants were between 18 – 39 years of age (74.3%). Nearly 75% of them had a personal monthly income below LKR 40,000. The majority of them were Sinhala Buddhists.

### **Factorability of the data set for PCA**

This was confirmed by the following results.

- The sample size (n=183) was acceptable as the number of items were 18, which gave a ratio of 1:10 between factors to items (Streiner, 1994).
- To perform PCA, the items should be correlated with each other but not too much. The anti-image correlation matrix which is the negatives of the partial correlation coefficients, the coefficients were well above the accepted level of 0.5 for the 18 items.

### **Sampling adequacy for PCA**

Kaiser–Meyer –Olkin measure and Bartlett's test of sphericity were performed to assess sampling adequacy. Kaiser–Meyer –Olkin measure was 0.847 and it was well above the required value of 0.6. Bartlett's test of sphericity was significant as required ( $\chi^2 = 1092.986$ ,  $df = 153$ ;  $p < 0.01$ ). Thus, all the 18 items in the draft instrument were considered adequate for PCA.

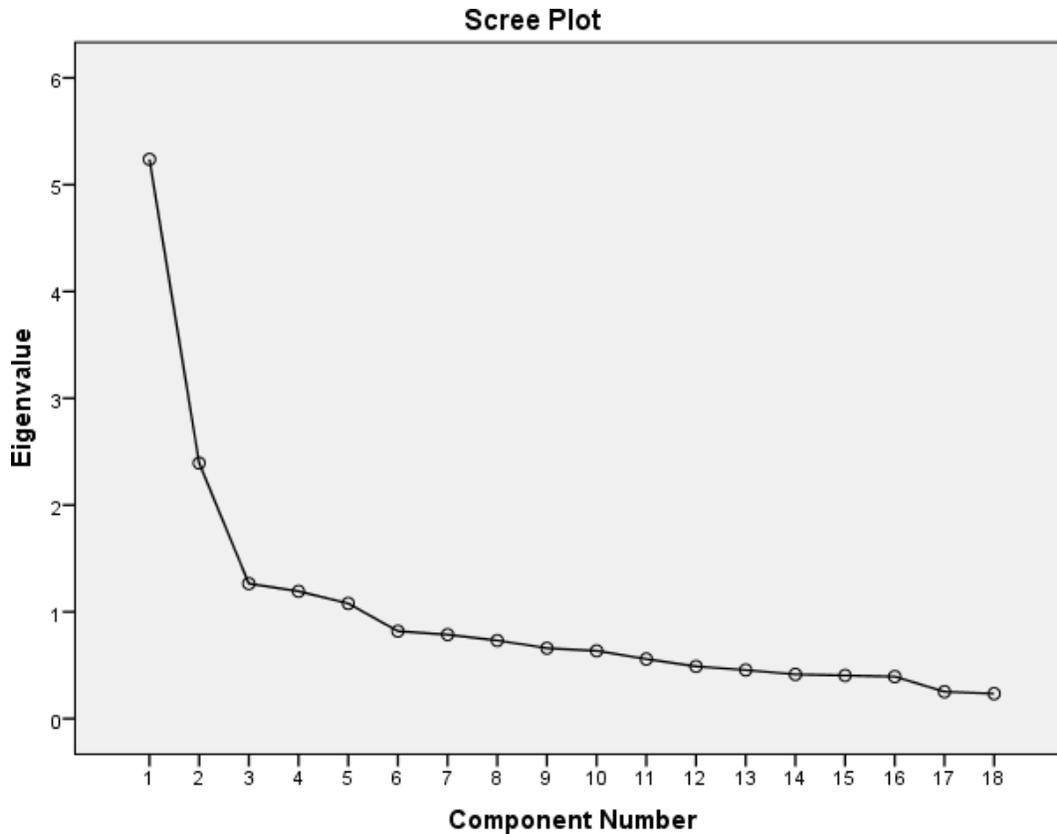
### **Selection of latent factors (Items grouped together in the PCA)**

Principal components were selected as the extraction method. The number of factors was decided depending on the Eigen value. A factor was considered relevant if the given Eigen value exceeded 1.0. In the current study, the Eigen values ranged from 5.238 to 1.079. Extraction was done depending on the eigen value of > 1. Initially five factors where the Eigen values were >1 were extracted. The initial eigen values are given in Table 1.

**Table 1: Total Variance Explained in PCA**

<b>Initial Eigenvalues</b>			
<b>Component</b>	<b>Total</b>	<b>% of Variance</b>	<b>Cumulative %</b>
1	<b>5.238</b>	<b>29.097</b>	<b>29.097</b>
2	<b>2.393</b>	<b>13.293</b>	<b>42.391</b>
3	<b>1.264</b>	<b>7.025</b>	<b>49.415</b>
4	<b>1.192</b>	<b>6.625</b>	<b>56.040</b>
5	<b>1.079</b>	<b>5.993</b>	<b>62.033</b>
6	.820	4.554	66.587
7	.787	4.371	70.959
8	.732	4.066	75.024
9	.660	3.665	78.689
10	.635	3.529	82.218
11	.558	3.099	85.317
12	.489	2.719	88.036
13	.455	2.529	90.565
14	.414	2.302	92.866
15	.404	2.243	95.109
16	.394	2.187	97.296
17	.253	1.403	98.700
18	.234	1.300	100.000

The scree plot suggests a three factor solution which seemed to be more appropriate. Therefore, a three factor solution was adopted for the current study. It is shown in figure 1.



**Figure 2: Scree plot of factor analysis of Behaviour Related Stigma Scale**

Since there could be some degree of correlation between factors, promax rotation method was used initially. Item number 17 was cross loading. Therefore, it was dropped and re-rotated. The final factor solution is shown as table 2.

**Table 2: Pattern Matrix of Items of the Behaviour Related Stigma Scale After Item no 17 was dropped – Sinhala Version**

		Component		
		1	2	3
ST1	I think that my behbehaviour is a punishment for me	.824		
ST2	I feel that my life is worthless because of my behaviour	.822		
ST5	I do not feel socializing like others do because I belong to a key population	.782		
ST4	I feel that I am not as good as the others	.702		
ST18	I feel that society thinks that I’m an unsuccessful person due to my key behaviour	.682		
ST3	I wish I did not belong to a key population group	.669		
ST9	I feel like I’m getting rejected when I am with people who don’t belong to a key population	.537		
ST16	I feel that the society thinks that key populations destroy our culture	.485		

ST14	I feel worried that people who know about my behaviour will tell it to others	.830
ST11	I feel that I should be very careful to whom I disclose about my behaviour	.817
ST15	I feel that I need to tell people close to me to keep the fact that I belong to a key population as a secret	.778
ST13	I feel that telling someone about my behaviour is risky	.638
ST10	I feel that I need to work hard to keep my key behaviour status a secret	.609
ST12	I feel worried that people may judge me negatively when they learn about my behaviour	.795
ST7	I feel that people are afraid of me once they get to know that I belong to a key population	.576
ST6	I feel that people tend to ignore my good points when they get to know about my behaviour	.567
ST8	I feel that I am able to live the life I want, although I belong to a key population	.393

Extraction method: Principal component analysis Promax rotation

**Factor naming**

The three factors were named by analyzing the items in each factor. The three factors were named as below.

F1: Negative Self Image: ST1, ST2, ST3, ST4, ST5, ST9, ST16, ST18

F2: Disclosure concerns: ST10, ST11, ST13, ST14, ST15

F3: Public attitudes: ST6, ST7, ST8, ST12

**Validity and Reliability of the instrument (BRSS)**

**Assessment of data set for comparability for confirmatory factor analysis**

The sample size was 180 for 18 items. The ratio of participants to variables was 10:1 which was satisfactory. Normality of data was assessed by Kolmogorov – Smirnov and Shapiro – Wilk test of normality which were statistically significant confirming non normality of data. Histograms drawn for each item showed a non-normal distribution of data. The standardized skewness and kurtosis were calculated. These ratios

were greater than 1.96 had a p value of less than 0.05, indicating a significant skew or kurtosis.

Data was checked for outliers. Although there were few univariate outliers, they were included in the dataset as it was decided that they were important to be included following the opinion of a panel of experts. Bivariate correlations between items were examined. The highest correlation observed between the two items was 0.64, indicating that none of the two items were highly or perfectly correlated.

**Assessment of construct validity through CFA**

Confirmatory factor analysis was carried out to assess the comparability of the factor structure obtained following PCA in a different sample using the finalized BRSS. Since the distribution of responses obtained for each item did not confirm to a normal distribution, Robust Maximum Likelihood (RML) method was carried out. Several models of factor structures were evaluated using RML estimation method. The summary of model fit statistics of the three models described above is given in table 3.

**Table 3: Model Fit Statistics of the One Factor, Two Factor and Three Factor Models of BRSS**

Model	Absolute fit indices			Comparative fit		Parsimony correlation	
	X2	GFI	SRMR	NNFI	CFI	RMSEA	NCP
<b>One factor model</b>	433.3 119 <0.000	df = p	0.741	0.115	0.622	0.669	0.121 314.305
<b>Two factor model</b>	230.13 118 <0.000	df = p	0.859	0.0935	0.864	0.882	0.073 112.132
<b>Three factor model</b>	172.7 116	df = p	0.895	0.0573	0.930	0.904	0.052 56.701

**Assessment of reliability of the BRSS:**

The Cronbach’s alpha value of the overall BRSS was 0.85. All the values exceeded Nunnally’s criterion of 0.7, which were satisfactory (Nunnally, 1978).

Test – retest method was employed to assess the reliability. The BRSS which was used in the validation study was re-administered to a randomly selected 20 participants by the PI independently following a two-week interval. The total scores obtained for each subscale at the two occasions were compared.

The intra class correlation coefficient was 0.97 which indicates that there is excellent inter rater reliability, and 95% confidence interval was 0.948 – 0.992.

#### IV. CONCLUSION:

A 17 item tool with a three factor structure was developed to measure behaviour related stigma among key populations. It was named as “Behaviour Related Stigma Scale” (BRSS).

#### V. DISCUSSION:

Behaviour related stigma scale (BRSS) is the first ever validated tool which measures all the component the behaviour related stigma among KP. This can be used in any key population group. This can be used by the service implementers to measure to assess behaviour related stigma among KP and direct them for necessary interventions to overcome them if necessary. The newly developed BRSS is a cost effective tool which can be administered by an interviewer who has completed secondary education or self-administered by KP with similar educational level. The average time spent to administer the instrument was 15 -18 minutes which was considered satisfactory for a community based study.

The validity and reliability of the scale, reliability of data of the study and meeting the presumed assumptions in respondent driven sampling has increased the quality of conclusions obtained from the study.

In the absence of specific guidelines to measure behaviour related stigma among KP, guidelines for the development of scales which measure psychometric properties were followed (McDowell & Newell 1996; Tay & Jebb, 2017). A similar method has been used in development of new instruments in the field of HIV related stigma by Berger, Ferrans & Lashley (2001).

According to the generated definition, operationalization of behaviour related stigma was done and items were generated. It was ensured that the construct was well explored by the selected items. Upon exploration of the items, it was identified that behaviour related stigma could be assessed by introducing common items to all the KP groups by generalizing the items to the whole target group. Expert opinion was obtained from the same panel of experts regarding the suitability of developing a common tool. The current study followed the item reduction which was done using a non-statistical method. This has been identified as an accepted method for reduction of items from a pool (Redding et al., 2006).

This tool included a five point likert scale which has been recommended that to adopt a minimum of five responses in scale development (Striener & Norman, 1995). Sixteen out of seventeen items of the BRSS were positively scored while one item was negatively scored. This was done purposefully to minimize acquiescence response bias (Latkin et al., 2010) as done in Berger’s HIV stigma scale as well (Berger et al., 2001).

Galle district was selected for the validation study because an adequate amount from all four KP groups with diverse socio economic and cultural background could be found (NSACP, 2013; NSACP 2018 a). It is not recommended to use the same data set to explore the factor structure as well as assess the validity of the instrument. Hence, for confirmatory factor analysis, data was

collected from a different set of participants from the same study setting where data was collected for the PCA.

Since EFA analysis provides the best option for identification of the constructs, especially when the constructs cannot be hypothesized (Stapleton, 1997), it was performed to explore the underlying latent factors in the draft instrument (BRSS). The sample size used was considered adequate as it was more than the minimum sample size required for factor analysis which was more than 1:5 ratio (Brown, 2006).

Although the behaviour related stigma among KP were described as self – stigma and perceived stigma, the latter consisted of disclosure concerns and public attitudes. This subdivision of disclosure concerns and public attitudes under the category of perceived stigma has been explained by Brakel (2006) and Gray (2002).

Since there was no gold standard to measure behaviour related stigma among KP, criterion validity of BRSS was not assessed. Yet, the BRSS has shown adequate validity and reliability statistics for it to be accepted as a suitable study instrument to measure behaviour related stigma among KP in community setting.

#### Acknowledgement:

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#### Declaration of interest:

I declare that there is no conflict of interest.

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# Work And Wellbeing: An Organizational Case Study

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**Abstract-** Present case study was conducted on CUK Gulbarga: site, formed in 2011, a branch of Unity Infraprojects Ltd. Work engagement survey was done on 11 employees out of 50 (including mesons) employees of project. Schaufeli, Salanova, et al. (2002) defined work engagement as “a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption”. Individual interview was conducted on Senior Project manager on quality work life and Assistant manager on job crafting. Lau et al, (2001) described QWL as the favorable working environment that supports and promotes satisfaction by providing employees with rewards, job security, and career growth opportunities. Job crafting is Self- initiated change behaviors that employees engage in with the aim to align their jobs with their own preferences, motives, and passions’ (Tims *et al.*, 2012, p. 173). Employees showed more resilient working and willingness to invest effort in work. Overall results showed employees moderately enthusiastic, energetic and committed to their work. And both interviewee’s showed overall satisfaction towards work life.

**Index Terms-** Work engagement, Quality work life (QWL), job crafting

## I. INTRODUCTION

Construction industry is viewed as high risk working environment as compared to others. It is one of the most dangerous industries (Carter G & Smith, S D., 2006). The challenges that construction industries encounter are profitability, research and development, training, price and cost, dissatisfaction or fragmentation. Unity Infraprojects Ltd is considered to be a leading engineering and construction companies in India with its focused areas – civil construction and infrastructures spread across the nation. CUK GULBARGA: SITE, formed in 2011. As construction industry is considered to be a risk work, it is essential to know what kind of work engagement is influence on employees to continue the job. How they are intrinsically motivating when basic needs are met. And also how the managerial staff increases their quality of work and crafts their job to stay tuned with the environment.

### *Work engagement:*

Work engagement reflects the individual's experiences of and feelings resulting from performing the work (e.g., Christian et al., 2011; Schaufeli & Bakker, 2010). Work engagement denotes passion and activation: a work engaged employee is vigorous and willing to invest effort at work (Macey & Schneider, 2008; Schaufeli & Bakker, 2010; see also Warr, 1990). Work

engagement is a more dynamic and energetic work related state of mind. According to Schaufeli, Salanova, et al. (2002), work engagement is defined as “a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption”. Vigor refers to high levels of energy and mental resilience while working, the willingness to take a position effort in one’s work, and persistence within the face of difficulties. Dedication is characterized by a sense of significance, enthusiasm, inspiration, pride, and challenge in one's work. Absorption refers to being fully concentrated and deeply engrossed in one’s work, and it's characterized by the sense of your time passing quickly and difficulty in detaching oneself from work. Work engaged employees are therefore enthusiastic and energetic, involved and committed to their work, and that they are often so intense in their work that it feels as if time is flying. (physical-energetic (vigor), an emotional (dedication), and a cognitive (absorption) component). Work engagement, a positive, fulfilling, work-related state of mind, has recently gained increasing research interest in the field of occupational health psychology (Albrecht, 2010b; Bakker & Leiter, 2010). Everyday connotations of engagement ask involvement, commitment, passion, enthusiasm, absorption, focused effort, zeal, dedication, and energy. In a similar vein, the Merriam-Webster dictionary describes the state of being engaged as “emotional involvement or commitment” and as “being in gear”. Work engagement refers to the connection of the worker together with his or her work. Engaged employees also convince be very active outside their jobs (Demerouti et al., 2001; Bakker, 2009). They are enthusiastic and positive, not only about their work but also about what they do in their leisure time and they communicate their engagement to others. Bakker (2009) formulated four reasons why engaged employees perform better than non-engaged individuals. Engaged employees (1) frequently experience positive emotions such as happiness, pleasure and enthusiasm; (2) tend to have better health; (3) communicate their engagement to others and they also (4) take responsibility and therefore the initiative for creating their own work-related and private resources. It is especially the extent of dedication, as a feature of their work engagement, which can be a highly important predictor of individual and organizational performance (Kodden, 2011). Personal resources include being optimistic and stress-resistant and having positive self- esteem. Work-related resources ask the physical, social or organizational aspects of labor. They are intrinsically motivating when basic needs are met, such as the need for autonomy, the need for appropriate as well as effective feedback and the need for social support.

Kahn's (1990) definition of engagement, employees feel obliged to bring themselves more deeply into their role

performances as repayment for the resources they receive from their organization. Alternatively, when the organization fails to supply these resources, individuals are more likely to withdraw and disengage themselves from their roles, which eventually might end in burnout (Schaufeli, 2006). A meta-analysis, Newman, Joseph and Hulin (2010) showed that engagement is closely related – or maybe even a constituting element – of what they dubbed “the A (attitude)-factor”, a combination of job satisfaction, job involvement, and affective organizational commitment.

#### *Quality work life (QWL):*

Feldman (1993) defined the quality of relationship between employees and the total working environment is QWL. Lau et al, (2001) described QWL as the favourable working environment that supports and promotes satisfaction by providing employees with rewards, job security, and career growth opportunities. In some organizations, top management appoints an executive to form throughout the organization. In most cases, these executives have a little staff and must believe the human resource department for help with employee training, communications, attitude survey feedback, and similar assistance. In other organizations, the department is responsible for initiating and directing the firm’s QWL and productivity efforts. Perhaps the foremost crucial role of the department is winning the support of key managers. Management support – particularly top management support appears to be an almost universal prerequisite for successful QWL programs. By substantiating employee satisfaction and bottom-line benefits, which range from lower absenteeism and turnover to higher productivity and fewer accidents, the department can help convince doubting managers. Sometimes documentation of QWL may result from studies of performance before and after a QWL effort. Without documentation of those results, top management won’t have continued its strong support. The policies and practices of the department also influence motivation and satisfaction indirectly. Safety and health programs, for instance, can give employees and supervisors a greater sense of safety from accidents and industrial health hazards. Likewise, compensation policies may motivate and satisfy employees through incentive plans. The motivation and satisfaction of employees act as feedback on the organization’s QWL. Mehdi Hosseini et al, (2010) concluded that the career achievement, career satisfaction and career balance aren’t only the many variables to realize good Quality of Labor Life, but QWL or the standard of labor system together of the foremost interesting methods creating motivation and may be a thanks to have job enrichment. It is also noted from the research that fair pay, growth opportunities and continuing promotion improves staffs’ performance which successively increases QWL of employees. Nasl Saraji and Dargahi (2006) identified QWL variables as fair pay and autonomy, job security, health and safety standards at work, reward systems, recognition of efforts, training and career advancement opportunities, participation in deciding, interesting and satisfying work, trust in senior management, balance between the time spent at work and with family and friends, level of stress experienced at work, amount of labor to be done, occupational health and safety at work

#### *Job Crafting:*

Cognitive modifications that employees make in the job task or interpersonal frameworks of their work which directs attention to the proactive, bottom-up strategies employed by employees to change the task, relational, and Cognitive frameworks of their jobs. (Berg, Wrzesniewski & Dutton, 2010, p. 179). Self-initiated change behaviors that employees engage in with the aim to align their jobs with their own preferences, motives, and passions’ (Tims *et al.*, 2012, p. 173). Job crafting is a proactive behavior, which employee may engage to shape their work in order to minimize job demands and maximize job resources. (Grant & Ashford, 2008).

#### *Types:*

*Task crafting:* employees can alter boundaries of their job by engaging in more or small tasks, expanding or diminishing the scope of tasks, or change how they perform the task (e.g., an accountant creating a new method of filing taxes to make her job less repetitive)

*Relational crafting:* by changing or modifying the nature or extent of interactions with other fellow workers employees engage in job crafting (e.g., a computer technician offering help to co-workers as a way to have more social connection and teach new technicians; making friends with people with similar skills or interests)

*Cognitive crafting:* cognitive crafting is how employees perceive tasks or sees’ their job, with the view to making it more personally meaningful (e.g., making an effort to recognize the effect one’s work has on the success of the organization or community; a hospital cleaner seeing his job as helping ill people rather just cleaning)

*Contextual Crafting:* contextual crafting is employees engaging in changing the work place or work environment (Dorenbosh, Grundemann and Sanders, 2011)

Research has come up with four theories of job crafting. Firstly, *Amy wrzesniewski and Jane Dutton*, in their theory, states that it’s the needs, values, preferences of employee which motivates him to craft his work. It’s altered perception of one’s identity at work or the meaning of work, or both. Secondly, *Adam Grant* and his colleagues, explains that how interactions with clients have greater impact on their job and helps them to craft their jobs. Here Adam discusses about four techniques, which helps the employees to craft their jobs: I. employees expand their roles beyond the basic functions of their jobs; II. Employees tailor their services to fit client’s specific preferences; III. Employee reprimand or avoid unpleasant clients; IV. Employees select meaningful context in which to conduct their work. *Justin Berg, Adam Grant, Victoria Johnson*, examined how it has influenced an individual who has chosen the occupation where he has passion for that work. Researches states that there are ways where employees craft their jobs: i. Giving more attention, time, and energy to one’s passion; ii. Taking on additional tasks that are related to his passion; iii. Reframing the social purpose of one’s work to align with one’s passion. *Brianna Barker Caza* has done doctoral dissertation, job crafting as effective technique to cope up with adversity of work.

Because of job diversity, it remains a very difficult task for managers to develop an optimal job design to suit the specific needs of employees (Berg, Dutton & Wrzesniewski, 2007). As result, employees will typically engage in job crafting behaviors

in order to meet their diverse competences and needs (Tims, Bakker & Derk, 2012). Job crafting is not a prescribed behavior but a proactive behavior of employee without permission of the supervisor (Tims & Bakker, 2010), it helps employees to balance between job, their own needs, competences and preferences (Tims et al. 2013). So it requires the behaviors that employees engage into modify their jobs to promote job satisfaction, job engagement, resilience, and work thriving, motivation, development performance (Tims & Bakker, 2010; Wrzeniewski & Dutton, 2001; Berg et al., 2007). A positive outcome of job crafting is work engagement (Tims et al., 2012). Work engagement has been defined as “a positive, fulfilling work-related state of mind that is characterized by vigor, dedication, and absorption” (Schaufeli et al., 2006, p. 702). Vigor refers to high levels of energy and mental resilience.

The interview is planned to be conducted on sr. project manager of CUK GULBARGA site. The interview will be structured interview. The interview has more number of close ended questions that yields yes or no. And in managing discipline and conflicts open-ended question will be asked. The questions will asked about work quality life: job satisfaction and job security, adequacy of resources/job resource, and managing discipline and dealing with the conflicts and mindfulness.

*Case study II*

The interview is planned to be conducted on junior engineer of CUK GULBARGA site. The interview will be structured interview. The interview has more number of close ended questions, that yields yes or no. some open-ended question will be asked if the answers yield are in yes for close ended questions. The questions will be asked about Job crafting which analyzes task crafting, cognitive crafting and relational crafting.

II. METHOD:

*Survey*

The survey was conducted among 11 employees of the organization of which 8 are married 3 are single, five are working from 5 – 12 years remaining 1 month to 4 years, three have diploma civil and three have done B.E in civil. Others are qualified with S.S.C, I.T.I, M.Tech and other degrees.

*Case study I*

III. RESULTS

**Employee Survey:**

The total of vigor is 287, dedication is 268, absorption is 392 and total work engagement is 803 and the mean is 26, 24, 26.5, and 73 respectively and over all standard deviation is 22.12239. Table I: Scorings of work engagement survey conducted among employees.

Sl no	Vigor	Dedication	Absorption	Work engagement
1	15	20	17	52
2	21	11	23	55
3	28	26	31	85
4	26	21	24	71
5	26	26	32	84
6	15	20	17	52
7	26	29	23	94
8	34	27	34	95
9	33	30	31	94
10	32	28	30	90
11	31	30	30	31
Sum	287	268	292	803
Mean	26	24	26.5	73

**Table 2: Descriptive statistics of work engagement survey conducted among employees.**

N	Sum	Mean	Std. Deviation
Vigor	11	287.00	26.0909
Dedication	11	268.00	24.3636
Absorption	11	292.00	26.5455
Work engagement	11	803.00	73.0000
Valid N (list wise)		11	

#### IV. DISCUSSIONS

Absorption and vigor is more among employees compared to dedication. The total work engagement is moderate/ average. Which means there are having high levels of energy and mental resilience while working, the willingness to take a position effort in one’s work, and persistence within the face of difficulties and fully concentrated and deeply engrossed in one’s work, and characterized by the sense of time passing quickly and difficulty in detaching oneself from work. It also shows employees feel obliged to bring themselves more deeply into their role performances as repayment for the resources they receive from their organization moderately. And they can averagely likely to withdraw and disengage themselves from their roles, when the organization fails to supply these resources, which eventually might end in burnout (Schaufeli, 2006).

**Case I:**

Interview was conducted on senior project manager. Objectives of the interview were discussed.

He feels comfortable and satisfied with his job. But he isn’t quite secured about his job and he thinks job security is good. His job allows him to be as productive as he could be. He feels the fair he earns are same compare to the one who does similar work in other companies. He is not okay with the job rotation method. He feels his work allows him to be best in his area. He says company provides resources to facilitate performances. Information flow and communication between departments is satisfactory. It’s shown that fair pay and autonomy, job health and safety standards at work, reward systems, recognition of efforts, training and career advancement opportunities, participation in decision making, interesting and satisfying work, trust in senior management, balance between the time spent at work and with family and friends, level of stress experienced at work, amount of work to be done, all are satisfactory to the interviewee. But the he isn’t secured about the job.

Whenever he sees the negative impact on construct caused by an employee’s negative behavior, he sees that negative attitude is changed by sharing his experience or giving an employee a chance to re-learn the work. He waits before disciplining the employee that he gets a chance to correct his behavior by himself. To avoid conflict he thinks proper negotiation and facilitating the coordination is good. Conflict management, employee discipline

is essential for proper functioning of an organization, interviewee gives a chance to be disciplined and have an idea to negotiate and coordinate the conflict raised.

He deals with others and environment consciously. He tries to help other and his employees. He is tolerant and patient and he is empathetic with others. The interviewee exhibits mindfulness. Mindfulness helps for shared social practice in an organization, and permeates routines, processes and practices between people and across teams, then the organization as a whole becomes more resilient and performs more sustainably.

As the interview was structured and more of close ended questions were asked it was quick and first come first immediate answers were obtained but was not so detailed and in some questions could not be explored in detail.

**Case II:**

Interview was conducted on Assistant manager. Objectives of the interview were discussed. He feels comfortable and satisfied with his job. But he isn’t quite secured about his job and he thinks job security is good. His job allows him to be as productive as he could be. He feels the fair he earns are same compare to the one who does similar work in other companies. He is not okay with the job rotation method. He feels his work allows him to be best in his area. He says company provides resources to facilitate performances. Information flow and communication between departments is satisfactory. It’s shown that fair pay and autonomy, job health and safety standards at work, reward systems, recognition of efforts, training and career advancement opportunities, participation in decision making, interesting and satisfying work, trust in senior management, balance between the time spent at work and with family and friends, level of stress experienced at work, amount of work to be done, all are satisfactory to the interviewee. But the he isn’t secured about the job.

Whenever he sees the negative impact on construct caused by an employee’s negative behavior, he sees that negative attitude is changed by sharing his experience or giving an employee a chance to re-learn the work. He waits before disciplining the employee that he gets a chance to correct his behavior by himself. To avoid conflict he thinks proper negotiation and facilitating the coordination is good. Conflict management, employee discipline is essential for proper functioning of an organization, interviewee

gives a chance to be disciplined and have an idea to negotiate and coordinate the conflict raised. He deals with others and environment consciously. He tries to help other and his employees. He is tolerant and patient and he is empathetic with others. The interviewee exhibits mindfulness. Mindfulness helps for shared social practice in an organization, and permeates routines, processes and practices between people and across teams, then the organization as a whole becomes more resilient and performs more sustainably. He introduces new approaches to improve his work and change the scope or types to complete his work. He introduces the new tasks to his work e.g., he prepared management excel sheet which shows both daily and monthly progressive work, and he was the first employee to introduce the pattern first, in 2013 the total site in India were 12 and all were asked followed the pattern he introduced by the head office. He doesn't take any additional work and gives more preference to the tasks which suits his skills and interests. He didn't think whether the job gives purpose to his life in 9 years of career but he no feels he may emerge as leader. He maintains the professional and personal life equally, doesn't mix them both. He thinks the job has role in his overall well-being. He makes effort to get know people at work because he thinks it brooders the communication and get know the industry, in the beginning of career when he joined BL kashyap he thought the industry was wide was after years of service he feels now as u communicate well it looks small. He doesn't attend or organize any social functions and doesn't organize any special events. He chooses to mentor new employees officially or unofficially only when they show interest and he feels it's a good opportunity to learn by teaching. He does not make friends with the people who have similar skills but prefers to be a compotator instead. He is good task crafter as in his relational crafting and cognitive crafting vary with his personal objectives e.g., being more of competitive rather being friends with the people who shares similar skills or interests at work.

## V. LIMITATIONS

The present study was a case study of particular construction site, it may not be suitable for universal generalizations. As construction industries are worldwide popular more wide range of research on the area has to be done so the present study is limits to one. With above researched variables more variable also could be exposed to experiment and get clearer results of influence of those variables on engineers working at construction field.

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# Management of Wastewater from Car Wash sites using locally sourced Natural Coagulants and simple Filtration Process

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**Abstract-** With the increasing car wash businesses in urban areas and cities in Nigeria, there is an increase in the volume of wastewater generated from these carwash sites. These wastewaters contribute to environmental pollution as they often found themselves flowing into the environment without any control or modifications. This study aimed to develop a simple and efficient treatment process for carwash wastewater based on coagulation and flocculation using natural coagulants namely *Carica papaya* dried seeds and Aluminium sulphate ( $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ ) in addition to a natural filtration system. The carwash wastewater samples were collected from different carwash sites located at Asaba, Delta State Nigeria. The management of the wastewater samples was planned prototype incorporating four phases namely: aeration, coagulation plus flocculation, sedimentation and filtration. The study examined the efficiency of the designed wastewater management and treatment system using different dosage (35, 70, and 140 mg L<sup>-1</sup>) of *Carica papaya* and Aluminium sulphate ( $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ ) respectively in the coagulation plus flocculation phase. The pretreated and post treated car wash wastewaters were analyzed for values of pH, dissolved oxygen (DO), chemical oxygen demand (COD) and turbidity (NTU). Values obtained for the post treated car wash wastewaters indicate that the designed treatment system was effective for primary treatment of raw carwash wastewater. The treated carwash wastewaters meet National Environmental Standards and Regulations Enforcement Agency (NESREA) requirements National Environmental Standards and Regulations Enforcement Agency (NESREA). Adoption of this process for waste water treatment is recommended as this would help reduce environmental pollution resulting from carwash wastewaters and save water for reuse in the small scale car washing enterprises in Nigeria .

**Index Terms-** natural coagulants, flocculation, filtration, sedimentation, *carica papaya*, environmental pollution

## I. INTRODUCTION

Environmental pollution due to wastewaters from industrial and commercially related activities in cities in Nigeria is increasing every day. Carwash wastewater is a potential environmental pollutant due to the plausible presence all types of

dirt, oil, grease, heavy metals and chemicals from soaps and cleaning agents used in car washes (Tekere et al., 2016). In Nigeria, at the moment, most of the car washes sites do not have any treatment plant or system for the wastewater generated from their businesses. The car wastewaters are often directly into the roadsides or into sewage or gutters running to the streets or nearby streams and rivers.

Most of the services in the urban areas requiring use of water and generating wastewaters are small and medium scale enterprises such as the local car wash stands common in Nigerian cities. These car washes are often manually operated with boys washing the cars and rinsing them directly from buckets and plastic containers with water and detergents. The cost of obtaining clean and usable water for washing and doing commercially activities often lead to the hike in prices of such water demanding services.

The Nigerian government in the year 1988 established the Federal Environmental Protection Agency (FEPA) through decree 58 of December 1988 (Omofonmwan & Osa-Edoh, 2008). This Agency later metamorphosed into the Federal Ministry of Environment (FMENV) in 1999. FMENV duties included formulation of national environmental guidelines, standards, and criteria, specifically in the areas of water quality, effluent discharge, air and atmospheric quality. In Nigeria, the car wash industry is not properly monitored or regulated yet. For example, the disposal of car wastewater is not monitored or regulated. Later in 2007, the federal government established the National Environmental Standards and Regulations Enforcement Agency (NESREA). This Agency is saddled with the responsibility to enforce environmentally related laws and ensure compliances to environmental regulations and guidelines (Suleiman et al., 2019).

The wastewaters generated from car washes often have high turbidity due to the presence of dissolved substances of various natures. Treatment of wastewater has inherent advantages. These include the reduction of possible environmental pollution impacts of the wastewater. Secondly, a simple water treatment process can ensure there is recycling of the water making good quality water available for use gain.

There is increasing interest in the use of natural coagulants in the development of water treatment systems especially in the coagulation and flocculation phases. The shift in paradigm use is connected with noted environmental and health complications arising from the use of synthetic flocculants and coagulants such

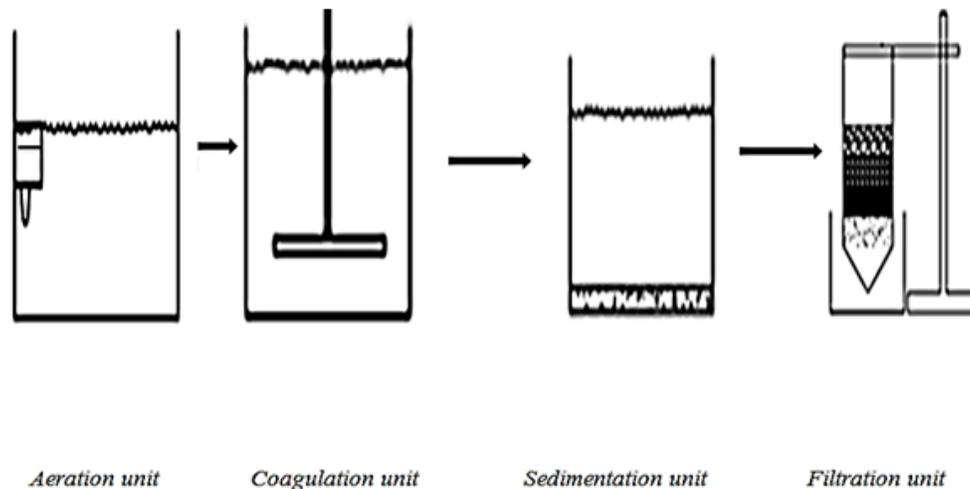
as ferric chloride and ferric chloride sulphate. Most of the chemicals used in waste water treatments are expensive and also sometimes carcinogenic and harmful to human health. Hence, the use of natural coagulants provides a cheaper and safer alternative to synthetic or artificial coagulants and flocculants (García-Fayos et al., 2018; Ang & Mohammad, 2020).

In a similar study, Radin et al (2014) investigated the efficiency of Drumstick tree (*Moringa oleifera*) seeds and clearing-nut tree (*Strychnos potatorum*) seeds as natural coagulants compared with some artificial common coagulants in the treatment of car wash wastewater. The findings indicated that both plants seeds contain coagulating substances that can improve water quality of waste or contaminated water. These were seen in the changes in turbidity, *chemical oxygen demand* (COD), *Biochemical oxygen demand* (BOD) and *Total suspended solids* (TSS) values of the wastewaters treated with these natural coagulants.

The present study adopts with some little modifications the treatment process of car wash wastewater by Mohamed, et al (2014). The waste water treatment phases consist of the aeration, coagulation and flocculation, sedimentation and filtration. The coagulant used was *Carica Papaya seeds* and Aluminium sulphate ( $Al_2(SO_4)_3 \cdot 18H_2O$ ). The target was to ensure that the treated water meets environmentally friendly standards as approved by the National Environmental Standards and Regulations Enforcement Agency (NESREA) requirements for effluents. The water parameters namely pH, dissolved oxygen (DO), chemical oxygen demand (COD) and turbidity (NTU) were assessed and monitored both at the pretreated and post treated phases.

## Material and Methods

### Collection of carwash wastewater samples



**Figure 1: Schematic representation car wash wastewater treatment process**

The scheme protocol involves putting, a volume of one litre of wastewater sample transported manually into the aeration tank (30cm×20cm×18cm), and aerated for 30 min. The wastewater was pumped into the flocculation and coagulation tank using a water pump. The flocculation and coagulation chamber was made of transparent bottle container (14cm×20cm×14cm) connected to a Direct Current motor (DC Geared Motor, DC12V)

The wastewater samples were collected from selected six busy car wash sites spread across Asaba capital city in Delta State Nigeria. The collection was done in the month of June 2020. The samples were taken using grab sampling technique into the plastic bottles (2 L) and transported to the laboratory for analysis (APHA, 2005).

Standard laboratory analysis procedures according to APHA (2005) were used to analyze the water samples. Included were test for pH, Turbidity, Chemical Oxygen Demand (COD), and Dissolved Oxygen (DO). COD were determined using Reactor Digestion Method (Method 8000, HACH DR 6000), the DO was tested using DO meter (EC Probe Meter), the pH, using a calibrated pH meter (EC Probe Meter) and the turbidity was done by Attenuated Radiation Method (Method 3750, HACH DR 6000).

### Preparation of *Carica papaya* seeds and Aluminium sulphate

*Carica papaya* fruits were purchased from a local market and the seeds were dried under the sunlight. The seeds were grounded into fine particles and dried at 100°C for 24 hrs. With the aid of a blender, the dried seeds were further milled into fine powder and then sieved through a 50-mesh sieve according to coagulant-method (Suhartini et al., 2013). The chemical Aluminium sulphate ( $Al_2(SO_4)_3 \cdot 18H_2O$  salts (CAS:7782-63-0, Fisher Scientific) was purchased and used as synthetic coagulant.

### Scheme of simple filtration based treatment system

The treatment system was designed as shown in the scheme below. It consists of four phases which comprise aeration, coagulation and flocculation unit, sedimentation and filtration unit.

with 1.1 watt, 103 rpm, 410 mA, 127.4 mN and 8 mm of shaft diameter.

The wastewater sample was mixed with 15 mg of prepared *carica papaya* powder was added into the flocculation and coagulation chamber for one hour. Next, the supernatant was pumped slowly into sedimentation chamber and allowed to settle for one hour. The supernatant was obtained from the natural filtration chamber comprising sand and gravel.

The same treatment process was repeated with different doses of *Carica papaya* and Aluminium sulphate ( $Al_2(SO_4)_3 \cdot 18H_2O$ ) (35, 70 and 140 mg, respectively). The pH, turbidity, DO and COD of treated car wash wastewaters were analyzed.

## II. RESULTS AND DISCUSSION

The mean of pH, turbidity, DO and COD of raw car wash wastewater are illustrated in Table 1.

**Table 1. Parameters of raw carwash wastewater samples.**

Parameter	Unit	Values obtained for Raw car wash wastewater	Effluent discharge Permissible levels by Nigerian NESREA standards
pH	-	6.95	6-9
Turbidity	(NTU)	170.1 ± 1.9	5
Dissolved Oxygen (DO)	(mg /L)	2.55	5
Chemical Oxygen Demand (COD)	(mg /L)	220	60
Oil and grease	(mg/L)	13	10

Car wash wastewater generated usually contains detergents, shampoo and diesel, and materials that usually contribute to making it very turbid. The sample turbidity, DO and COD were

higher than the effluent discharge Permissible levels by Nigerian NESREA standards (2011).

While, pH was within the international standards limits. These results are in agreement with those reported in similar studies on treatment of car wash effluents conducted in Malaysia and in India (Lau et al., 2013; Mazumder & Mukherjee, 2011). However, they were differed from that reported in a related study by Radin et al., (2014).

The increasing the turbidity of wastewater indicated can be an indication that the wastewater has high concentrations of total suspended solid (TSS (Sarmadi et al., 2020). High TSS values are usually due to presence of dirt particles from washed cars and vehicles which is a reflection of the type of dust and mud particles in the environment.

The high COD values might be related to the presence of soap or detergents used in the car wash sites. These detergents can cause oxidation process of organic compounds resulting in high COD of the sample waters (Ahmad et al., 2019).

Generally, it is seen that the parameters of raw carwash wastewaters are higher than the effluent discharge permissible levels by Nigerian NESREA standards (2011). Consequently, these wastes need to be treated to improve their characteristics and prevent resultant pollution from their discharge into the environment.

### Efficiency of coagulant integrated filtration treatment

The efficiency of the integrated treatment system design here for treating of carwash wastewater was evaluated based on pH, turbidity, DO and COD. The characteristics of wastewater treated with different doses of *Carica papaya* and  $Al_2(SO_4)_3 \cdot 18H_2O$  are presented in Table 2.

**Table 2. Characteristics of carwash wastewater treated with different doses of *Carica papaya seed powder* and  $Al_2(SO_4)_3 \cdot 18H_2O$**

Coagulant dose (mg L <sup>-1</sup> )	pH		Turbidity (NTU)		DO (mg L <sup>-1</sup> )		COD (mg L <sup>-1</sup> )	
	<i>Carica papaya</i>	$Al_2(SO_4)_3 \cdot 18H_2O$	<i>Carica papaya seed</i>	$Al_2(SO_4)_3 \cdot 18H_2O$	<i>Carica papaya seed</i>	$Al_2(SO_4)_3 \cdot 18H_2O$	<i>Carica papaya seed</i>	$Al_2(SO_4)_3 \cdot 18H_2O$
0	6.95		274.0		2.40		220	
35	6.80	5.25	39.7	47.7	4.19	3.6	215	217
70	7.05	4.83	23.4	30.7	5.86	4.90	195	205
140	6.17	3.85	8.35	17.5	7.15	6.35	141	165
NESREA standards (2011)	6-9		5		5		60	

Dissolved Oxygen (DO); Chemical Oxygen Demand (COD).

NESREA (2011).

It can be noted that pH, and DO of treated wastewater reduced to meet Nigerian NESREA (2011) standards for effluents. The maximum value of pH was recorded with 70 mg L<sup>-1</sup> of *Carica*

*papaya*. In contrast, pH was decreased with increasing amounts of  $Al_2(SO_4)_3 \cdot 18H_2O$  to pH 3.85 at a dose 140 mg L<sup>-1</sup>. These results indicated that the natural coagulant is more efficient to adjust pH value of wastewater than chemical coagulant ones. These findings

were similar to that recorded by Radin et al., (2014). However, in that study the author reported that the alum and Ferric sulphate used as coagulant was better as coagulant because little or no further addition of chemical would be required to correct the finished water pH. Conversely, this study demonstrated that *Carica papaya* is the better coagulant because the pH value still within the standards limits 6-9 even at high concentrations.

*Carica papaya* seed as a coagulant caused increased car wash wastewater DO from 2.40 to 7.15 mg L<sup>-1</sup> at a dose of 140 mg L<sup>-1</sup>, while Aluminium sulphate (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O) increased it to 6.35 at same concentrations.

Both coagulants were effective for reducing turbidity from 274.0 NTU to 8.35 and 17.5 mg L<sup>-1</sup>NTU respectively at 140 mg L<sup>-1</sup> of concentrations. The values obtained for turbidity of the car wash wastewaters however remained higher than Permissible levels for effluent discharge by Nigerian NESREA standards (2011). However, the wastewater treated with *Carica papaya* was almost near to meet the standards limits (5 NTU).

The results showed that the coagulation of wastewater with *Carica papaya* reduced turbidity by approximately 97% (from 274.0 to 8.35 NTU). With 140 mg L<sup>-1</sup> coagulant dose, the COD exhibited less response for both coagulant substrates. The COD values reduced from 220 mg L<sup>-1</sup> to 141 and 165 mg L<sup>-1</sup> due to effects of *Carica papaya* and Aluminium sulphate (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O) respectively. However, the car wash wastewater meets the regulations required NESREA (2011) standards for effluents.

In general, *Carica papaya* was more effective in the treatment of raw carwash of pollutants than Aluminium sulphate (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O) at different concentrations investigated in this study. This result might be related to nature of *Carica papaya* as adsorbent for H<sup>+</sup> ions. Natural adsorbents do display the ability of neutralization of solution. Thus, the turbidity in the wastewater treated with *carica papaya* seed was less than that treated with Aluminium sulphate (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O). An obvious advantage of the use of *Carica papaya* compared to Aluminium sulphate Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O is that it can be locally sources from farms and gardens in Nigeria. It is cheap to get and the seeds are usually discarded by most people who consume *carica papaya* fruit.

### III. CONCLUSION

The study shows that *Carica papaya* was effective as coagulant for treatment of raw car washes wastewater. The wastewater treated with low concentrations of *Carica papaya* meet the regulation required in NESREA guidelines in the terms of pH and DO permissible values for effluents. The reduction of turbidity and COD also satisfied NESREA guidelines. In general, the noted parameters of treated car wash wastewaters in the study makes the output waters suitable for washing and other domestic purposes. The assessment of the car wash wastewaters from the selected sites revealed instances of non-compliance with NESREA guidelines for effluents. There is need for effective monitoring of industrial wastewater discharges from car wash businesses in Nigeria by relevant regulatory bodies to ensure compliance with set environmental standards for effluents that can negatively impact the environment..

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# Alternative Dispute Resolution Role in Enhancing Intergovernmental Relations between Nairobi City County and the National Government.

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## Abstract

Relations between levels of government continue to pose threat to the goals of decentralization the world over. This study sought to determine the role of Alternative Dispute Resolution on intergovernmental relations between national government and Nairobi City County in Kenya. A structured and semi-structured questionnaire was administered to 83 stratified randomly sampled respondents. The descriptive and inferential findings presented in tables and charts demonstrated ADR process not being cost-

effective, inflexible and dissatisfactory verdict. To that end, the study recommended the study recommends ADR process streamlining to be cost-effective, flexible and satisfactory resolution.

**Index Terms:** Alternative Dispute Resolution, Conflict, Intergovernmental Relations.

## INTRODUCTION

Many countries continue to experience certain levels of strained relations between different levels, among arms of government or within decentralized units (Carter & Post, 2019). These conflicts are attributed to sharing of resource allocation, administrative, jurisdictional and legislative functions that impede service delivery (Grossman, Pierskalla & Dean, 2017). In effort to resolve conflict, various countries have employed ADR mechanisms especially ADR's Cost effectiveness, ADR's flexibility and ADR's verdict satisfactory level with mixed outcomes although majority have been effective (Moore, 2014).

In Kenya, the governments at the national and county levels are distinct and inter-dependent hence expected to conduct their mutual relations on the basis of consultation and cooperation in discharge of their exclusive and shared functions as assigned pursuant to the Fourth Schedule to the Constitution (Cheeseman, Gabrielle & Justin, 2016). However, the conduct of mutual relations between the two levels of government have been characterized by recurrent conflicts which often escalate into disputes resulting in the erosion of the spirit of consultation and cooperation (Karuti, 2016). Notably, one of the worst intergovernmental conflicts witnessed recently in Kenya is the toxic conflict between Nairobi City County and the national government over administrative functions, revenue sharing and staff deployment roles. This has resulted into poor service delivery.

Although there exist many statutory mechanisms in resolving and ensuring smooth, cordial and harmonious intergovernmental relations such as National and County

Governments Coordinating Summit, Council of Governors and Intergovernmental Relations Technical committee. Others include, Intergovernmental Budget and Economic Council, County Intergovernmental Forum, Sectoral Forums as well as Joint Intergovernmental Technical Committee, conflicts linger on (D'Arcy & Cornell, 2016).

Currently, levels as well as arms of government mostly use litigation to settle their disputes which is costly and negatively imparted on funds allocated for development and service delivery (Kenya's Judiciary Watch Reports Series, 2016). In any event, the Summit and the Council of Governors do not constitute independent and impartial third-party neutrals suited to facilitate the effective resolution of intergovernmental disputes. Neither are they well suited to determine or resolve disputes arising from purely contractual relationships between the two levels of government or between county governments inter se (ICJ Kenya, 2015).

Efficient service delivery by the two levels of government with competing, and often conflicting, interests can only be attained if there is in place an effective and efficient dispute resolution mechanism to resolve relational disputes (other than political or administrative conflicts) (Khaunya, Wawire & Chepnge'eno, 2015). Such a mechanism must be characterized by (a) expedition; (b) cost-effectiveness; (c) party autonomy (where both levels of government have an equal voice in the process); (d) complete independence from the parties; (e) quality procedures; (f) quality outcomes; and (g) party satisfaction.

Regrettably, above established conflict resolution mechanisms, the judicial system is not reputed for

delivering a justice system that can be identified with all of the foregoing characteristics. It is painstakingly slow, costly and inappropriate for parties who are bound under the Constitution to undertake service delivery in the spirit of consultation and cooperation (Mungai, 2016). Litigation is inappropriate to resolve disputes between state organs that are in reality the aggregate of one whole, but for the governance model of devolution of power and the decentralization of service delivery (Simiyu., 2015).

This calls for effective conflict management and dispute resolution strategies that guarantee good governance and conducive environment for effective service delivery at both levels of government and among arms of government in the spirit of consultation and cooperation. However, the prevailing constitutional order and the extant statutory framework are not well suited to facilitate effective conflict management and expeditious dispute resolution among the key players in the devolved system of government, not to mention the gaping lacunae in the extant mechanisms for the resolution of contractual disputes.

Why ADR? This paper argues that alternative dispute resolution is most appropriate to address IGR in Kenya as

currently is. ADR is a set of market mechanisms that maximize (a) proportionality; (b) party control; (c) expedition; (d) quality procedures and outcomes; and (e) consumer satisfaction. Despite such challenges, there are insufficient empirical evidence on this issue in the context of Kenya. The proposed study, therefore, addresses the gap in this area by examining this issue with special reference to Nairobi City County, national government, the Judiciary, Legislature and Executive.

#### **Research Objectives.**

- (i) To determine the effect of ADR's Cost effectiveness on intergovernmental relations between the national government and Nairobi City County.
- (ii) To analyze the effect of ADR's flexibility on intergovernmental relations between the national government and Nairobi City County.
- (iii) To establish the effect of ADR's verdict satisfactory level on intergovernmental relations between the national government and Nairobi City County.

### **RESEARCH METHODOLOGY**

The study preferred a descriptive survey approach comprising quantitative and qualitative techniques. Stratified random sampling was used to select 8 village elders, 4 Members of County Assembly and 10 imams in the sub-county at time of the study. Additionally, 3 civil organizations personnel working in the affected region, 25 police officers and 23 most recently worst affected conflict victims in the sub-county totalled to 83.

An open-ended and closed-ended questionnaire was utilized for primary data collection. Collected data was quantitatively and qualitatively analysed before presenting findings graphically followed with explanation in continuous prose.

### **FINDINGS**

established that the ADR process does not provide expedient resolution of justice, the facilitators (mediator and witnesses) and that during ADR process are not few. Similarly, each party does not bear its own costs during ADR process. Also, the ADR charges or fines are not few and bargainable and ADR process does not have less documentation, few or none exhibits, and little bureaucracy as well as few technicalities. Inferential findings disposed a significant and positive correlation between ADR's cost effectiveness and intergovernmental relations between national government and Nairobi City County.

Equally, it was established that parties do not create rules guiding the ADR process, there is no personal presentation during the ADR process, parties do not select moral, trusted and acceptable to mediate the ADR process. Also, the ADR process is not voluntary, it is not consensual and also it is not risk-free as well as parties are not allowed to seek alternative options in the event of a stalemate. Further, process is not less agrimony hence preserves relationship between warring factions. Furthermore,

inferential findings documented a strong and positive association between ADR's flexibility and intergovernmental relations between national government and Nairobi City County.

As well, descriptive findings reported that parties but juries do not decide verdict during the ADR process, the verdict of the ADR process is not easily acceptance hence it is not easily compliable. Also, the findings conveyed during the ADR process, a verdict cannot be made confidential verdict if parties choose and a verdict reached during the ADR process is retributive hence cannot ensure harmony between national government and Nairobi City County. Further, the ADR resolutions reached are not aimed at addressing the parties' concerns and the ADR verdict addresses parties' both legal and non-legal needs as opposed to court process that satisfies legal aspects exclusively. Inferential findings posted a significant and positive association between ADR's verdict satisfactory

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level and intergovernmental relations between national government and Nairobi City County.

## RECOMMENDATIONS

Based on the findings, the study recommends that the ADR process be streamlined to provide expedient resolution of justice as well as reducing the number of facilitators (mediator and witnesses) and that during ADR process for effective resolution of conflicts between warring factions. Likewise, the study recommends that each party should bear its own costs during ADR process. In the same way, it is recommended that the ADR charges or fines should be few and bargainable and the ADR process should have less documentation, few or none exhibits, and little bureaucracy as well as few technicalities for quick conflict resolution among antagonistic parties.

Alike, it is recommended that parties should be allowed to create rules guiding the ADR process, as well as permitting personal presentation during the ADR process. Also, the study recommends the need to ensure parties enjoy free hand in selecting moral, trusted and acceptable individuals to mediate the ADR process. In the same vein, it is recommended that the ADR process should be voluntary as well as consensual and also it should be risk-free.

Further, the study recommends the verdict arrived at is appealable to give chance for further ventilation by the unsatisfied party. Finally, it is recommended the process should be made less agrimony to preserve relationship between warring factions.

Similarly, it is the view of this study that parties but juries should have a final say on the verdict during the ADR process. Also, the verdict of the ADR process should ensure the verdict is easily acceptance to make it easily compliable to satisfy all parties. In addition, this study recommends that during the ADR process, a verdict should be made confidential verdict if parties choose. More so, the study recommends that a verdict reached during the ADR process should not be retributive to ensure harmony after the ADR process. It is also recommended that the ADR resolutions reached should be aimed at addressing the parties' concerns. Further, the study recommends that the ADR verdict should address parties' both legal and non-legal needs as opposed to court process that satisfies legal aspects exclusively.

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# A Study On The Fundamental Aspects Of Intelligent Drug Delivery System

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**Abstract-** Drug delivery is an advanced approach in which patients are distributed narcotics in a targeted order, increasing the concentration of the medicament delivered only for the targeted body portion of their concern such as tissues and cells, which increases treatment effectiveness by minimizing administered medications' side effects. The intrinsic value of this procedure means that the necessary medication with its decreased dosage has been given and its side effect has been reduced. This fundamental benefit of the smart drug delivery system is also the foundation of the therapeutics and diagnostics research and advancement in the clinical and pharmaceutical sectors. In essence, targeted/smart drug delivery is to help the drug molecule enter the intended site ideally.

**Index Terms-** Drug delivery, Drug carrier system; Diagnostics, Therapeutics

## I. INTRODUCTION

Conventional drug delivery systems are also related to multiple side effects, approaches to designing novel medication transport formulations are important where possible. This form of drug supply on demand is also known as smart drug supply or smart drug supply. These new methods improve clinical values and also reduce diverse side effects. The smart regulated drug delivery systems can efficiently minimize the dose rate in contrast to traditional drug delivery systems, while retaining the concentration of the drug in targeted bodies/tissues for a longer time. The managed drug delivery systems provide broad insights and interesting properties for reduction in variations in drug concentration, reduction in drug toxicity and enhancement in therapeutic efficacy (Muller and Keck, 2004). In recent decades, traditional drug delivery systems (DDSs) have taken part in intelligent drug delivery systems with stimulant-responsive characteristics, with their surprising advancement in biomedical nanotechnology. Benefiting from reacting to particular internal or external stimuli, these well-defined nanoplateforms can boost the effectiveness of drug targeting while reducing the side effects / toxicity of payloads that are key factors in enhancing compliance with patients. Various smart drug delivery systems in diverse interesting structures such as stimuli-responsive polymeric nanoparticles, liposomes, metal / metal oxides and exosomes have been extensively demonstrated in academic fields. These nanoplateforms, however, lack a consistent development process, toxicity evaluation experiences as well as strong relevance between clinical and preclinical trials, which contribute to

enormous difficulties in securing regulatory and ethical clearance. These relatively complex nano-drug delivery systems susceptible to stimuli are therefore not currently licensed for clinical use (Hrubý et al, 2015).

Targeted drug delivery is a form of intelligent drug delivery device that delivers the drug miraculously to a patient. This traditional system is achieved by the ingestion of the medicinal product through a biological membrane while the targeted release system is where the medicinal product is delivered in a dosage form. The targeted method of medicaments provides a certain quantity of a medicinal agent for a longer time duration to a targeted diseased region within the body. This helps to preserve the necessary amounts of plasma and tissue in the body, while protecting the healthy tissue from being damaged by the medication. To maximize the drug delivery system it is extremely integrated and involves diverse disciplines of science (Wang et al. 2013).

This latest class of smart, smart and sensitive delivery systems has been developed to carry out different tasks, such as diagnosis, separation and/or release of therapeutic agents to treat various diseases. Smart drugs are often focused on activating polymers that feel the shift in a particular variable and trigger distribution, which is reversible. To control the release of drugs, a vast number of materials such as polymers, lipids and inorganic materials were created to build a smart drug delivery system.

Products dependent on the distribution mechanism shall be prepared taking into account the particular properties of target cells, markers, or carriers or vehicles that bring medication to particular receptors and mechanically modulated components. Ideally, targeted drug delivery mechanisms should be biochemically inert (non-toxic), non-immunogenic, mechanically and chemical stable in vivo and in vitro, confined to target organism, tissue and organ drug dissemination, and universally capillarized distribution. The rate of drug release should be controllable and consistent, and the release of drugs should also have no effect on drug action. The drug should be issued in therapeutic doses and should be minimally hazardous during transit. For a longer period of time and large levels of controllability, active drug molecules can selectively aggregate in the disease region to improve their therapeutic effects and reduce associated side effects. Drug distribution refers to the methods, preparations, processes and structures required for delivering therapeutic drugs to produce their intended therapeutic results safely and efficiently (Liu et al., 2016). Conventional prescription products have also been accompanied by neurological side effects, mostly due to their non-specific biodiversity and uncontrollable

medication release characteristics. To overcome these restrictions, advanced drug delivery systems have been built to achieve spatially controlled release of payloads at the target sites. The smart regulated drug delivery systems can efficiently minimize the dose rate in contrast to traditional drug delivery systems, while retaining the concentration of the drug in targeted bodies/tissues for a longer time. The managed drug delivery systems provide broad insights and interesting properties for reduction in variations in drug concentration, reduction in drug toxicity and enhancement in clinical effects.

The final element is the most demanding function of a drug product that ensures the highest degree of intellect. When the drug is administered at the desired spot, it is important to adjust the surface area for an acceptable targeting mobility, which allows the carrier to bind to cells of interest. The distribution of the amount of medication needed involves a catalyst that determines the amount of medicine released at a certain moment. The cause may be an externally supplied stimuli (extrinsic triggers) or the internal surroundings of the environment in which the drug delivery system is implemented (internal triggers). Extrinsic triggers, for example, include electric field, magnetic field, ultrasound, electromagnetic radiation or temperature that can be used to activate or suppress the carrier's medicine release while internal stimuli include pH, temperature, ionic setting, proteins, carbohydrates, etc (Vyas and Khar, 2008).

## II. COMPONENTS AND BENEFITS OF INTELLIGENT DRUG DELIVERY SYSTEMS

1. A drug delivery mechanism is mostly a target and drug carriers or identifiers.
2. Target means a single organ or cell or community of cells that need care in the chronic or acute condition.
3. The path of administration requires the pharmaceutical carriers as essential targeting companies and after their leaking from their carriers/markers to the medication by biological metabolism via their clearance and not to enter the unspecified position in order to make this distribution mechanism more specific for medicines with decreased side effects and their size.
4. Carrier is one of the special molecules or structures important to the efficient delivery of loaded pharmaceutical goods to pre-selected locations.
5. These are engineered entities that hold the medication inside or onto it either through encapsulation and/or spacer movement and transport or transport it near the target cell.
6. Smart drug delivery systems are capable of distributing the drug according to physiological specifications.
7. This method aims to control the therapeutic concentration of plasma medications.
8. Localized supply of medications to a single compartment (target site) can be accomplished.
9. Preserve easily killing narcotics, increase stability.
10. Improve compliance for patients.

## III. TYPES OF DRUG DELIVERY SYSTEMS

Classification includes two separate groups

1. Open-loop system: these systems are also referred to as externally operated or pulsate systems. They used external stimuli to supply the medication such as magnet, temperature, ultrasound, electrical effects, etc.

2. Close-loop framework. This are also classified as self-regulated drug delivery systems.

The following applications are approached: urea-responsive, pH, glucose, thermo-sensitive, inflammatory sensitive, etc.

Responsive thermal device; Temperature is one of the most effective and effective variables when compared with other stimuli to regulate drug release. Poly (acrylamide) gel swells with increasing temperature, while poly(N-alkyl substituted acrylamide) gel disappears. Disease condition body temperature normally increases as Certain diseases, such as inflammation and cancers, have higher temperatures than normal tissues relative to normal conditions (Danhier et al., 2010). And using this difference in temperature. The smart drug distribution can be used to enhance the release of drugs into tumours from cancer and normal tissues. The tumour site is another temperature sensitive technique (Zhao et al. 2011).

External stimuli (ultra sound, magnetic field, etc.) may be heated to enhance the release of the drug inside the tumour microenvironment vasculature (Torchilin, 2014)

Device Redox-responsive; The oxidation-reduction reaction mechanism has been very interested in disease treatment. The redox potential in microenvironments in various tissues is multivariate and can be used to establish redox-sensitive distribution mechanisms. The design and manufacture of Glutathione sensitive nanoparticles can provide a promising approach to drug delivery (Mura et al., 2013).

Device Reacting to Enzymes; Enzymes that are used as a catalyst in the production of intelligent drug delivery systems are attacked because of their particular superiorities such as substrate specificities and high selectivity. Given its associated impact on virtually any biological and metabolic phase, enzymes (such as glycosidases, lipases, phospholipases, or proteases) may be used to release the enzyme-mediated medicines (De La Rica et al, 2012).

PH-responsive system Use pH as a catalyst to release the drug in this sort of system. Changes in the pH of the atmosphere allow the polymer to swell or de-swell. PH-responsive carriers are used for sensing pH at various body sites, including the vesicle (pH cubicle 2) and intestinal tract (pH cubicle pH 7).

Additional sensitive structures; Glucose and other sensitive Saccharide systems, electrically liable systems, inflammatory responsive systems, electrically controlled systems, Urea Responsive Delivery Systems, Morphine Activated Naltrexone Delivery Systems, System Using Anti-body Contacts, and System Using Chelation are also used to monitor smart system releases of pharmaceutical drugs. Dual stimulated DDSs are more widespread and have been studied, for example thermo- and pH-responsive systems, redox and pH-responsive systems, ultrasonic and magnetic reactive systems (Guo et al., 2015).

Light, magnetic and ultra-sonic; Photo-sensitive carriers are used to build light reactive drug delivery systems and to release drugs with external lighting at the desired spot. External magnetic

and ultra-sound drug delivery device are respectively used to activate drug molecules at a particular location

#### IV. STIMULI-RESPONSIVE DRUG-DELIVERY SYSTEMS

In clinical trials, stimulant-responsive drug delivery systems are:

AuroShell: Thermosensitive gold nanoshell is prepared for intracranial tumours by Nanospectra Biosciences

Opax: Cell Therapeutics, Inc. prepares enzyme-activated polymer NP for ovarian cancer.

ThermoDox: Celision Company prepares thermosensitive liposomal doxorubicin that is useful for breast cancer and primary liver cancer.

NanoTherm: Magnetic sensitive iron oxide NPs are prepared for glioblastoma, prostate, esophageal and pancreatic cancer by MagForce Nanotechnologies AG.

Intelligent drug delivery involves selectively administering medications to selected cells and tissues while staying unaffected for other stable body parts. While several areas of study have been carried out to optimise the distribution of drugs at a target site and thus the delivery of drugs, biomedical science has attracted substantial interest due to their ability to minimise dramatically the side effects of narcotics, and monitor over long periods the concentration and position of the active product released into the bloodstream. Clearly, emerging methods for drug delivery devices are able to selectively unleash drugs at a targeted site, helping to improve much of the latest drug therapy issues (Shaffer et al., 2007).

#### V. RECENT ADVANCEMENTS

Diabetes mellitus' ultimate aim is to regulate blood glucose levels by insulin distribution to minimise long-term diabetic complications. Actually, insulin is the primary medication for diabetes patients by subcutaneous infusion. For regular blood glucose levels, two or three injections are needed every day. As this approach is burdensome and intrusive for living beings, the condition of the patient in terms of quality of life is not pleasant. Therefore an electric and mechanically operated insulin pump has been developed, which automatically injects insulin into the bloodstream. An insulin pump consisting of polymer materials has been tested. Many experts focus on mobile system insulin. A biographer of Gluco Watch is non-invasive, look like a system that tests glucose. A plastic portion of Gluco is snapped and stuck to the skin. It takes automatic reading every ten minutes up to thirteen hours. Gluco watch is currently leading the way in user-friendly glucose control strategies. This method is based on the reverse iontophoresis theory (Jain and Mohanty, 2018).

#### VI. CONCLUSIONS

In the future, various controlled releases of nano-materials for intelligent DDS will be used with the advancement of materials research, medicinal science and biomedical science. Although intelligent nano-DDSs have proved to be substantially more effective for both diagnosis and care, future drugworthiness also needs to be tested before intelligent DDSs hit clinics. Researchers

will face an immense challenge in developing advanced DDS preclinical research to reproducible and translatable production and to achieve clinical trial success. Nevertheless, it must be recalled that the ultimate aim of all our actions is patients' care. Future studies on smart DDSs for managed drug delivery should concentrate on the clinical translation research in order to achieve more clinically use of stimulus-sensitive nano-medicine. The provision of the drug molecule to its precise position is itself a dynamic task in an organism's complex cell network. Finally, the targeted delivery of medications constitutes one of the most innovative medical technologies in the detection and treatment of a few deadly diseases. It has gone through the early years and has now reached a height of success in clinical and pharmaceutical research and development. Overall, a large database of numerous studies may be inferred, and the study of site-specific or tailored distribution has become intellectual and knowledgeable with links and the development of scientific technology. The manifestation of both these techniques and innovative medicinal technology will contribute in the future to a new age in therapeutics and diagnostics. Several problems have been found, studied, and solved during the development of drug targeting strategies for clinical applications for various therapies, particularly in cancer therapy. Several other preparations have now joined the stages of clinical testing or testing. Such techniques should be continually assessed, however in view of the developments in the understanding of the multiple processes that exist as a result of carrier's administration or vehicles of site-specific drugs of concern.

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# Major and Trace Elemental Analysis of *Curcuma leucorrhiza* Roxb. (Zingiberaceae Family) rhizome: A medicinal plant

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## Abstract

*Curcuma leucorrhiza* Roxb. is a flowering plant and belongs to the zingiberaceae or ginger family having enormous medicinal properties such as antiseptic, anti-inflammatory, antibacterial, antioxidant, antacid, antifungal and carminative. Contents of major and trace elements in the medicinal plants also contribute to various therapeutic roles. Here, we have carried out the major and trace elemental analysis in the rhizome of this plant using the most sensitive techniques such as Flame atomic absorption spectroscopy (FAAS) to determine the elements Na (4.3 ppm), Mg (2.6 ppm), K (30.7 ppm), Fe (0.67 ppm), Ca (0.58 ppm), Inductively coupled plasma mass spectrometer (ICP-MS) to determine V (< 2 ppb), Cr (5 ppb), Mn (820 ppb), Co (< 2ppb), Ni (< 4ppb), Cu (48 ppb), As (< 5 ppb), Pb (14 ppb), Energy dispersive X-ray (EDX) to determine C (62.45 at.%), O (36.70 at.%) and Carbon - Hydrogen - Nitrogen – Sulphur (CHNS) to determine C (37.44 wt.%), H (7.04 wt.%), N (2.69 wt.%) and the presence of S was rule out. The elements C, O, N and H are the major elements, whereas Na, Mg, K, Fe, Ca, V, Cr, Mn, Co, Ni and Cu are the minor elements. Their presence in the medicinal plants plays a vital role to treat various diseases

**Index Terms-:** *Curcuma leucorrhiza*, minor elements, Zingiberaceae, medicinal plant.

## Abbreviations:

Atomic absorption spectroscopy (AAS), Flame atomic absorption spectroscopy (FAAS), Inductively coupled plasma mass spectrometer (ICP-MS), Relative standard deviation (RSD), Scanning electron microscopy (SEM), Energy dispersive X-ray (EDX), Carbon - Hydrogen Nitrogen – Sulphur (CHNS), X-ray diffraction (XRD).

## 1. Introduction

The plants belonging to Zingiberaceae or ginger family provide us the varied natural resources for the mankind such as food, perfume, spices, dyes and medicines (Riao & Gutierrez, 2006; Chen, et al., 2007; Nelson, et al., 2017; Kress, Prince, & Williams, 2002). These comprise of about 53 genera and more than 1300 species (Kress, Prince & Williams, 2002). They are found in areas of the tropics and subtropics regions and are especially abundant in Southeast Asia (Yan-Qing, et al., 2018). The

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parts of a plant such as flower, stem, leaf, fluid and rhizome or root are very useful to us in many aspects. A few examples of these plants are *Zingiber officinale* (Ginger), *Curcuma caesia* (Black turmeric), *Curcuma longa* (Turmeric), *Alpinia zerumbet* (Shellflower), *Ravenala madagascariensis* (Traveler's tree), *Musa textilis* (Abaca), etc. India is one of the richest and diverse regions for Zingiberaceae where there are 20 genera and more than 200 species are available (Sabu, 2006). Most of these plants had been used for medicinal purposes since ancient times. One of the interesting areas of this plant family is that they have the varied colours of rhizomes such as brown (*Kaempferia parviflora*), pale yellow (*Curcuma aromatica*), deep yellow (*Curcuma longa*), greenish blue (*Curcuma caesia*) and colourless (*Zingiber officinale*) in various species and accordingly, their medicinal properties are also different.

Particularly, the North-East states of India have many genera (19) and many species (90) of Zingiberaceae (Kumar, Asish, Sabul & Balachandran, 2013; Dutta, 2015; Linthoingambi, Asem, Singh & Laitonjam, 2013). Manipur is one of the North-East states of India which lies in the Indo-Burma Biodiversity Hot – Spot Region which ranks 6<sup>th</sup> among the 25 biodiversity hotspots of the world (Singh, Singh & Singh, 2009). The area of Manipur covers longitude of 93°03 – 94°78 East and a latitude of 23°83– 25°68 North. The ratio of plain to hill areas is about 1:9. The maximum rainfall ranges from 933 mm to 2600 mm and temperature varies from 0 °C in winter (January) to 32 °C in summer (May-August). Altitude of plain area varies from 746 to 850 meters lying above sea level and that of hilly regions varies from 900 to 3000 meters lying above sea level. Owing to different climatic conditions varying from tropical, subtropical, and temperate zones, Manipur is rich in biodiversity which happens the major existence of medicinal plants (Devi, Devi & Singh, 2015) such as *Curcuma caesia*, *Kaempferia parviflora*, *Curcuma aromatica* and so on.

In Manipur, a wild medicinal plant, *Curcuma leucorrhiza* Roxb. (zingiberaceae) has been extensively used in traditional medicines for its remarkable therapeutic properties such as antiseptic, anti-inflammatory, antibacterial, antioxidant, antacid, antifungal, enlarged liver and spleen, ulcer in stomach and carminative (Linthoingambi, Asem, Singh & Laitonjam, 2013; Devi, Devi & Singh, 2015; Sinha, 1996; Pal & Srivastava, 1976; Theanphong, Mingvanish & Jenjittikul, 2016). In fact, medicinal plants contain both organic and inorganic constituents. Organic constituents such as alkaloids, amines and glycosides are highly responsible for medicinal property (Jyothsna, Manjula, Suthari & Rao 2020). There are reports on the studies of organic components (secondary metabolites) in the *Curcuma leucorrhiza* rhizome (Asem, 2014) but the studies of the inorganic components in the treatment of various diseases has received less attention. However, macronutrients and trace (micro-) elements present in medicinal plants also play a significant role to prevent various diseases. Trace elements are very important components in the plants for various physiological activities and cofactors in the production of enzymes (Sattar, et al., 2012). The deficiency and excess amount of trace elements are also responsible for toxicity in plants (Chrzan, 2016). A study reported on the presence of the elements Fe (0.971 ppb), Zn (0.414 ppb), Cu (1.70 ppb), Mo (0.013 ppb), Cr (5.091 ppb), Mn (0.015 ppb) in the *Curcuma leucorrhiza* Roxb rhizome using atomic absorption spectroscopy (AAS) (Singh, Singh & Phucho, 2014). But, their results are not reliable because AAS technique cannot determine concentration of elements below 1 ppm.

In this study, we have carried out analyses of the trace and macro elemental concentrations in the rhizome of the *Curcuma leucorrhiza* plant using different experimental techniques. This will help in understanding of the effect of these elements on human health and also environmental impacts on the selected plant.

## 2. MATERIALS AND METHODS

### 2.1 Plant sample

*Curcuma leucorrhiza* Roxb. is a perennial and aromatic herb of Zingiberaceae family. The plant started growing in the month of April-May and its full growth completed within 2-3 months (**Fig. 1a**). The plant bears white flower with partly pink at the top. The rhizomes are colorless with distinctive characteristic which is shown by transverse sectional view of fresh rhizomes

(Fig. 1b). The plant had been authenticated by Department of Life Sciences, Manipur University, Imphal, whose voucher specimen was (000815) (Asem, 2014).

## 2.2 Collection of Rhizomes

About 45 kg of freshly harvest tubers (*Curcuma leucorrhiza* Roxb. Rhizomes) was collected from Waphong Inthan Village of Senapati District of Manipur, North-East, India, in the month of December, 2017. The collected tubers (rhizomes) were washed thoroughly with running tap water and then with distilled water to remove impurities present in the rhizomes. Finally, it was washed with deionized water. The cleaned rhizomes were sliced into small pieces (Fig. 1c). It was shed air dried at room temperature (i.e., maximum effort was done to avoid incorporation of unwanted impurity that might change chemical composition of the sample). After some days i.e. 2-3 weeks, the colour of the sample was observed to slight change from white (Fig. 1c) to yellowish (Fig. 1d). The sample was found completely dried after nearly 30 days of drying; and the sample was easily breakable and dark yellow in colour (Fig. 1e). Finally, the dried rhizomes were stored in an air tight container. The dried rhizomes were made fine powder with an electric grinder. The powdered rhizomes were stored in the glass bottles for various analyses.

## 2.3 Sample preparation for analysis

1 gm of the powder sample was mixed with 10 ml of ultra-pure nitric acid in a volumetric flask and warmed to dissolve it. It was then added deionized water to make the volume up to 100 ml (Fig. 1f). This solution was kept for FAAS and ICP-MS studies. For analysis of elements present in part of plant, the solvents such as HNO<sub>3</sub>, HNO<sub>3</sub>-HCl and HNO<sub>3</sub>-HClO<sub>4</sub> were used for dissolution (Uddin, et al., 2016; Daran, et al., 2017; Deschamps, & Matschullat, 2011).

1 cm diameter pellets of dried powders of rhizomes were prepared under hydraulic pressure and these pellets were given for SEM-EDAX study. Also, some (about 200 mg) of dried powders of rhizomes were kept for CHNS and XRD studies.

## 2.4 Methods

For determination of elements such as Na, K, Fe, Mg, Ca up to ppm (µg/ml), the Flame atomic absorption spectroscopy (FAAS) with model GBC 906AA AAS unit with deuterium-arc background correction was employed. The air-acetylene flame was used. Nanopure water (18.3 Mega ohm) was used as diluent in this estimation.

For determination of elements such as Cr, Mn, Co, Cu, Pb, As, V up to ppb (ng/ml), the Inductively coupled plasma mass spectrometer (ICP-MS) with model VG PQ Ex Cell, VG Elemental, UK was used.

Relative standard deviation (RSD) = (SD × 100)/x, where x is provided in ppm or ppb as mean. In this study, RSD values for FAAS and ICP-MS techniques are calculated to be 2-5 % and 5-10%, respectively. All experiments were performed after standardization for every element.

The scanning electron microscopy (SEM) images were recorded using model TESCAN VEGA3; and energy dispersive x-ray (EDX) analysis of elements present in the sample was analysed using same instrument.

For determination (quantitatively) of elements such as C, H, N, and S, Thermo-Fischer Flash EA 1112 Series CHNS Analyzer was used.

X-ray diffraction (XRD) data of the dried power sample was recorded using PAN analytical powder X-ray diffractometer with Ni-Filtered Cu-Kα (1.5405 Å) at 40 kV and 30 mA.

## 3. Results and Discussion

FAAS technique provides the presence of elements such as Na, K, Fe, Mg, Ca in ppm level, whereas ICP-MS technique provide the presence of elements such as Cr, Mn, Cu, Pb in ppb level and As, V, Ni, Co in below 5 ppb level in the *Curcuma leucorrhiza* rhizome (Table 1).

**Figure 2(a, b)** shows the SEM image of the dried powder of sample (*Curcuma leucorrhiza* rhizome) along with its EDX spectrum and **Table 1** gives elemental composition of sample. This provides the content of C and O in the sample and the amount of C is about 1.7 times than that of O. SEM-EDX detected the following elements also in the sample but they are treated as negligible in amount as their concentrations are less than 1 at.%; viz. Cl (0.01 at.%), Br (0.04 at.%), I (0.01 at.%), P (0.12 at.%), Zr (0.02 at.%), Mo (0.02 at.%), Hg (0.02 at.%), Se (0.05 at.%). Notably, this technique cannot provide the exact contents of light elements such as Li, B, C, N, etc. ( $Z < 10$ ) because the intensity of X-ray characteristics lines is low.

From CHNS data (**Table 1**) indicates the presence of C, H and N but the presence of S is ruled out in the sample. This weight percentage of the elements is expressed with respect to the mass of sample taken. Only 47.17 wt. % is found contributed from C, H and N. The XRD pattern of the dried rhizome is shown in **Fig. 2c**. It shows a broad peak with maximum at  $2\theta = 23^\circ$  indicating the amorphous nature of the test sample. Even if crystalline compounds are present, their amount per mass of powder sample is very less, which cannot be determined by XRD technique. Usually, such crystalline compounds are obtained after solvent extraction through multi-step processes.

**Table 1** gives the results of elemental analysis of sample using the various instrumental techniques along with reported ones. As and Pb are also detected in the sample and they are within the permissible limit. So there will be no effect of these metals in the therapeutic properties of the rhizome (Karayil, Bhavani & Vivek, 2014). Trace elements are essential micronutrients that exist in very low concentrations in the body, forming less than 0.01% of the total body weight (Sherbeny, Behairy, Mohammad & Elsayed, 2016). But, they play very important roles in various physiological processes and are crucial for proper functioning of the immune system (Gray, et al., 2010).

After correlating the various results of the different instrumental techniques, we have explored a comprehensive elemental fingerprint data of the rhizome. The study have determined the presence of 17 elements: Na (4.3 ppm), Mg (2.6 ppm), K (30.7 ppm), Fe (0.67 ppm), Ca (0.58 ppm), V (< 2 ppb), Cr (5 ppb), Mn (820 ppb), Co (< 2 ppb), Ni (< 4 ppb), Cu (48 ppb), As (< 5 ppb), Pb (14 ppb), O (36.70 at.%), C (37.44 wt.%), H (7.04 wt.%) and N (2.69 wt.%). These results are compared with those of 2 rhizomes reported elsewhere in **Table 1** (Daran, et al., 2017; Devi, Sarma & Kumar, 2007). Our study covers a wider range of elemental analysis as compared to the reported ones. The literature shows that many plants have the presence of different elements, which are broadly classified as major and minor or trace. In this view, C, O, H and N are major elements and other elements in ppm or ppb range are classified as trace/minor elements (**Fig. 3**). The present study showed three categories of elements

- 1) **Major elements:** C, O, H and N.
- 2) **Minor elements:** Cr, Na, Mg, K, Co, Fe, Ca, V, Mn, Ni, and Cu.
- 3) **Toxic elements:** As and Pb.

Here, we are discussing on the importance of each element obtained in this study:

**Chromium (Cr):** The daily requirement of chromium is about 0.005 mg/day. Cr is an essential micro nutrient which potentiates insulin action and hence influences carbohydrate, lipid and protein metabolism (Raju, Sarita, Rao, Rao & Reddy, 2013). Its deficiency causes impairment of glucose tolerance and its toxicity causes in renal failure, dermatitis, and pulmonary cancer (Cefalu & Hu, 2004). **Sodium (Na):** It is one of the important electrolytes of blood which is very important for many regulation systems in the body. The daily minimum requirement of Na in the body is 2.4 g (Parab & Vaidya, 2016). **Magnesium (Mg):** Magnesium acts as a cofactor of many enzymes which are involved in energy metabolism, protein synthesis, DNA and RNA synthesis, and maintenance of the electrical potential of nervous tissues and cell membranes (Classen, 1984). Deficiency of it may be lead to the etiologies of cardiovascular problems, diabetes, hypertension and atherosclerosis in humans (Jing, et al., 1995). **Potassium (K):** Potassium is extremely important to cells and without it we could not survive. K participates actively in the maintenance of cardiac rhythm (Babu et al., 2015). and deficiency of it may cause weakness as cellular processes are affected. Excess of K can cause Hyperkalemia (Bihl & Meyers, 2001). **Cobalt (Co):** The daily requirement of cobalt is 0.0001

mg/day. It is a component of Vitamin B12. The deficiency of it in human beings affects seriously in some biological processes (Sullivan, 2002). **Iron (Fe)** Iron is an essential trace element found in living organisms. The total content of iron in the body is about 3-5 g. Out of which 75% is in blood while the rest is in liver, bone marrow and muscles (Vasudevan & Sreekumari, 2007). Average daily requirement of Fe is 1-2 mg. Iron is absorbed from food when it is being needed. Enzymes and proteins which contain Iron, often consist of heme prosthetic groups perform various biological oxidations and transportation. Excess of Fe causes rapid increase pulse rate, coagulation of blood vessels, drowsiness and hypertension (Naziri, et al., 2015). Deficiency of Fe causes severe disorders; most important among them is anaemia (Lieu, Heiskala, Peterson & Yang, 2001). **Calcium (Ca):** Calcium is an essential nutrient which helps in preventing and curing all bone related issues (Chattopadhyay & Eddouks, 2012). It also helps to repair worn out cells, building of RBCs, strong teeth in humans and body mechanism. Therefore, it is very useful for treatment of various diseases. **Vanadium (V):** Vanadium is an inhibitor of enzymes, minimise plasma cholesterol levels, influence glucose metabolism. It is important for toxic interactions of chemicals (WHO, 2000). Excessive vanadium intake causes gastrointestinal disturbances (WHO, 1996). **Manganese (Mn):** It is a trace element used for reproduction and normal ducting of the central nervous system (Kaur, et al., 2012). It is present mainly in mitochondria. Deficiency of manganese causes human myocardial infarction and other cardiovascular diseases. And excess of manganese is toxic in brain and causes a Parkinson type syndrome (Aschner, 2000). **Nickel (Ni):** Deficiency of nickel particularly affects carbohydrate metabolism (Anke, Groppe, Kronemann & Grün, 1984). Nickels are found in DNA and RNA in significant amounts. It may act as a stabilizer of these nucleic acids (Phipps et al., 2002). **Copper (Cu):** After Iron and Zinc, the third largest trace element found in human body is Cu. Copper plays a vital role in our metabolism because it allows many critical enzymes to function properly (Harris, 2001). It is the main constituent of bone, connective tissues, brain, heart and other body organs (Morabad, Patil & Tapash, 2013). Copper deficiency causes the liver damage malnutrition, malabsorption disorders, depigmentation of hair and skin.

#### 4. Conclusions

In the present study on elemental analysis of *Curcuma leucorrhiza* rhizome, various elements of interest are identified and quantified. The main factors of the varied elemental concentrations are attributed to the differences in chemical structure, environment effect, age, water in which the plants are grown. Major elements: C, H, N and O are the backbone of organic compounds such as organic oils, alcohols, protein and carbohydrates present in plant. The minor or trace elements: Na, Mg, K, Fe, Ca, V, Cr, Mn, Co, Ni and Cu are therapeutically important. Further, the present study has evaluated that no excess quantities of toxic elements were detected. The study will be very useful to pursue further study in the area of herbal and alternative medicines.

#### Conflict of Interest Statement:

The authors declare no competing financial interest.

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Fig. 1 *Curcuma leucorrhiza* Roxb.: (a) Growth of plant during April-July. (b) Transverse sectional view of fresh rhizomes. It appears colorless. (c) The cleaned rhizomes were sliced into small pieces. It appears white/ colourless. (d) After some days i.e. 2-3 weeks, the colour of the sample appears yellowish. (e) It completely dried after nearly 30 days of shed dry at room temperature. It appeared dark yellow in colour. (f) Solution of 1 g of dried powder per 100 ml deionized water after dissolution in ultrapure HNO<sub>3</sub>.

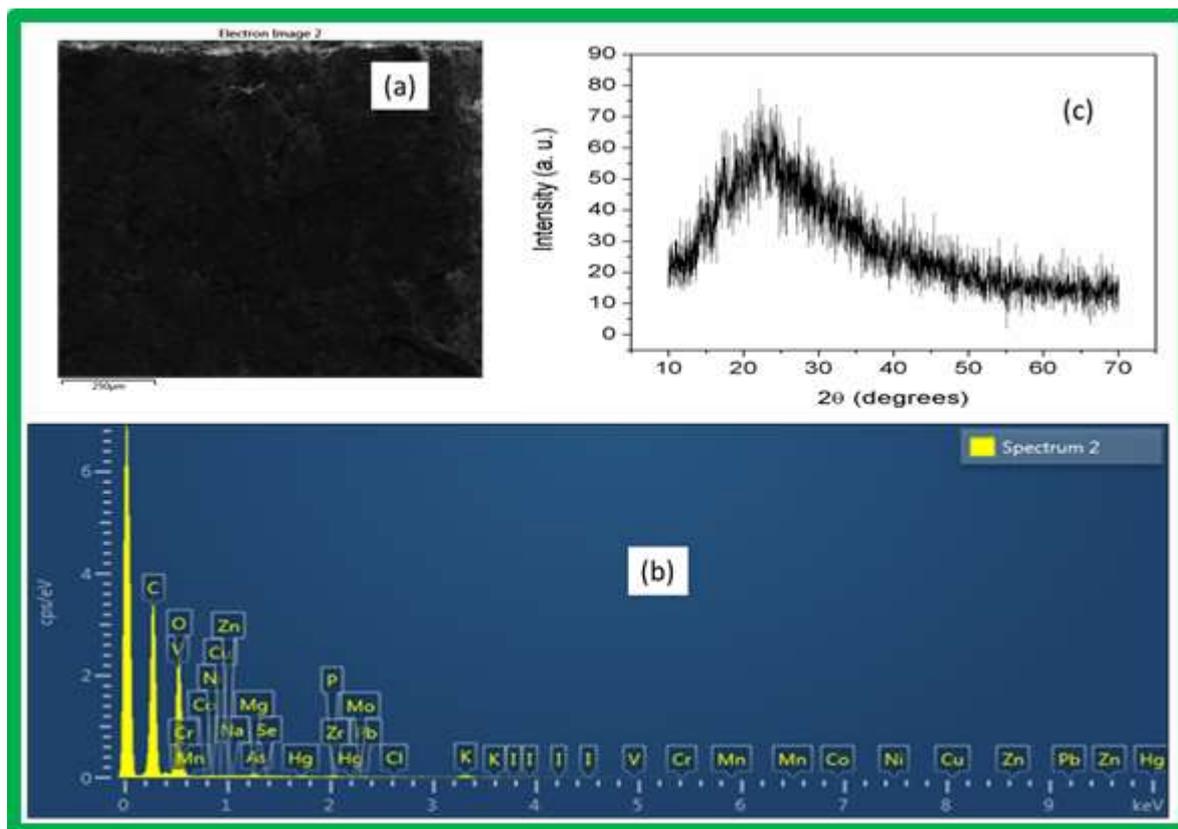


Fig. 2 (a) SEM image of dried powder of rhizome, (b) EDX spectrum and (c) XRD pattern.

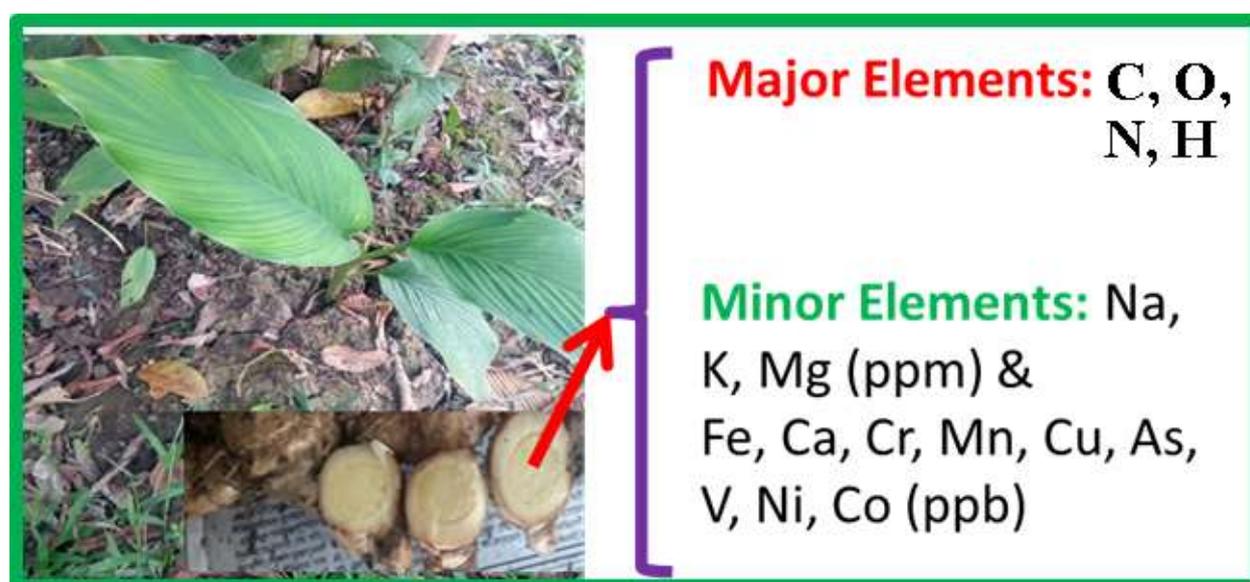


Fig. 3 Major and minor elements present in the rhizome of *Curcuma leucorrhiza* Roxb.

**Table1: Comparison of the sample with standard material and two other elsewhere studies**

Elements	<i>Curcuma leucorrhiza</i> Roxb (our study)				<i>Zingiber zerumbet</i> [26]		<i>Zingiber officinale</i> (Ginger) [27]
	FAAS	ICP-MS	SEM-EDX	CHNS	ICP-MS	INAA	PIXE
	µg/ml	ng/ml	at. %	wt. % per mass of sample	ppm	ppm	% or ppm
C	-	-	62.45	37.44	-	-	-
H	-	-	-	7.04	-	-	-
N	-	-	-	2.69	-	-	-
S	-	-	-	0	-	-	-
O	-	-	36.70	-	-	-	-
Na	4.3	-	0.00	-	-	-	-
Si	-	-	0.00	-	-	-	-
Mg	2.6	-	0.19	-	-	-	-
K	30.7	-	0.36	-	-	-	0.77%
V	-	<2	0.00	-	-	<0.1	-
Cr	-	5	0.00	-	-	1.52 ±0.94	-
Mn	-	820	0.00	-	-	-	313.4
Fe	0.67	-	0.00	-	-	-	216.6
Co	-	<2	0.00	-	-	0.61 ±0.05	-
Ni	-	< 4	0.00	-	-	-	-
Cu	-	48	0.00	-	-	-	4.5
Zn	-	-	0.00	-	-	-	72.5
Cl	-	-	0.01	-	-	-	-
Br	-	-	0.04	-	-	-	-
I	-	-	0.01	-	-	-	-
P	-	-	0.12	-	-	-	-
Zr	-	-	0.02	-	-	-	-
Mo	-	-	0.02	-	-	-	-
As	-	<5	0.00	-	-	0.09 ±0.01	-
Hg	-	-	0.02	-	-	-	-
Se	-	-	0.05	-	-	-	-
Pb	-	14	0.02	-	1.04 ± 0.10	-	-
Ca	0.58	-	0.00	-	-	-	0.165%
Cd	-	-	-	-	0.02 ± 0.01	-	-
Be	-	-	-	-	<0.01	-	-
Tl	-	-	-	-	<0.01	-	-
Al	-	-	-	-	-	254 ± 40	-
Ba	-	-	-	-	-	<1.0	-
Rb	-	-	-	-	-	-	12.9
Sb	-	-	-	-	-	<0.05	-
Sr	-	-	-	-	-	<1.0	-
Th	-	-	-	-	-	0.26 ±0.01	-
U	-	-	-	-	-	<0.05	-

# An Efficient Approach for Mining Association Rules from Web Log Data

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**Abstract**— Mining of association rules from frequent patterns has recently been a large field of interest in data mining studies. In addition to that, the demand of mining association rules from large web log data is increasing rapidly. When we discover hidden information from large web log data is known as web data mining. The main objective behind this mining is obtaining information regarding navigational behavior of the web users that can be used for system improvement, advertising purpose, e-commerce or business application as well as understanding user reaction, network communication etc. In this paper, we have tried to introduce a new algorithm which mines association rules from a web log dataset in which access of the users to different pages are given in some sequence of page visits. The analysis is performed over the server log dataset to generate the required association rules. Experiments have been done with our algorithm using large web log data and considerable improvement has been found.

**Keywords**— data mining, apriori algorithm, association rules.

## I. INTRODUCTION

Extraction of meaningful and hidden knowledge from a large collection of data is the main goal of data mining. And the extraction of that meaningful knowledge from large web data has become a big part of data mining in the recent years, which is known as web data mining. Being a massive unstructured data repository, web provides us an incredible amount of data information. Web mining is the integration of information gathered by traditional data mining techniques and strategies with information gathered over the World Wide Web.

We have been observing a growing trend among various organizations and individuals to gather information through the web data mining in order to utilize that information of their best interest. Large web log data increases the complexity when dealing with the information from different types of users, business analysts and service providers. However, web mining doesn't mean only to apply data mining strategies on data stored in the web. The algorithms need to be modified in such ways that they'll better suit the demands for web datasets.

Different areas of web data mining includes web content mining (WCM), Web structure mining (WSM), and web usage mining (WUM). However, our research part is about web usage or log mining and extracting interesting rules from the log data which consists of textual data and is represented in a sequential format which describes the page visits of users. There are many important application areas of WUM such as E-Commerce/Business Applications, Site Reorganization, System improvement, Web Personalization etc. The aim of this kind of mining is to model and examine the web log data in such a way that it can be able to determine the usage behavior of the site users. As an example, suppose an Internet Service Provider (ISP) wants to get single level knowledge on the websites their clients frequently visit. Now, if they have a large dataset from the core repository (if available) in which each row represents a user and each column is for a website, then they need to use mining approach for determining user behavior. Association rules play a big role in understanding those user behavior. These rules usually used in finding the relationship between attributes from an itemset. In case of web usage mining, item set is a set of pages. Association rules are generated from frequent items with respect to minimum support and minimum confidence, which is an important parameter of any apriori algorithm based approach. Rules are applied to understand pages which often looked together in order to disclose associations between groups of users with specific interests.

## II. LITERATURE REVIEW

### A. Data Mining

Data mining is the process by which we analyze data from different perspectives and summarize those data into meaningful information. It is an interdisciplinary research field which has drawn from areas like database systems, data warehousing, high-performance computing, information retrieval, statistics etc. Data mining is the task where interesting patterns are discovered from a large amount of data which can be stored in databases, data warehouses or other information repositories. That knowledge is applied in decision making, process control and query processing. Also, the discovered knowledge can be used for various applications

ranging from market analysis, fraud detection to customer retention and production control.

**B. Web Mining**

Another area referred as web mining which involves the integration of information that is gathered by conventional mining techniques using available data over the web. According to analysis, various types of web mining includes web usage mining, web content mining and web structure mining.

Content mining discovers productive information available on the web. Different types of web content provides useful information to users which includes unstructured data (plain text), semi-structured (html document), structured (xml document) and multimedia data. The main objective of such mining is to give an efficient mechanism that will assist the system users to discover required information. There have been a rapid development in approaches of web content mining in the past few years.

Another type of mining, named as web structure mining, means the process of finding the hyperlink structure throughout the web. In reality, this kind of mining emphasis on internal document information. Also, web structure mining finds the link structures at the internal document level. The focus is to know the authoritative and a given subject for the hub pages. A page containing a large amount of referencing hyperlink means that the information of the page is important, and also trustworthy. Hubs are web pages having many links to authoritative pages, so they always help to cluster the authorities. Structure mining can be gained only in a single portal and sometimes on the whole web too. The task of web content mining is supported by mining the structure of the web. The document retrieval process becomes more efficient by using the information about the structure of the web, while the reliability of these documents can be greater. Web structure mining exploits the graph structure of the web in order to develop the performance of the knowledge retrieval and to develop document classification.

Web usage mining uses three types of log files. The client side, the server side and the proxy servers store Log files. Navigational patterns of the users, storing the information more than one place make the mining process harder. Only if one has data from all these three types of log file, then reliability could be achieved in results. Generally, server side doesn't contain or save all the web page accesses which are cached on the proxy servers or in client side. The stored page requests in the client side are removed. Yet, it becomes difficult to get all the information of the client side. Thus, most algorithms are based on the server side data. Some commonly used algorithms of data mining for web usage mining are sequence mining, clustering and association rule mining.

There are three stages of web use mining, including pre-processing, pattern discovery and pattern analysis. Again, pre-processing has three steps. The data collected should be

cleaned up initially, which ensures that graphical and multimedia entries are removed. Then it is important to recognize various users having different sessions.

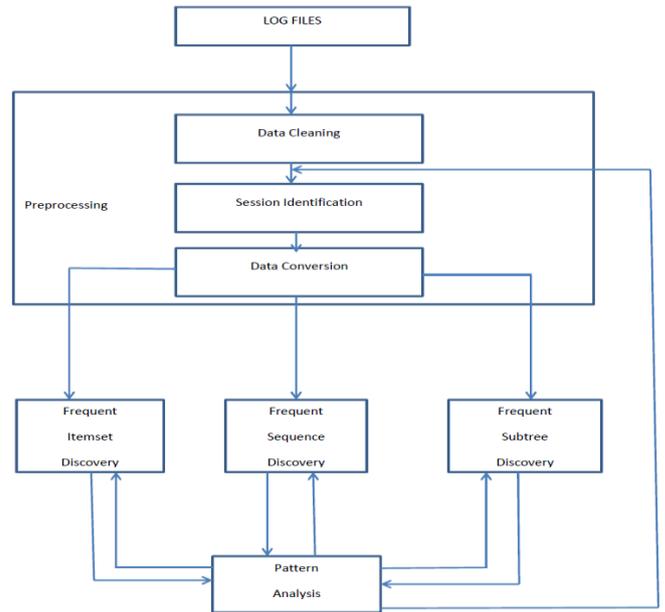


Fig 1: Process of web usage mining

A session is considered as a group of activities that when a user navigates via a given site, he/she conducts. It is not an easy move to understand the sessions from raw data, since the server logs do not always have all the required details. In this work, pattern discovery implies that the frequent sequential pattern discovery procedures implemented have been applied to the desired log data. That is why in the pre-processing stage, the data must be transformed so that the transformation output can be used as the algorithm input. Analysis of patterns involves knowing and drawing a conclusion on the outcomes obtained by the algorithms. The motive behind this study is to figure out the rules in the pattern discovery stage from the collection discovered. The methodology of research is generally controlled by the application for which this web mining is performed. However, web usage mining is our working part. In more detail, extracted interesting rules from the web usage or log data which consists of textual data and is represented in a sequential format which describes the page visits of users.



Fig 2: Major Applications of Web Usage Mining

### C. Itemset

An Itemset  $X = \{x_1, x_2, x_3, \dots, x_n\}$  is a set of one or more items where  $X \subseteq I$ . Here,  $I$  is the set of all possible items in the database. An item-set with  $k$  items is called a  $k$ -itemset. For instance, {google; facebook; yahoo} is a 3-itemset with three items.

### D. Frequent Itemset

An Item-set is said to be frequent if all the items in the set is available in the transaction database,  $D$  at least more than or equal to the minimum support threshold,  $\sigma$ . For example, an item-set  $I = \{I_1, I_2, I_3, \dots, I_n\}$  is frequent if  $\text{frequency}(I) \geq \sigma$ , minimum support. If a database holds a minimum support threshold of 30% and number of transactions in the database is 200, any itemset  $\{i_1, i_2, i_3, \dots, i_n\}$  will be frequent if it satisfies the minimum support threshold i.e. the frequency of the itemset must be at least 60 out of the 200 transactions.

### E. Support

Fraction of transactions involves a collection of objects. The  $\text{sup}(X)$  support of an itemset  $X$  is defined as the proportion of transactions that the itemset contains in a data set. If a dataset has 5 transactions, and within those a 3-itemset {local, news, sports} is present together in 2 transactions, the  $2/5$  is the support of that itemset. since it occurs in 40% of all transactions (2 out of 5 transactions). Again, the support of a sequential pattern includes the number of sequences where the pattern takes place, divided by the total number of sequences in the database.

### F. Confidence

Confidence is an interesting measure of an association rule that refers to the state of likelihood given the precedent of the rule resulting from the rule. If  $n\%$  of sessions in  $D$  that have  $X$  also have  $Y$ , the rule  $X \rightarrow Y$  holds in a set of sessions  $D$  with confidence  $n$ . The following formula is used to measure the confidence of a rule, where  $\text{Supp}$  represents candidate support.

$$\text{Conf}(X \rightarrow Y) = \text{Supp}(X \cap Y) / \text{Supp}(X)$$

### G. Association Rules

Let  $X = \{x_1, x_2, \dots, x_p\}$  and  $Y = \{y_1, y_2, \dots, y_p\}$  be two Item sets where  $X, Y \subseteq I$  and  $X \cap Y = \phi$ . Here  $I = \{I_1, I_2, \dots, I_n\}$  be a finite set of  $n$  items. Thus an association rule is defined as representation of the form  $X \rightarrow Y$ . The set of items  $X$  is here called the antecedent and the set of items  $Y$  is called the consequent.

For example, let  $I = \{\text{facebook, google, yahoo, youtube}\}$  and a set of frequent items be {facebook, google, yahoo}. Now an association rule could be {facebook, yahoo}  $\rightarrow$  {google} which means that if people visit facebook and yahoo, then they visit google as well. One of the well-researched data mining approaches is association rule mining. It focuses on extracting interesting similarities and regular trends in the transaction databases or other data repositories between sets of

objects. In fields such as risk management, business research, inventory control, these rules are extensively used.

### H. Related Works

There have been advancements in the sector of web data mining. Different techniques of web data mining have been proposed recently. Some of them were frequent sequential pattern mining from web logs, applying OLAP and data mining technology on web log etc. Pattern mining are important and useful for knowledge extraction. This extracted knowledge can be used in improvement of web site design, system performance analysis, network communication, user response and motivation learning and building adaptive website [11,12]. Different data mining techniques can be used in web usage mining. Association rules are used to find out the pages that are visited together, which shows the interest of specific group of people [2,6]. Using this knowledge of the prediction of visiting of next page of user can be determined. In sequence mining WAP-tree is used for efficient pattern storing [10]. Tree-like topology pattern and path traversal is used in searching in data mining [8, 9, 10]. For mining closed sequential pattern NCSP used MSNBC dataset [7]. NCSP Algorithm first scans the whole database and removes the infrequent items. Then it builds vertical bitmap. From the bit map it finds 1-sequence frequent item set. Then it generate the candidates.

Agrawal and Srikant introduced sequential pattern mining problem [4]. A sequence set is given here, and each sequence has a list of elements while each element consists of a set of objects, and sequential pattern mining finds all frequent subsequences given a user-specified minimum support threshold, i.e., the subsequence that occurs frequently within the sequence set is no less than minimum support. GSP was introduced by Agrawal and Srikant, which generalized the sequential pattern concept that surpasses their Apriori All algorithm [3,4]. GSP works efficiently in the case where transactions are not large and the sequences are not long. However, when the length of the sequences increases or transactions are large, the generated candidate sequence number can grow in exponential way, and GSP will fall in difficulties. All of the above studies that relates with (either sequential or periodic) frequent pattern mining takes the form of an Apriori like paradigm, advancing a generate-and-test methodology (generate a set of candidate patterns, then test when each candidate have enough support in the database). To find frequent set of pages, ItemsetCode algorithm [3,16] was introduced in web data mining which is a level-wise "candidate generate and test" method. It also follows apriori algorithm, but not fully. The algorithm enhances the Apriori on lower level. Here, small frequent itemsets are discovered in an improved way and it is considered as a better and faster way to find greater itemsets.

An improved apriori algorithm for association rules was introduced by Al-Maolegi and Bassam[17]. Firstly, all transactions are scanned by the algorithm to get frequent itemset of one item that contains the items, their support count

and the transactions ids. Then eliminate the candidates which are infrequent that means their support are less than the minimum support. Then it stores all the transaction ids against the individual frequent items. After that, candidate 2-itemset is generated from the first frequent itemsets. It generally perform join operation in frequent 1-itemset. After that, it checks whether support of an itemset is minimum or not. Then those transactions are scanned to count the support of newly created set or join set. This is done for all join sets and terminate those itemsets whose support value is less than the given support value. Then it performs the same operation of storing. After that it performs the 3-itemset operation and so on until the candidate set is empty.

### III. PROBLEM STATEMENT

Being a core algorithm of data mining, Apriori plays a vital role in web data mining and traditional mining procedure as well. Here the target is to generate frequent itemsets and producing association rules based on those itemsets. In web data mining this algorithm is used for mining frequent pattern from a transaction data set which is a repetitive process. This algorithm searches level wise. Apriori organizes a “subset frequency based pruning optimization” which means, it only process a itemset whose subsets are also frequent. The major disadvantage here includes: i) It performs n number of passes through the database, where n stands for the distance of largest frequent itemset. The count of candidate itemsets having a length k can be obtained through k<sup>th</sup> pass, ii) Requires much runtime for large real datasets. Apriori algorithm divides the complexity of mining patterns into two different steps: Firstly, find all combinations of items which have transaction support beyond the minimum support, and then generate frequent patterns. Secondly, a pass k (being a subsequent pass), consists of two phases. First, the frequent pattern L<sub>k-1</sub> (the set of all frequent (k-1) - patterns) found in the (k-1)th pass are used to generate the candidate set C<sub>k</sub>. The algorithm ends when L<sub>k</sub> turns out to be blank.

Here for n itemset, it explores n+1 itemset. First it generates frequent itemset of 1-item comparing with support value. After that it produces candidate set. Then it generates the 2-itemset frequent value using support and confidence. It produces 2-itemset using combination of first frequent itemset. It generates more frequent itemsets until n\_itemset are found which satisfies both the support and confidence. It scans the whole database for each and every time of iteration. It is very costly to generate candidate set. In web mostly the data sets are huge so it is not cost effective at all. Apriori takes more time to scan the large data set and produce frequent itemset. For instance if we take 104 1-item sets, apriori will produce 107 length-2 candidates and accumulate and test if their frequency occur there. Moreover, to find out a frequent pattern of size 100 such as {a1.a2.....a100}, it should generate 2100-2 ~ 1030 candidates totally. This is the candidate generation cost. So the number of database scan is always increasing thus the candidate generation increase and so the computational cost. As the search space is increased and so the I/O cost will

increase. Because of lot of iteration it takes more time to execute and memory consuming as well.

## IV. PROPOSED SYSTEM

### A. Proposed Method

In this section, we discuss our strategies to achieve the goal of our algorithm which is mining association rules from web log data. We are given with a transaction database which is an anonymous web log data, where each transaction represents an user’s web page hits in a sequential form. Besides that, the required input parameters are given which consists of minimum support, confidence thresholds, web categories, sort flag.

Here is a flowchart of our working procedure. The sequential steps include reading log data file, cleaning the data, data conversion (that refers to making the matrix format), frequent itemset generation, pattern analysis and at last association rule mining.

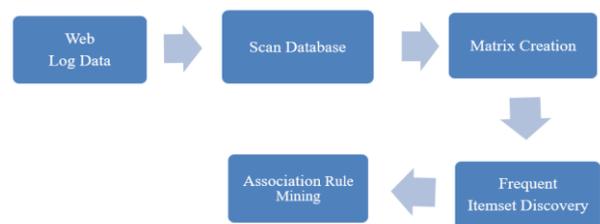


Fig. 3: Working Procedure

### B. Algorithm

In this part we discuss about our proposed algorithm and its input and desired output. Our algorithm is based on the apriori algorithm, a widely used data mining algorithm. Association rules can be generated from frequent items with respect to the minimum support as well as minimum confidence, which is an important parameter of any apriori algorithm based approach. However, the algorithm have modified in a way so that they better suit the required demands for web datasets having sequence of page visits of users.

The algorithm can be described as below:

Input: Dataset D, Minimum Support  $\delta$ , Minimum Confidence  $\gamma$

Output: Association rules from frequent itemsets

```

begin
  Scan D
  build a zero matrix(R,C);
  for each item Ii in Transaction Ti in D do
    matrix(Ri, Ci) = 1;
  end
end
call ruleFinder (matrix,  $\delta$ ,  $\gamma$ );
display result;
end
    
```

Now, in the *ruleFinder* procedure (which have the matrix, minimum support  $\delta$  and minimum confidence  $\gamma$ ) includes the following steps:

- Step 1. Find frequent itemsets of size 1 (one) (list of all items with  $\delta$ )
- Step 2. Find frequent item sets of size  $\geq 2$  and from those itemsets, identify rules with  $\gamma$
- Step 3. Generate all the possible combinations of items that are in frequent itemset
- Step 4. Store the frequent itemsets
- Step 5. Sort the rules in descending order based on the support or confidence level
- Step 6. Save the rule in a text file.

Here the function that performs association analysis is *ruleFinder*. Given a set of transactions, It is able to find rules that'll predict the occurrences of different items based on the occurrences of other items in the same transaction. Generally, rules are of the form  $A \rightarrow B$  (e.g. {news, misc}  $\rightarrow$  {local}). Here, Other parameters are sortFlag, categories, nRules.

## V. EXPERIMENTAL RESULTS

### A. Dataset

The MSNBC is an Anonymous Web Data Set. We used this big dataset for the experiment of our algorithm as it is suitable for our proposed methodology. The data type is of discrete sequence and a very dense dataset. This set provides information about the page visits of the users who already visited msnbc.com during twenty-four hour period on a specific day.

This dataset has taken from Internet Information Server (IIS) logs for msnbc.com, for the whole day of September 28, 2011. A page view of the user over a span of twenty-four hours reflects every single sequence in the dataset. Again each event in a series represents the request for a page from a user. Here, requests have not been reported in depth at the very best level (not at the URL level) but have been recorded at the level of the page category (as decided by a site administrator). The types available are as below:

“frontpage”, “news”, “tech”, “local”, “opinion”, “on-air”, “misc”, “weather”, “health”, “living”, “business”, “sports”, “summary”, “bbs” (bulletin board service), “travel”, “msn-news” and “msn-sports”.

Also, any page request that is served via a caching mechanism did not record in the server logs. Hence, they were not present in the data. David Heckerman (heckerma@microsoft.com) is the Dataset provider. Total number of users inside the dataset is 989818.

Here is the table of page category number with the code that is given inside the dataset:

Page Category	Code	Page Category	Code	Page Category	Code
frontpage	1	misc	7	summary	13
news	2	weather	8	bbs	14
tech	3	health	9	travel	15
local	4	living	10	msn-news	16
opinion	5	business	11	msn-sports	17
on-air	6	sports	12		

Table 1: msnbc.com page category codes

### B. Result Analysis (Tabular)

After implementing our proposed algorithm we got our required association rules as output. Several sample rules (1st 25 rules) which were found by the implementation of the algorithm are given in the following table. Here, the given minimum support is 0.1% and minimum confidence is 50%. Note that, the table is sorted in decreasing order of support.

Rule	Support	Confidence
news,misc $\rightarrow$ local	1.04870%	52.1137%
tech,health $\rightarrow$ news	0.54939%	57.4174%
local,health $\rightarrow$ news	0.52596%	55.7626%
tech,living $\rightarrow$ news	0.51484%	52.9290%
health,business $\rightarrow$ news	0.49211%	54.4611%
misc,weather $\rightarrow$ local	0.48120%	55.7924%
misc,summary $\rightarrow$ on-air	0.47524%	79.4192%
misc,health $\rightarrow$ on-air	0.45089%	57.7510%
health,living $\rightarrow$ news	0.41614%	57.4798%
misc,health $\rightarrow$ news	0.40573%	51.9669%
tech,misc $\rightarrow$ news	0.38765%	50.9021%
misc,living $\rightarrow$ news	0.35017%	53.6948%
misc,living $\rightarrow$ local	0.34218%	52.4710%
misc,living $\rightarrow$ on-air	0.33309%	51.0767%
health,sports $\rightarrow$ news	0.31602%	57.5847%
opinion,living $\rightarrow$ news	0.31309%	57.6880%
health,summary $\rightarrow$ on-air	0.31117%	64.8148%
tech,opinion $\rightarrow$ news	0.31087%	59.3214%
local,opinion $\rightarrow$ news	0.28581%	55.3512%
opinion,business $\rightarrow$ news	0.25894%	62.7110%
opinion,summary $\rightarrow$ on-air	0.25005%	64.1026%
opinion,misc $\rightarrow$ on-air	0.24328%	62.5780%
opinion,health $\rightarrow$ news	0.23873%	66.9595%
living,summary $\rightarrow$ on-air	0.23651%	56.6965%
opinion,sports $\rightarrow$ news	0.22317%	60.0761%

Table 2: Rules with support and confidence (Our Approach)

Now, we will show the results that we get after using msnbc dataset in an improved apriori algorithm [19]. Note that we implemented the algorithm in the same environment and the results are shown below:

Rule	Support	Confidence
misc -> on-air	3.3625%	41.3382%
summary -> on-air	1.4178%	48.0616%
news,misc -> local	1.0487%	52.1137%
tech,business -> news	0.69669%	46.9084%
on-air,health -> news	0.62062%	43.2819%
local.business -> news	0.58728%	41.4977%
tech.local -> news	0.58182%	41.2477%
local.living -> news	0.55394%	48.3424%
tech.health -> news	0.54939%	57.4174%
local.health -> news	0.52596%	55.7626%
on-air.living -> news	0.51999%	44.6943%
tech.living -> news	0.51484%	52.929%
travel -> news	0.46908%	42.1861%
travel -> living	0.45241%	40.6869%
tech,sports -> news	0.43553%	44.9718%
tech,misc -> news	0.38765%	50.9021%
news,summary -> on-air	0.37866%	44.0164%
opinion,on-air -> news	0.36027%	48.656%
misc,weather -> news	0.35299%	40.9277%
opinion.living -> news	0.31309%	57.688%
tech,opinion -> news	0.31087%	59.3214%
local,opinion -> on-air	0.28581%	55.3512%
opinion,business -> living	0.25894%	62.711%
opinion.health -> news	0.23873%	66.9595%

Table 3. Rules with support and confidence (Improved Apriori)

C. Result Analysis (Graphical)

Here is a graphical view of time required to build up the binary matrix which helps us to count the itemset frequency in an efficient way. The execution time of the algorithm after building the matrix is found less than the traditional apriori approach. The required time for building the matrix for upto 800k transactions is given below:

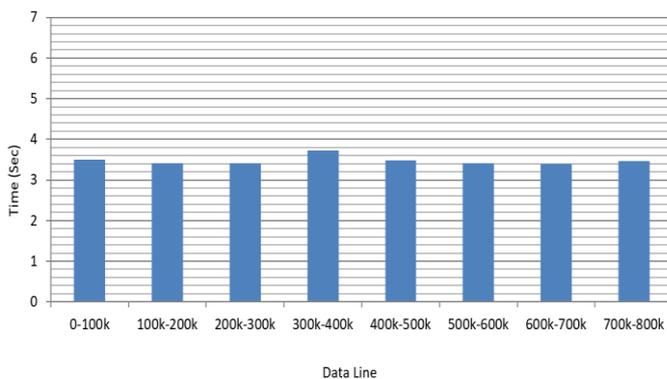


Fig. 4: Time required to build data matrix

The performance of our proposed algorithm has been showed that it takes less runtime than an existing algorithm improved apriori. We used 32000 transactions for runtime evaluation. So, we used the same number of transaction and compared

with their performance and got runtime less than improved apriori.

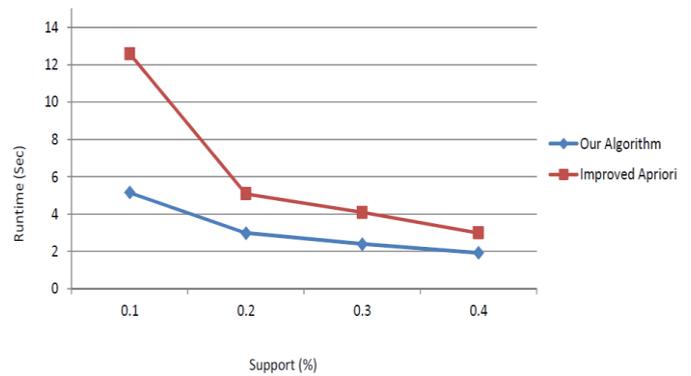


Fig. 5: Performance comparison using MSNBC dataset

VI. CONCLUSION

There have been a increasing trend to explore required information by mining web data among individuals and organizations in order to utilize the collected information of their best possible interest for increasing personal or company profit. Web data mining does not mean only to apply data mining methods to the data that stored in the web, rather the algorithm need to modify in a way so that they better meets the demands for web datasets. And we have done this work. Our main contribution is that we have modified the traditional apriori approach is such a way so that a large web log data (that contains sequential user access patterns) can be processed in an efficient way without scanning many times and then generate association rules. Result proved that the transaction database matrix has reduced from the very first scan where new matrix is created that contains only frequent itemsets. It also reduced the computational cost and we found our proposed algorithm faster. Thus we can easily conclude that, we have found a remarkable improvement in our proposed work for large web log data.

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# Use of MathCad software in the preparation of students majoring in engineering.

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**Abstract:** The article discusses the use of the MathCad system in the educational process of students of engineering specialties in the study of disciplines for the development of modern computer technologies and software. Using the MathCad system plays a huge role in solving traditional engineering problems, as well as mathematical programming problems.

**Key words:** software, MathCad, Given, computer technology, programming, differential equations, multimedia.

## I. INTRODUCTION

This article describes the purpose of the following problems, the methodology of solving suggestions and comments and their implementation in practice, its effectiveness. The modern higher education system requires the introduction of innovative technologies, including the widespread use of computer and information technologies in the organization of the educational process. A modern engineer must have extensive knowledge and good training, be able to improve their skills and understand innovations, be able to make non-standard decisions, be able to quickly search and analyze legal and economic information, and know foreign languages and use modern information technology necessary. Such demands require a new approach to ensuring the quality of education of engineers.

Therefore, the article describes the methodology of using the Mathcad system in the process of teaching engineering students modern computer technologies and software. The use of the Mathcad system is of great importance in solving traditional engineering problems as well as mathematical programming problems. For that reason, there is a need to use modern information technologies in the educational process to generalize and improve traditional methods of solving problems in the field of engineering. This problem is reflected in the article.

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Therefore, the article describes the methodology of using the Mathcad system in the process of teaching engineering students modern computer technologies and software. The use of the Mathcad system is of great importance in solving traditional engineering problems as well as mathematical programming problems. For that reason, there is a need to use modern information technologies in the educational process to generalize and improve traditional methods of solving problems in the field of engineering. This problem is reflected in the article.

## II. RELEVANCE AND NECESSITY OF THE TOPIC

In accordance with the tasks set in the state program for the implementation of the Action Strategy on the five priority areas of development of the Republic of Uzbekistan in the "Year of Science, Enlightenment and Digital Economy" and through the widespread introduction of modern information technologies The Resolution of the President of the Republic of Uzbekistan dated April 28, 2020 No. PP-4699 on the development of digital economy and e-government was adopted. The decision of the state to choose the way of development of the digital economy opens new directions in the field of information technology and electronic document management in general. The decision of the state to choose the way of development of the digital economy opens new directions in the field of information technology and electronic document management in general. The shift towards "digital technology" has been fueled by the development of the global Internet and quality communications. Therefore, the training of engineering students as advanced specialists in the field of modern computer technology is of great importance today.

**Aims and objectives of the topic.** The use of tools designed to solve mathematical problems in engineering descriptions is currently undergoing a fourth revolutionary change, consisting of Mathcad, Mathematica, Matlab, Derive, Theorist, and other powerful computer packages (the first three stages of this revolution were marked by the timely emergence of tools such as a

scoreboard or microcalculator). They allow the student to focus on the material being studied, freeing them from large-scale, outdated, monotonous calculations.

The range of tasks performed using these computer packages is very wide, and their use in many ways helps students to work actively and smoothly, increase the efficiency of the learning process and the quality of education. The peculiarity of these computer packages is that they have the following tools (capabilities) and their implementation is as follows:

1. perform digital calculations;
2. perform symbolic (analytical) calculations and changes;
3. create various graphs;
4. creation of documents using new multimedia tools, including hypertext and hypermedia-links;
5. Integration with other software tools.

These software systems allow not only the use of computers in the teaching of mathematics and computer science, but also the teaching of all subjects included in the curriculum in the training of future engineers.

Many optimized engineering tasks can be solved using the MS Excel spreadsheet processor included in the Microsoft Office suite. Although spreadsheets are primarily designed to solve economic problems, their tools can also be used to solve problems in other areas, such as calculating formulas, building graphs and diagrams. So, learning MS Excel is important for engineering professionals and requires them to have the ability to work with MS Excel. However, MS Excel does not have enough capabilities to complete the many and comprehensive data needed to solve engineering problems.

The Mathcad - Mathematical Computer Aided Design package created by MathSoft (USA) has a high capacity to perform such tasks.

Mathcad is a unique collection of applications of modern numerical methods of computer mathematics. It included experiments, rules, and methods of mathematical calculation accumulated as a result of the development of mathematics over the years.

Mathcad package is a software tool for engineering and computational work, it is designed for professional mathematicians, engineers - technologists. It can be used to solve algebraic and differential equations with variable and invariant parameters, to analyze functions and search for their extremums, to construct tables, graphs, and other similar tasks to analyze the solutions found. Mathcad also has its own programming language for solving complex problems.

Mathcad is simply a tool that allows a student to focus on the concepts and logic of methods, algorithms, and get rid of large, over-computational tasks that are difficult to remember. But this tool cannot be used as a visual aid alone without understanding the physical meaning of the task at hand. Despite the widespread penetration of computer technology into all fields and processes, it is difficult to understand the theoretical foundations of mathematics and methods for solving engineering problems without the usual theorems and algorithms.

The basis of training should be based on a computer package with a clear interface and universal capabilities.

In MathCad, mathematical equations are written on paper as they are written on paper. Results can also be obtained at the same time. The user can easily write comments on the equations and also draw 2- and 3-dimensional graphs. One of the advantages of MathCad is its ability to perform complex calculations. MathCad offers a lot of opportunities in solving the user problem, preparing all the scientific works, formatting them and making them look beautiful. MathCad can understand more than a hundred systems of linear and nonlinear equations with variables and constants, operations on matrices and vectors, algebraic calculations, Laplace, Fourier integrals, arrays, simple differential equations, boundary conditions, special derivative differential equations, polynomials. MathCad allows you to visualize the results of scientific work with graphs. The user will be able to easily depict functions in 2 and 3 dimensional graphics, different color views, planes and space. The MathCad Help window is very easy to use, you can easily search for the information you need from this directory.

Classes are organized in such a way that students perform individual tasks independently (each depending on their level of preparation). Every student with a different level of knowledge is obliged to make accurate calculations. The student then, under the guidance of the teacher, determines the possible limit of the variable based on the result of the variable parameters given in the conditions of the Given logic block, as well as analyzes the extreme properties of the obtained results. Thus, by the end of the lesson, each student will have mastered the material at their own level. Students will be able to conduct research independently when there are study guides with sample problem solutions and detailed assignments, which is especially important for the introduction of distance learning.

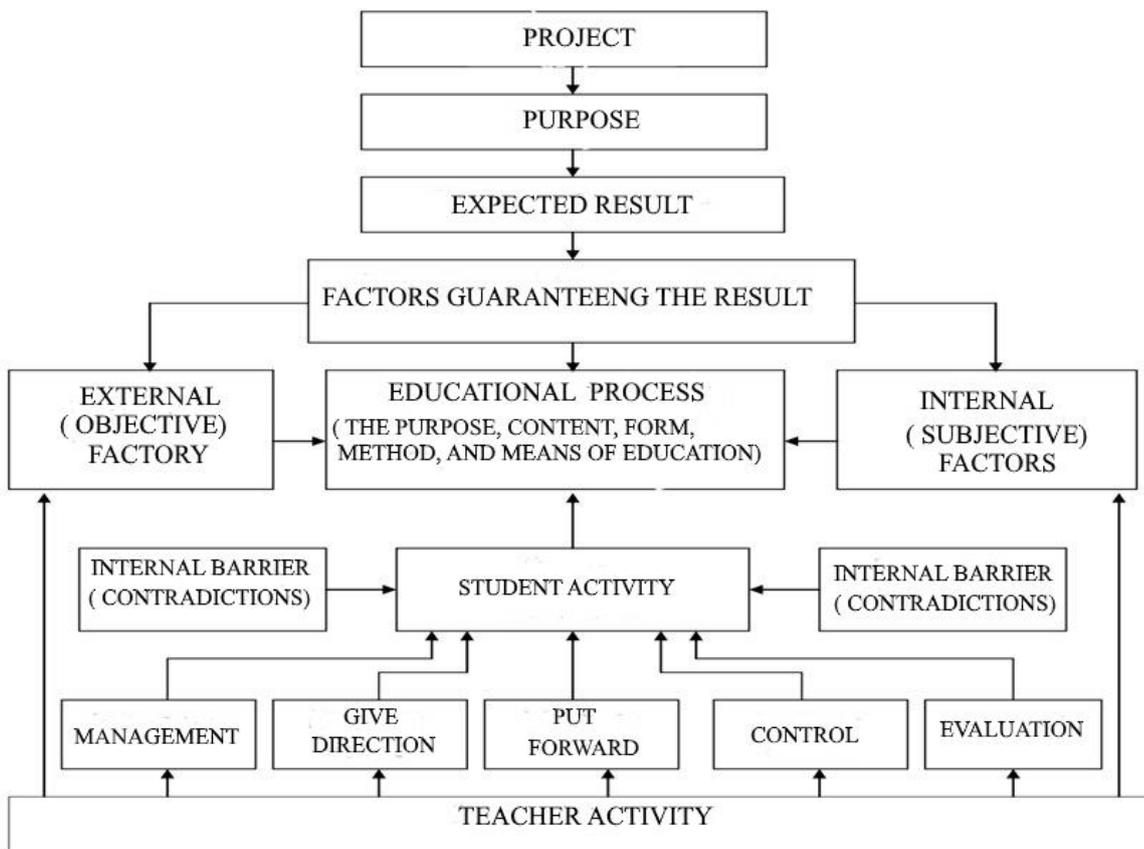
As a result of completing assignments using the MathCad system, students develop the ability to use computer programs to perform engineering tasks. In addition, the use of MathCad in the course work allows students to be fully aware of the achievements of modern computer science and computer technology. This will speed up the process of acquiring new knowledge in order to ensure the high professionalism of future engineers.

Even users with no special knowledge in the field of programming (such as the majority among scientists and engineers) can take full advantage of the achievements of modern computing science and computer technology from the capabilities of MathCad. The user's basic skills are sufficient to work effectively with the MathCad editor, on the other hand, professional programmers can also use a variety of other software tools that significantly expand the capabilities described directly in MathCad itself.

**Scientific and practical significance of the topic.** Today, computer and information technologies are becoming a priority in the development of higher education. Their use helps to plan the time spent on computational work, which requires a lot of work in the learning process, to improve the quality of education, as well as the formation of academic and professional competence of the student.

Practice shows that the use of an integrated Mathcad system in the learning process significantly enriches the learning process, facilitates the comprehension of information, encourages the student to work independently, contributes to their intellectual development.

**Introduction of the topic result.** We have tried to illustrate the functional structure of educational technology through an image as follows. In the presence of social competition, moderate activity, the creation of business immunity to competition, creates an opportunity to "survive" in a conflict of interest, to gain a high position. Therefore, students are getting a conscious approach to learning, acquisition of theoretical and practical knowledge.



**Figure 1:** Functional structure of educational technology

This creates an incentive for them to get an education. Now it is becoming a vital necessity to get an education, to acquire knowledge of a certain profession or specialty, to form certain skills and competencies in this regard. Incentives for learning and its content can be a guarantee of the success of the educational process.

Encouragement to learn is also important in shaping the foundation of learning activities with the participation of students and teachers. In the recent past, the participation of the student in the educational process is satisfied with the role of the subject as a subject who receives theoretical knowledge and demonstrates acquired theoretical knowledge, practical skills, while according to the requirements of educational technology, the student is seen as a leading subject. Now the pupil and the student do not accept the information (knowledge) transmitted by the teacher. Perhaps the instructor's guide acquires theoretical knowledge through independent acquaintance with the recommended teaching resources in accordance with the instruction, developing practical skills and competencies under the teacher's supervision. The student is required to be able to work independently, to develop the ability to put forward ideas, to present arguments, to defend their opinions, to determine the qualities of self-criticism, self-assessment on the basis of theoretical knowledge. The demand of the time requires the student to become an active participant in the educational process, rather than a sluggish listener.

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### **III.SUGGESTIONS AND RECOMMENDATIONS**

In the study of modern computer technology for students majoring in engineering:

- effective organization of independent work in the classroom and outside the classroom at home;
- competencies of independent thinking, creative work skills;
- development of self-control competencies;
- the development of the digital economy and e-government will serve to increase the theoretical and practical significance of research work.

As a result of research and experimental research, a methodology for teaching mathematics based on a competency-based approach has been developed and proven to increase students' knowledge, methodological recommendations and methodological manuals have been developed and put into practice.

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# Azerbaijan and Iran`s Battle genre in the classical period Turkic dynasties rule of miniature painting in XIV-XVI centuries.

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**Abstract-** The present article is devoted to the problems of Persian miniatures painting. Research is a traditional sense considering its specific chronological segment in its style evolution a genre approach is applied in this case. The main purpose is to examine the material of battle scenes in miniatures, covering the history of the Persian and Azerbaijani schools as well as their mutual influence due to a change in the rule of the Turkic dynasties in Iran in the era of the XIV and XVI centuries. In tandem, each of the stages in the evolution of the battle genre is given a comparative parallel to the existing other styles of miniature painting.

**Index Terms-** Tabriz school, miniatures, battle genre, Persian miniatures, Azerbaijan, Iran, painting art, Turkic dynasty

## I. INTRODUCTION

The art of Azerbaijan and Iran has passed through a difficult century's way of development and the history of medieval rule by Turkic dynasty that developed architecture, arts and crafts,

fine arts, and music were the brightest pages of world culture. It expressed itself in the wealth of carpet schools, jeweler metal artists, identity and beauty of clothes, etc., but the most precise and perfection is embodied in miniature painting of the Tabriz school, which, throughout in the three centuries of development, it was a leading school, a school of law, and was never confined to a narrow national framework.<sup>1</sup> In spite of all these advanced art expressions the most accurate and perfect embodiment in miniature painting by the Tabriz school, which throughout the entire three-century period was the leading school of legislator.<sup>2</sup> It is necessary to say about the general picture of the evolution of style in its main stages is outlined in the works of the scientists as foreign and domestic researchers. At the same time, considerably enriched by facts and new samples, miniature painting allows applying a thematic approach to the study of its history based on such manuscripts as "Varga and Gulshah", "Jami al-Tawarikh"(Compendium of chronicles) (the Edinburgh, London, Istanbul, Berlin, and Paris copies)"<sup>3</sup>(F.1).

<sup>1</sup> Abbasli M. Bir elyazmanin miniaturleri /Qobustan 1988, №1, p 74-79

<sup>2</sup> Aslanov E. Azerbayjan Miniaturleri/Qobustan, 1988, № 4, p.8

<sup>3</sup> Akimushkin O. F. Persidskaya rukopisnaya kniga//Rukopisnaya kniga v kulture narodov Vostoka M. 1987, p. 330



**F.1.** Illustration from manuscript of the Romance of Varqa and Gulshah, c1250  
Source: [http://warfare.ga/Turk/40-Varka\\_wa\\_Gulshah.htm?i=1](http://warfare.ga/Turk/40-Varka_wa_Gulshah.htm?i=1)

The division of the pictorial it's not new, it's broad has been applied in both foreign and Azerbaijani art history; several works on the theory of genres, their mutual influence, merging of two or more genres in the art of painting were published. However, at the same time, the Oriental art in particular, miniature live painting, in such schools as Geyrat, Tabriz, Shiraz, there is possible discover clear differentiation of genres, as legendary-mythological, lyric-epic, animalistic, historical and battle. The latter of the art of the East since ancient times occupies one of the first places along with hunts, which were military exercises. For several centuries since Caliphate the existence of a miniature painting battle genre has come to a difficult way development, first adhering to the most ancient, and enough schematic compositions that came in rock art from the Middle Ages frescoes, toreutics and ceramics. Each of these compositions, as the style evolved, acquired a completely different interpretation outgrew the narrow framework of the canon and following the requirements of the time and introduced a new understanding of art, revealed more and more new possibilities.<sup>4</sup>

The numerous corps of Tabriz illustrated manuscripts makes it possible to isolate the code of battle plots. Their high artistic qualities make it possible to trace the evolution of the battle genre alone, which is our immediate task, and in its entirety, the development of the very style of Tabriz miniature. The battle genre, one of the most stable and widespread, takes its roots in the art of the Pre-Islamic times.

Alongside with the scenes of investors, feasts, genre scenes, there was, moreover, occupied the dominant the place in terms of importance and the battle genre, namely: war, hunting, which were essentially military exercises, scenes of the siege of cities, fortresses, a battle of armies, fights of legendary and historical heroes. The prevailing stereotypes, known to us from paintings, reliefs, images of Achaemenid, Sassanid on objects of decorative and applied art, testify to the canonicity and their inviolability for

many centuries. In the Muslim East, and in particular, in the earliest phase of the development of book miniature art, in the works of the Arab Mesopotamian School, the battle genre was absent.

## II. THE EVOLUTION OF THE BATTLE GENRE AND ANALYSIS OF TURKIC INFLUENCE IN THE XIV CENTURY

The evolution of the battle genre in the XIV century it is long life was traced in the art of the style of miniature illustrations for "Jami'al-tawarikh" for such a long period (from the beginning of the XIV to the middle of the XVI century), early compositional schemes undergo significant changes, sometimes becoming difficult to recognize. But the original concept, the principle of selection plots, the scenes of the assault on the fortress walls of cities, the scenes of fights of the knights of the warring armies, as well as the battles of the armies following the series of fights, remain unchanged, although the early horizontally elongated compositions become square, and later vertically directed. A completely different picture of the development of the battle genre was given by the Great Tabriz Shahnameh or Shahnameh of Demotte (Great Ilkhanid Shahnameh). They testify to the appearance and development in the genre, along with the aforementioned, and another line, revealing new opportunities that cross narrowly genre boundaries.

In the scenes of fights, especially in the so-called "Pathetic" manuscript miniatures, a complex range of feelings, the fierce intensity of the struggle, the tragedy of a hero dying in the color of years, the triumph of the winner and humility to fate, the doom of the vanquished - such is the wide range of feelings of the characters in Demott's Shahnameh. Among the miniatures, there are also typical battle genre scenes of battles of armies, fights, the pursuit of the retreating enemy, the hero-a serpent, defeating either

<sup>4</sup> Gasanzade J. Zarojdenia i razvitiye Tebrizskoi miniaturnoi jivopisi v kontse XIII- nachale XV vekov, B, 1999, p.328

a dragon or some other some kind of monster, but there are as rare as the scene executions of Ardavan or Navdar capturing a moment before the execution<sup>5</sup> (F.2).



F.2. Demotte Shahnameh ARDASHIR CAPTURES ARDAVAN

Source: <https://asia.si.edu/learn/shahnama/s1986-103/>

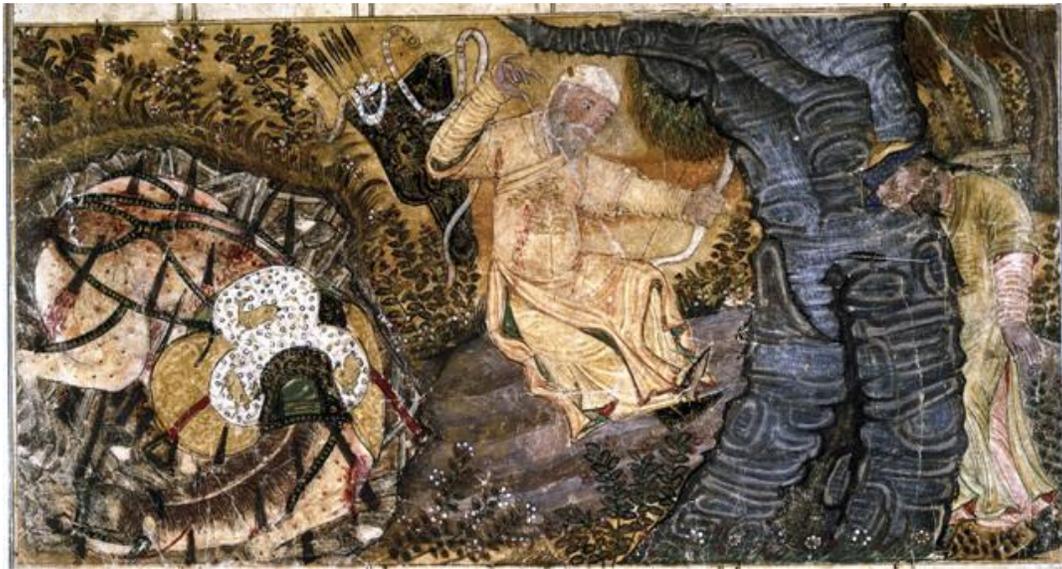
These changes took place based on the old familiar patterns, but how far the illustrators Shahnameh Demotte went from them, leaving only the old skeleton of the composition. No wonder Dust Muhammad in his message (which, according to the general opinion of researchers, is the most faithful and capacious essay of miniature painting) figuratively says that "Ahmed Musa opened the curtain from the face of the painting".

The most bright example of how far the masters of Shahnameh Demotte have gone from painting the previous stage is a comparative analysis of the miniatures "Rustam slaying Shagad" (F.3), from the Edinburgh "Jami al-Tavarikh" and "Shahnameh" of Demotte. The style gives out the influence of fresco painting, withstanding multiple increases. Due to the horizontal tension of the format, the rapid the diagonal flow of

power takes on a powerful scope. Notwithstanding in such a framework it is much more difficult to create an interconnected, integral composition, the artist brilliantly copes with the task of uniting individual parts of work into a single whole<sup>6</sup>. In the lower-left corner of the composition is the agonizing Rakhsh, the faithful horse of Rustam, his constant companion in feats of arms. According to the plot, he falls into a wolf pit dotted with spears and swords. His anguish is expressively conveyed by his upturned head and convulsive movements of the croup and legs. This horse directly goes back to its genetic prototypes of wall paintings of Bezeklik (East Turkestan, Uyghuria), which are distinguished by realism and expression. Above it, on the hillside, a quiver, bow cases, a belt painted in Chinese fashion with a gold pattern are scattered.

<sup>5</sup> Brian D.A. Reconstruction of the Miniature Cycle in the Demotte Shah-nameh. / *Ars Islamica*, v. VI, 1939, pp. 97-112.

<sup>6</sup> Grabar O. Notes on iconography of the Demotte Shahnameh/Paiting from Islamic lands. Ed by Pinder-Wilson Ralph . Oxford, 1969, pp. 32-47



**F.3. Rustam slaying Shaghad**

Source: [https://www.britishmuseum.org/collection/object/W\\_1948-1211-0-25](https://www.britishmuseum.org/collection/object/W_1948-1211-0-25)

Extremely successfully, the artist expands the space, alternating plans with tubercles, overgrown with grass, executed in the technique of washing. Also graphic, in the Far East, a powerful tree trunk is made to the right, behind which Shaghad is trying to hide from revenge, whose intrigues led to the death of the epic hero Rustam. Other goals are pursued by the author of a one-story miniatures “Rustam slaying Shaghad” of the Greater Tabriz Shahnameh: he “collects” all the figurative elements into a single unit, moving away from horizontal. Powerful spring spiral cut from above and from below, it incorporates into itself a wolf hole, with a dying Rustam Rakhsh horse, the artist collapses in a ring of horse’s croup pierced with spears and swords, and his bent neck. This ring closes the edge of the pit, below, and branches of an overhanging tree above. The figure of Rustam swaying in the centre, exploding the composition with his tension, as if presses outward, forming the epicenter of explosive force.

From this wave, the killer Shaghad arches as well, stitched with an arrow of agonizing Rustam, and a tree, with which the arrow tightly connected to Shaghad. All elements of the landscape are bent as if from impact fired arrows. There is one gets the impression that a certain force emanates from Rustam’s outstretched hand, pressing on the periphery of the composition and forcing everything to spin in a whirlpool of centrifugal forces. The color scheme is limited but expressive: its earth ocher, a dark grey trunk, olive green foliage and crimson dots of flowers and drops of blood. It is noteworthy that here the tree is equivalent artistic element<sup>7</sup>.

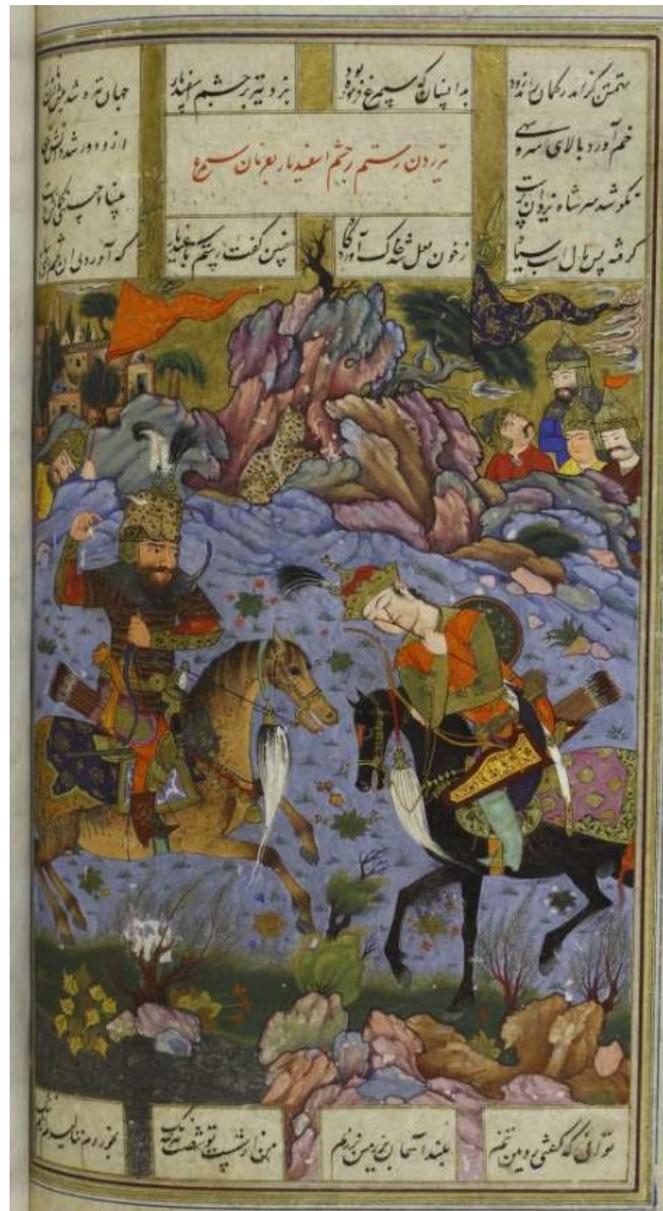
“In the miniature “Rustam slaying Shaghad,” the English researcher R. Hillenbrand, note that one of the most expressive

techniques is the masterful use of curves, namely: the death convulsions of Rakhsh, the horse of Rustam, the bend of a tree whose recess accommodates Rustam; on the opposite side, a tree trunk bent outward, pushing against Shaghad and pushing him to the edge of the composition, as well as rhythmic wave-like circles of the saddle and quiver. In the application of tinting robes - echo manuscripts of Rashid-Al-Din. Large hem folds the garments, as well as the folds of the sleeves, small and numerous, are emphasized in red or dark brown. But the most significant change is the rising role of a landscape. The central role of the tree in the composition is explained not only by its massiveness, power but also by its shape, its size, and bark pattern, reminiscent of an ornament on Chinese bronze.”

The miniature “Rustam shoots Esfandiyar”, also one of the best in the manuscript of “Shah-name” by Demotte, uses one of the most ancient types of composition - heraldic, that is, sample mirror symmetry. A sloping hill is divided in two by a tree in the center of the composition and a withered stump. On both sides of standing opposite the heroes of the scene. Rustam, insidiously hit Esfandiyar with a shot two stung arrows in the eye and the dying Esfandiyar. The scene of their duel preceding this miniature also based on the heraldic principle, but it only dutifully copied mediocre an artist. In the next scene, Esfandiyar’s death, the hero’s bent figure in the saddle upsets the balance, and the image of a broken, dried tree echoing with him takes us to another dimension, where the language of pictorially and literary metaphor reinforces the epic grandeur of the scene, its tragedy (F.4)<sup>8</sup>.

<sup>7</sup> Hillenbrand R. Imperial Images in Persian Painting. A Scottish Arts Council Exhibition. Edinburg, 1977, 177 p.

<sup>8</sup> Stchoukine I. Les peintures de Shahnameh Demotte / Arts Asiatiques, V.5, 1958. Pp. 83-96



**F.4.** Rostam shoots Esfandiyar in the eyes with a double-pointed arrow  
[http://orient-digital.staatsbibliothekberlin.de/receive/SBBMSIllustration\\_illustration\\_00001313](http://orient-digital.staatsbibliothekberlin.de/receive/SBBMSIllustration_illustration_00001313)

In the composition, the author through silhouettes opposing riders and their horses with bowed heads, as well as the sloping silhouette echoing by them a hill as if building two large volumes (or spirals) converging in the center, which emphasizes clash of heroes, their struggle and inevitable death one of them. Resolving in the center, these oncoming volts intensify the allegorical load of the stump, focusing attention on it. The color of the miniature is built on a discreet range of colors. Equestrians stand out against a neutral gray hill background, brisk speckled flowers. The muffled colors of red head, armor, as well as the rich shades of ocher, blue and sepia, the play of cold and warm colors, free brushwork - all this, as in the previous miniature, creates the

monumentality and fresco of the work. Artifacts such as clouds swirling at the top and decorative swirls of dust in a synthesizing style under the feet of the riders we are also familiar with battles from the Rashid-Al-Din chronicles. Having the armies flanking the central stage of the duel with plans, one above the other, the artist thereby approaches the solution of the problem, the solution that later became canonical (see similar compositions in Istanbul and Berlin albums, and the Herat "Shahnameh" of 1430, "Khamse" 1481 and many others). In the future, the composition grows so much that it is often built in the form of a diptych - the turn of the manuscript<sup>9</sup>.

<sup>9</sup> Stchoukine I. Les peintures turcomanes et Safavides d'une Khamse de Nizami achevée à Tabriz en 886/1481. /Arts Asiatiques, v. XIV, 1966, pp. 123-154

“The duel of Ardashir with the son of Ardavan” is one of the miniatures of the illustrative cycle of the history of Ardashir. Here are again, as, in the case of Rostam and Esfandiyar, this scene of the duel precedes the scene of the death (or execution, as in the present case) of one of the heroes. Here is the ancient subject matter of the confrontation duel is again used as the original material, but at a different level. The tree (for the umpteenth time already!) transforms the whole work: its curved trunk, framing the composition to the left, violates the symmetry, and its hanging over the upper border of the miniature crown is a living frame of

the scene. The faces of the fighting equestrians cannot be distinguished, but by the onslaught of the character on the right, by his victorious posture and the mace carried over his head, one can identify Ardashir, the future founder of the Sassanid dynasty. The streaks of earth running towards the center limit the composition from the sides and close it by focusing attention on the duel. Here we find the very balance, the ideal ratio of details, the equivalence of figures and elements of the landscape, when neither the figures nor the lush landscape obscure each other (**F.5**).



**F.5.** Figures Ardashir Battles Bahman, Son of Ardavan

[http://warfare.ga/Persia/14/Great\\_Mongol\\_Shahnama-Ardashir\\_defeats\\_BahmanDetroit\\_35-54.htm?i=1](http://warfare.ga/Persia/14/Great_Mongol_Shahnama-Ardashir_defeats_BahmanDetroit_35-54.htm?i=1)

We feel the same profound difference in another typical plot about the victorious army pursues the enemy. So, one of the best examples is the miniature “Iron Warriors of Iskander”. The miniature “Iron Warriors of Iskander” describes the battle of the Indian army with the army of Iskander, where the latter inventively uses the effect of burning oil embedded in iron chariots with iron figures of warriors. Grinding of metal, the flame that engulfed everything around, so terrified soldiers of the Indian king Fur, which ultimately lead to their stampede. As in previous miniatures of the same type from the London “Jami al-tawarikh” (“The Battle of the Heroes of the Mahabharata”) and “Shah-name” Demotte (“Duel of Fur and Iskander”), the effect of swirling

clouds and dust is already turning into the main expressive means. The composition, divided into unequal parts by three dark gray steel figures, is rapidly developing diagonally. Curls of swirling clouds and huge golden flames of fire cover the entire space of the miniature. Mixed, they merge into a single unit, unusually strongly affecting the viewer. The atmosphere of horror declared by the Indian army is emphasized by several looking back Indian warriors, whose white pupils stand out on their dark faces. Oriental miniaturists rarely reached such a power of expression with the help of the element of fire, which pushed aside even the main heroes of the action - characters, operating only with landscape elements (**6.F.**)<sup>10</sup>.

<sup>10</sup> Stchoukine I. Les peintures de Shahnameh Demotte. / Arts Asiatiques, v.5, 1958, pp. 83-96.



6.F. Figure Iskandar's Iron Cavalry Battles King Fur of Hind

Source: <https://www.harvardartmuseums.org/collections/object/216944?position=6>

This exceptional in artistic quality the miniature opens the way to numerous further techniques of playing out the effect of clouds and flame, which gives us the subsequent history of the development of the genre. In these scenes of fights of two armies, the artist discovers a sense of time, the length of the action, which varies depending on the nature of what is happening. So, the battle scenes of large armies or the siege scenes depict an episode stretched over time. Such are the scenes of persecution, quite frequent in both “Varg and Gulshah”, and in the manuscripts “Jami at-Tavarih”, and in the Shahnameh of Demotte, and the long string of battles of the Seljuks and Ghaznavids, and many others, the tradition is stable until the end the classical period of the history of miniature painting<sup>11</sup>.

At the same time, in many miniatures, a parallel theme is traced, where only one moment of action is captured. And in this sense, the scenes of murder and execution stand apart. In contrast to the scenes of separation and death when it comes it is about death in battle or at the hands of the enemy, or when to the captured prince (captured) his opponent cuts the throat or orders execution, or if the adversary tortures him is a common stereotype of behavior when the hero in the face of death does not detect obvious manifestations of suffering, despair, not screaming and not calls for help. Be it a legendary hero or a shah, he must show

himself at the height of his position, to which he is obliged by his high origin. In such cases, the socio-cultural model of behavior requires, on the contrary, as much self-mastery as possible. Turks and Mongols, born warriors, not prone to external manifestations of their feelings, accustomed to face death face to face, converted to Islam and ready for any trial obedient to the will of Allah, never resorted to lamentations, cries of despair and pleas for mercy. Moreover, this would not have changed their fate in any way but would have covered them with shame in the eyes of posterity and the face of history, not to mention the fact that it would have brought great pleasure to the winners.

Look at their faces: in them, even in already cut off heads, determination and determination reign in the expression on their faces, and a fraction of shock, as if they exclaim: “Well, that's all over!”<sup>12</sup>

Winners according to the ancient Eastern tradition rest against the back of a kneeling enemy and cut the throat, throwing his head to the beard. Some substitute an overturned shield to collect into it and drink the blood of the enemy. Among them: “Execution of Navdar”(F.7.) from Shah-name of Demotte, “Execution Siyavush ” (F.8.) from the Injun Shah-name of 1333 (GPB, Petersburg), or“ Execution of Afrasiyab” (F.9) from the so-called “Small Shah-name” (1341; Baltimore, Hood. Walters Gallery).

<sup>11</sup> Kerimov K.J. Role Tebrizskoi shkoli v razvitii miniatyurnoi jivopisi v Kazvini //Iskustvo I Arxeologiya Irana . M. 1971 pp. 163-171

<sup>12</sup> Gasanzade J. Tebrizskaya miniatyurnaya jivopisi. Baku. Oscar, 2000, p 592



F.7. Figure Afrasiyab kills Navdar

Source: <https://www.wikiart.org/en/ahmad-musa/afrasyab-kills-navdar-1336>



F.8. Guruy executing Siyavush, Cambridge University Library

Source: <https://cudl.lib.cam.ac.uk/view/MS-ADD-00269/213>

In these miniatures, as well as in subsequent murders and executions of similar scenes, the artist shows us the very moment the fate is ordered. They often depict body parts scattered on the ground, weapons, etc., fountains of blood striking from a dissected throat, or the moment when a head is split in two when a decapitated or spear-struck soldier falls out of a saddle, or a rider is cut in two to the saddle, etc. Among of all the related stories on this topic stands out “Ardashir and the captive Ardavan” from Shah-name Demotte. In the scene of the execution of Ardavan, pathetic and tragedy reach a culmination. With the external static character of the heroes, the passions are created by the tragedy of the situation itself. In the defeated Parthian army, the soldiers of Ardashir recognize Ardavan wounded by arrows. Ardashir orders to cut him in two. As O. Grabar note, “the transformation of an ordinary episode when the soldiers amid the army recognize Ardavan, in a heroic scene, elevates the miniature to the drama of confrontation and makes it one of the most striking in the manuscript”. The location of the two kings in the corners of the triangle underlying the compositional scheme exacerbates the situation, contrasting the victor on a white horse and the wounded Ardavan, the last king of the Parthian dynasty, surrounded by grotesquely expressive executioners with red faces. And here also the tree, large, sprawling, plays a crucial role in creating the image. Among the pathetic miniatures can also include the above-mentioned “Rustam and Shagad” and “Rustam and Isfendiyar” from the same manuscript.

The second half of the XIVth century marks as the period the final addition of iconography of all kinds of battle scenes and related compositional stereotypes. There is no need to talk about virtues miniatures of “Shah-name” by Demotte. Their meaning

outgrows the scope of the genre of epic illustration. For the first time in history, a miniature, having overcome a secondary role in the manuscript, becomes independent, regardless of the text, an existing work of art. Only a few decades later, after a long pause, during the reign of Shaikh Awais Jelayir, this tradition will rise again to a new, even greater height, which will be connected with the name of Shamseddin Ustad.

As we mentioned above, among the huge material that is randomly compiled and stitched into albums, at the moment we are only interested in the part that illustrates “Shah-name”. Let us turn to the contents of the famous Istanbul albums. In the Istanbul albums of I. 2153 and N. 2160 there are a lot of examples of illustrations for the “Shah-name”: over fifty miniatures and about forty (56 and 38) drawings, all from the second half of the XIV century. One of the most striking - “Manuchehr with the head of Salm” (H.2153, l.35a) tells of tribal revenge, which became the outline of the whole epic. Let us recall how treacherously killed the youngest son of Feridun, the father of Manuchehr, Shahzadeh Iraj. His assassins, older brother Salm, the Arab king, and middle brother Tur, owning lands of Central Asia sent the head of Iraj to his father, saying that he was torn to pieces by wild animals on a hunt. Having grown up, Manouchehr fights with the Arab army and in the fight defeats the Arabian hero Kakui, the grandson of Zohhak. After a fierce attack by Manuchehr, the Byzantine emperor, Salma's ally, retreats. At the time of the persecution, Manouchehr catches his uncle Salma and with one blow cuts off his head. Then he orders to plant it on the tip of the spear and triumphs, after which he sends it to his grandfather Faridun (F.9).

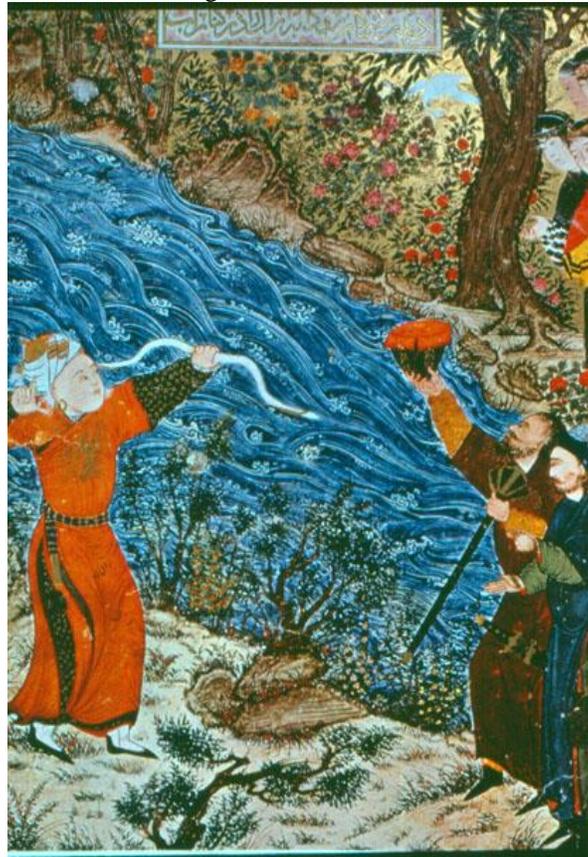


F.9. Figure Manuchihr kills Salm

Source: [http://warfare.ga/Persia/14/Jalayrid-Haz\\_2153\\_f35a.htm?i=1](http://warfare.ga/Persia/14/Jalayrid-Haz_2153_f35a.htm?i=1)

The miniature “Zal shoots fowl” is made in the best traditions of the Big Tabriz Shah-name and could be one of them. Here the episode of the poem is narrated when Sam himself sends his son to Manouchehr with a letter of recommendation. Manouchehr, having tested his mind, remains satisfied with the answers. The next day a tournament is scheduled for strength and

skill in military art. The hall shoots at the powerful trunk of an old tree. An arrow, fired with extraordinary power, pierces the barrel through and through, which delights all those present<sup>13</sup> (F.10).



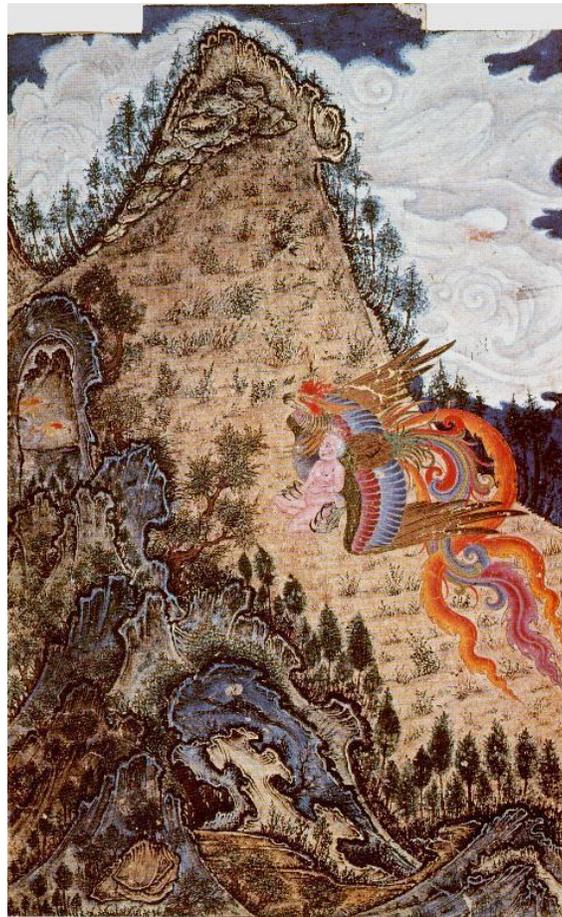
**F.10.** Zal shoot fowl

Source: [http://warfare.ga/Persia/14/Jalayrid-Haz\\_2153\\_f65b.htm](http://warfare.ga/Persia/14/Jalayrid-Haz_2153_f65b.htm)

The miniature background is golden. In the upper right corner, the rectangle is cut out and a fragment of the painting is inserted on silk with a picture of a flower. On the left side, a tree rises to the full height of the leaf. In the center, a shooting hall is shown all over the place, and behind - viewers. The Zal is shown at the moment when the arrow is released from the bow, with the left arm extended forward. He is shown with his back to us and his head profile. Ahead him on a field the inscription: “Zal, Kar-e Ahmed Lachin” - “Zal, work of Ahmed Lachin”. The compositional solution of the miniature, the style of writing, the

color, the decision of figures of people and horses, the development of soil running away deep into the plans - all testify to the best traditions of Demotte, but perhaps the most indisputable proof is the image of a powerful old tree playing here the same role as Mount Elburz in miniature "Simurg takes Zal to the nest" (F.11).

<sup>13</sup> Grabar O., Blair Sh. Epic images and contemporary History. The illustration of the Mongol Shahnameh. Chicago, 1980, p.203



**F.11.** Figure The Simurgh taking Zal

Source: <https://www.pinterest.pt/pin/345158758927668865/>

**The development of the battle genre of Tabriz school and Safavid schools in the XV-XVI centuries.**

The only one battle miniature of the entire XV century from the Khamsa of Yagub-bek in 1481 “Khosrow’s battle with Bahram Chubine” presents a grandiose battle scene, seen as if from a bird’s eye view. Large sloping hills, wave-like rhythms as if laying on top of each other, for greater expressiveness, the artist scaled up the size of the central figure groups. Many times repeated elements like helmets, spears, shields, banners, legs, and heads of horses as if pressed into a single color spot, stand out against the light

background of the hill. The miniature drawing, exquisite and delicate, delicately depicts every smallest detail, and the composition is built on a dynamic follow of undulating plans that are echoed by groups of soldiers. In the color against the background of a grayish-pink hill, accents of purplish-red, chestnut-brown and muted orange in the image of the figures stand out. This battle, like all other miniatures of the manuscript, testifies to the original, own path of development of the Tabriz school, which already portends the imminent flowering of style at the beginning of the XVI century (F.12).



**F.12.** Figure Khusraw and Bahram Chubin in battle

Source: [http://warfare.ga/Persia/Timurid/Khusraw\\_and\\_Bahram\\_Chubin\\_in\\_battle-1475.htm](http://warfare.ga/Persia/Timurid/Khusraw_and_Bahram_Chubin_in_battle-1475.htm)

The Tabriz masters, being well acquainted with the images of the Behzadi school, nevertheless did not get captured by its artistic influence and in this genre, like in the rest, managed to express a rather old, seemingly conservative theme in a language unlike any other, bright and unique<sup>14</sup>.

Unfortunately, magnificent frescoes with battle scenes from the Uzun-Hasan palace have not been preserved. "November 6, - writes the Venetian diplomat Ambrogio Contarini adopted Uzun Hasan in 1474 - we were invited to check, and he showed us most of his residence amid meadows, crossed by a stream, in a charming place. The square-shaped hall was decorated with a depiction of the scene of the beheading of Timurid Abu Saeed videlicet at the moment when he was brought to the place of execution by Ugurlu Muhammad with a rope around his neck. This latter also ordered to decorate the walls of his palace scenes of his exploits. Note also that Abu Said he was extradited by Uzun-Hasan, whose captive he was, Yadigar Muhammad, also Timurid, who executed him in 873

H. / 1468-69, to avenge the murder of his grandmother, wife of Shahrukh, Goukhar Shad-Khatyn . The fresco depicted the moment of the issue of the captive at the mercy of the enemy<sup>15</sup>.

Thus, having found out in comparison the characteristic features of the battle genre in the XV century, we can turn to the next, XVI century, which marks the highest phase of development not only of Tabriz but of the entire miniature painting of the Muslim East.

The most characteristic of Tabriz miniature I quarter of the XVI century is pathos beating over the edge energy, the power of self-affirmation that was the whole era of the creation of a new dynasty is permeated, conquests, in a short time made Safavid power one of the strongest in the world.

"Some Orientalists," writes T. Bayramov, "seen and still see in the power of the Safavids Iranian national state, as if succeeding a long period of dominance of Arabs, Turkic and Mongolian nomads in Iran. The position of these authors (Hinda

<sup>14</sup> Stchoukine I. Les peintures turcomanes et Safavides d'une Khamse de Nizami achevée à Tabriz en 886/1481. /Arts Asiatiques, v.XIV, 1966, p. 123

<sup>15</sup> Aga-Oglu M. Preliminary Notes on some Persian Illustrated MSS in the Topkapi Sarayi Miizesi, part I/Ars Islamica, I, 1934, 00. 183-99

and others) is opposed by the position N.D. Miklukho-Maklay, B.N. Zakhoder, I.P. Petrushevsky, O.A. Efendiyev, A.S. Sumbatzade, who believed that "the leading political role in the Safavid state at least before the reforms of Shah Abbas I belonged to Azerbaijanis - Kyzylbash tribes". Is the culture of the Safavid state Azerbaijani or Iranian? Tabriz miniature - Azerbaijani or Persian art? Shiism - the "national religion" of the Persians?<sup>16</sup>.

Firstly, here we should talk about the interaction of Azerbaijani and Persian traditions, which in the most perfect examples of artistic culture reaches synthesis. Secondly, we need to talk about the supremacy of "energy" over "Aesthetics": Persian culture in Safavid the period was fed by the energy of Kyzylbash-Azerbaijanis.

No energy supports there are only possible conservation of tradition in the frozen, deadening forms. In this regard, it is very significant that divorced from the native roots of the Azerbaijani land, the tradition of Tabriz transferred to Iranian land schools gradually faded away in the XVII century. Thirdly, the principle of historicism should be adhered to. Persian culture, especially Persian and Khorasan The school of poetry had a tremendous impact on Azerbaijani Persian literature in the XI-XII centuries, during the Muslim Renaissance. But in the Khatai era, the impact of Azerbaijani culture on Iranian, perhaps, was more powerful than Persian influence on Azerbaijani".

In the beginning of the palace style of Ak-Koyunlu was dominant at the court of Shah Ismail, as can be seen from the miniatures of Hamsa Yagub-bek. Another example of this style is

two at the same time created miniatures for the incomplete list of "Shah-name" of the XVI century. The first of them, one of the most beautiful Tabriz miniatures of all time, is the famous "Sleeping Rustam" from the British Museum. Another moved from Schultz's private collection to the Leipzig Museum and was lost during the II World war. "Rustam lasso Camus" with his impressive circular composition, and dynamic central the group is perhaps one of the brightest images of an epic hero in miniature painting. To the same group belong "Dastan about Jalal and Jamal" and Asafi from Uppsala. Like the Khamsa by Nizami Yagub-bek, the manuscript was begun under Ak-Koyunlu, but most of the miniatures, although in the same style, were added in the era of Shah Ismail. The text dates from 908 A.H. / 1502, but in two miniatures there are dates: 909 A.H. / 1503-4 g. and 910g. H. / 1504-5, and also most of the characters are in kyzylbash turban"<sup>17</sup>.

The culmination of these idioms is evident in the unfinished miniature of the Shah-name from the British Museum Sleeping Rustam (F.13). This miniature is the accurate equivalent of the visionary nature of Shah Ismail, aspects of his personality, expressed in his ecstatic poetry. It could also be the highest stage in the early work of the leading artist of this school, Sultan Muhammad, who could be the head of works in Kitabkhan-Library at the time of illustrating "Dastan" and "Khamsa" of Yagub-bek after the transfer of these manuscripts to the properties of Shah Ismail<sup>18</sup>.

<sup>16</sup> Bayramov T. R. Etnokulturnaya dinamika I razvitiye iskusstva v sefevidskiy period.//Prioritetniye napravleniya azerbajjanskogo iskusstvovznaniya. Baku, 1998, s. 73-78

<sup>17</sup> Binyon L., Wilkinson J.V., Gray S. B. Persian Miniature painting. A critical and descriptive catalogue of the miniatures

exhibited art Burlington House, 1931. Oxford, 1933. II edition 1971, 233 p.

<sup>18</sup> Welch S.C. Wonders of the Age: Masterpieces of Early Safavid Painting (1501-1576). Harvard, 1979, p.176



**F.13.** Figure Rostam sleeping while Rakhsh fights a lion

Source: [https://www.britishmuseum.org/collection/object/W\\_1948-1211-0-23](https://www.britishmuseum.org/collection/object/W_1948-1211-0-23)

All miniatures of the manuscript “Dastan about Jalal and Jamal” are made in the same style and presumably by the hand of the one master. However, even in this mass of stylistically homogeneous works we can distinguish those that differ in great external similarities between themselves and represent a separate group.

As already noted, in them, in the same way, the text is placed – below the illustration itself in three columns. Great similarities are also found in types of heroes, and their gestures, and raiment; the further stylistic analysis also reveals the identity of many elements of the landscape, and since the action in all miniatures takes place against the background of the landscape, it is the main attribute that unites them. Moreover, it necessary to say what exactly landscape gives to these works imagery and poetry, special charm. Their refined beauty, the splendor of a blossoming spring garden with many different shades green, vivid robes of characters, blooming bushes, and trees, dazzling gold of heaven

literary subject upstage though in some cases, the latter takes quite complex and dramatic, for example, in miniature “Jalal kills Shamtal”.

In the miniature “Jalal kills Shamtal”, on the contrary, with all the drama of what is happening the artist’s actions only absorb decorative artistic beginning: on the left side of the building depicts the ornate castle of the diva Shamtala; behind a hill in the dense thickets of flowering shrubs watching a duel the vizier sitting on the white horse. In the foreground is Jalal, jumping on his bay stallion through the flame, which covers seven heads of Shamtal, cut off by the hero. The headless body of a diva, covered in blood, lies nearby. Multicolor palette works give it decorativeness and thereby weakens the dramatic content of the episode. This impression is also compounded by careful the development of landscape elements, its important role in work (F.14)<sup>19</sup>.

<sup>19</sup> Robinson B. W. Persian miniature painting from the collections in the British Isles. London, 1967, 198 p.



**F.14.** Figure Jalāl and Jamāl  
Source: <https://azerhistory.com/?p=23736>

Miniatures of the manuscript, although executed in painting traditions of the Tabriz school, in many ways prepare us for the future flowering of style shortly. So the master who created these wonderful works come close to resolving those art problems that so brilliantly developed in subsequent works and Tabriz miniatures mid of the XVI century.

Crucially important all these works must make it possible to refute the erroneous opinion that the heyday of the Tabriz miniature was due to the relocation to Tabriz in 1522 of Kemaleddin Behzad and his appointment as the head of the shah's workshops. In conclusion, there is a need to emphasize, the most characteristic features of this brilliant pictorial tradition of the beginning of the century crossed and were fundamental in the classical period of its development. This is the dynamism of both the compositional solution and individual images, the deeply spiritualized, pantheistic perception of nature, in color - this is the tendency to sharp, sometimes contrasting color combinations, and the large role of color in the image of a work. These qualities, which distinguish Tabriz miniature from other schools at all stages of its existence, suggest that the so-called "baroque" is a common property of the style in general and not just a certain period of its development.

Extreme interest from both an art historian and a historical point of view is the manuscript of the history of the acts of Shah Ismail - "Shahnameh and Shah Ismail" Gasimi, written in poetic form, created in 948 / 1541-2. (London, British Library, Add. 7784). The artist chose to illustrate exclusively the theme of wars, hunts and palace techniques. The leitmotif of the poem, of course, is the military exploits of Shah Ismail, his valor and courage. A characteristic feature of the manuscript miniatures is their vivid emotional attitude. Artists especially succeed horses with their frantic energy, unusually expressive and in each case distinguished by some memorable features, each time avoiding the stereotypes in this battered theme<sup>20</sup>.

The images of trumpeters and drummers, as well as standard-bearers with standards, which are often found in miniatures, are very expressive.

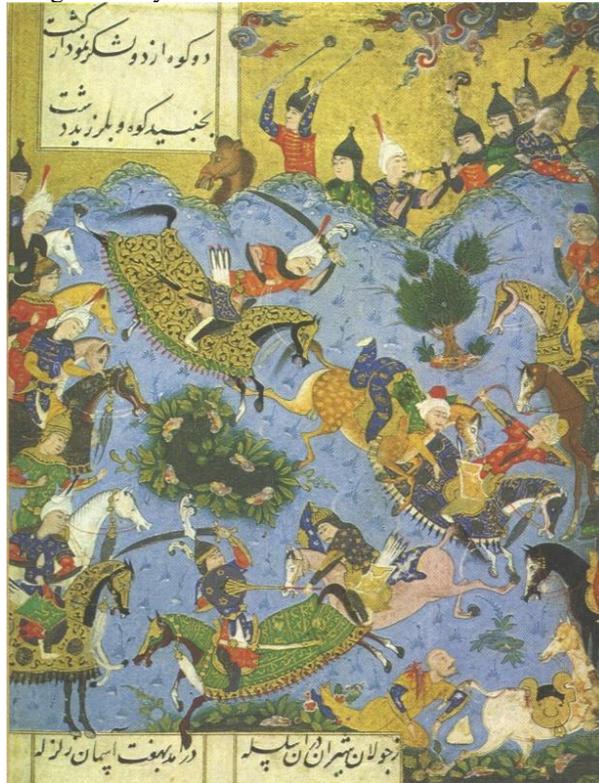
In general, by minimal means, the artist creates the maximum effect, individualizing every image as much as possible. So, in the battle scene of the manuscript "Shahnameh-i Shah Ismail" from page 107b, in the heat of battle, Shah Ismail seems to be "pushing" the enemy firing back from the miniature fields. The figures are large, there are not many of them, each plays a significant role in the composition, the rhythm of the banners piercing the frame of the miniature, the randomly scattered bodies

<sup>20</sup> Roemer R. The Safavid period.// CHI,VI, 1986, chapter V, p. 345

of the riders killed and wounded under their feet indicate a brutal battle. So, in the battle scene of the manuscript “Shahnameh-i Shah Ismail” from page 107b, in the heat of battle, Shah Ismail seems to be “pushing” the enemy firing back from the miniature fields. The figures are large, there are not many of them, each plays a significant role in the composition, the rhythm of the banners piercing the frame of the miniature, the randomly scattered bodies of the riders killed and wounded under their feet indicate a cruel battle<sup>21</sup>.

In miniature “The Battle of Shah Ismail with Farrukh Yassar” the artist chooses bright, sonorous colors: golden sky with swirls

of clouds, blue hill background, battlefields and bright, red, blue, yellow colors clothes and armor. Framed by rows of warriors central figures far exceed them the dimensions. A clear diagonal of Shah Ismail, racing behind the Shirvanshah Farrukh Yassar, at full gallop with a saber, the horseman galloping hard, barely holding himself in the saddle, two below in the heat of battle with a mace and a sword, all this makes a battle bright, memorable work in a series of contemporary images of the genre (F.15).



**F.15.** Figure Battle in the war between Shah Isma'il and the King of Shirvan.  
Source: <http://warfare.tk/Persia/Shahnama-i-Isma'il.htm>

Beautiful examples of the battle genre adorn the two best manuscripts of the Tabriz school of prosperity, the famous “Khamsa” Nizami 1539-1543 years and “Shah-name” Haughton 1520-530 years.

About the miniatures of the magnificent London Khamsa was written much for Tahmasib as abroad and also in Azerbaijan. We only note that by the 14 miniatures of this “Khamsa” of 1539-43. Muhammad Zaman added three more in the XVII century. 14 miniatures suffered less from time than Shah-name of Houghton, but Muhammad Zaman “restored” many female faces in his contemporary aesthetic taste and a Europeanizing style. He resized miniature, frames made much ruder. It is possible that it was his fault that part of the miniatures was removed from the manuscript. So, one of them, “The Battle of Khosrov Parviz with Bahram

Chubin”, attributed to Mir Seyid Ali, is now in the Royal Scotland Museum in Edinburgh<sup>22</sup>.

This “Battle of Bahram Chubine with Khosrow” from the collection of the Royal Scottish Museum in Edinburgh is considered by many researchers to be removed from the manuscript (B.V. Robinson, E. Hillebrand). It is distinguished by a wealth of coloristic sounding, extraordinary oversaturation of figures. The artist, in essence, turns the monumental panorama of the battle into a series of fights. The movement goes from the monolithic row of Khosrov’s army on the left and grows as you move to the Bahram warriors galloping away.

Khosrov, who is seated on a rich throne-palanquin, carries a huge white elephant, and next to him the venerable gray-bearded old man, holding up an astrological instrument, turns to the overlord. The elder is most likely the main court astrologer,

<sup>21</sup> Robinson B. W. Persian miniature painting from the collections in the British Isles. London, 1967, 200 p

<sup>22</sup> Robinson B.W. A survey of Persian Painting. 1350-1896.//L`Art et societe dans le monde Iranian. Paris. 1982. pp 13-82.

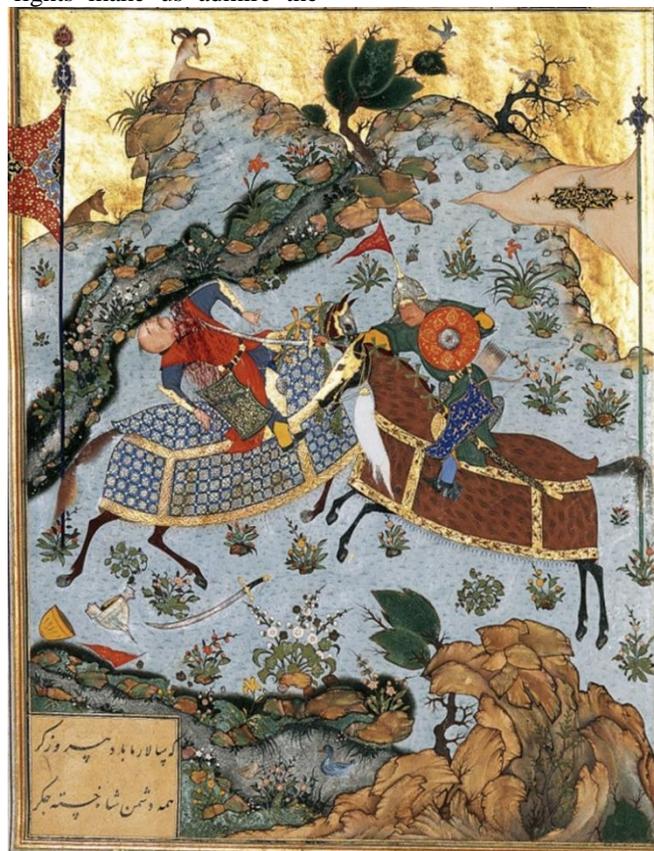
munejim-bashi. Flickering, of swords, horse hooves, rain of streaming arrows create a visible picture of a fierce battle for the throne. The artist masterfully solves the problem of color; the ratio of cold and warm colors creates the perfect harmony and balance of masses in miniature.

“Although officially the list of “Shah-name” is known named owners: Edmond Rothschild and Arthur Houghton, in the minds of lovers of oriental miniatures, he is inseverable linked with the name of S.C. Welch from the Fogg Museum at Harvard. It was he who played a decisive role in extracting the manuscript from the Rothschild collection, i.e. essentially out of oblivion; it is he spent a decade of dedicated work on the study, attribution, and publication of miniatures, all 258. There are no words worthy of describing the splendor of this manuscript. It was created from approximately 1522 to the 1550s, is the highest achievement of the Safavid miniature and is fundamentally important, since it was here, as if in a giant laboratory, that they mixed interacted and various styles, talents, and personalities crystallized”<sup>23</sup>.

The manuscript is decorated with many battle scenes, some of which are variations on the theme of fights, others are large paintings of battles, and, finally, several miniatures indirectly related to the theme of military victories. Refined beauty and perfection of miniatures obscure the plot itself, the details of the bloody events. So, the scenes of fights make us admire the

amazing skill of the artist, his ability to revive screen design, avoid repetition. Traditional sloping hill with a tree on top, a stream at the bottom parts of the composition (or side to top), rocky protrusions that close the miniature from the bottom and top, two figures of fighting warriors in the center, sometimes rows warriors flanking the main characters - here, perhaps, the entire arsenal of the artist’s visual aids in this case.

However, comparing three fights: Fariburza with Kalbad, Rostam with Shangul and Bijan with Farud, we find the uniqueness of each of them. In miniature “Duel of Fariburz and Kalbad”, the first from 11 miniatures of fights of knights of Iran and Turan, riders, one of whom has cut off his head and blood pouring in streams, look part serene beautiful landscape with exquisitely delicate grass by the shore of a silver stream, a gentle blue hill, and golden sky. The same extravaganza draws a picture of the duel Rostam with Shangul, where graceful, graceful Rostam on the fire horse of Rakhsh, it’s easy, like a feather, spears the spears of his opponent. In miniature “Bijan takes flight” blow Bijana, cutting the croup of a horse, crouched from animal severity, blood spatter - all these brutal details of the fight go to the back plan obscured by the beauty of the landscape, graceful palace, blue and pink cliffs, elegant robes characters (F.16)<sup>24</sup>.



**F.16.**Figure *Fariburz And Kalbad*

Source: <https://www.pinterest.com/pin/152418768616717083/>

<sup>23</sup> Robinson B. W. A survey of Persian Painting. 1350-1896.// L'Art et societe dans le monde Iranian. Paris, 1982.

<sup>24</sup> Welch S. C. King's Book of Kings. London, 1972, p.199

The miniature “Attack on the Iranian camp” illustrates the episode when the Turanians learn about the drunken revelry in the enemy’s camp and, under the leadership of the old commander Piran, attack the enemy, destroying almost two-thirds of the troops. The next morning, the picture of the night battle clears up - the whole field is covered in blood and littered with corpses of

Iranians. White Tent Covers break the composition into micro spaces, each of which represents an independent battle scene. In color, as if reflecting all the horror and tragedy of the situation, red, crimson, violet colors prevail, rhythmically disturbed by white accents (F17.).



**F17. Figure** The Besotted Iranian Camp Attacked by Night  
Source: <https://www.metmuseum.org/art/collection/search/452145>

In general, summing up the achievements of the Tabriz school of prosperity in the I half of the XVI century, we note an ever-increasing mastery. Once found, these techniques were more and more refined, brought to the highest possible degree of perfection, followed by their canonization. This process has already been outlined in some miniatures from Shah-Name Haughton. Let us take one of the most preferred, the plot of the struggle between Rakhsh and the lion at the time of Rustam's rest. So, “Sleeping Rustam” of the late 14th century (N. 2153) does not yet portend such a frantic, explosive glow that is inherent in the famous “Sleeping Rustam” from the lost Tabriz list of the beginning of the XVI th century. Haughton's “Sleeping Rustam” is a riot of feelings gives way to a serene beautiful picture of nature. Also the thumbnail “Rustam Caracas Camara” from Houghtonian instance with all virtuoso mastery inferior in strength to emotional exposure to its early counterpart from the same lost manuscript. This miniature, stored in the Museum of Art in Leipzig, was destroyed during the Second World War. But even her black and white the reproduction conveys a complex view of

the central figures and the dynamically unwinding spiral of the composition<sup>25</sup>.

After the capital was transferred to Qazvin in 1555, the Tabriz masters retained the classical traditions of the Tabriz school for a long time, as evidenced by the illustrations for another royal copy of the Shah-name of Firdousi - “Shahnameh” of 1576 for Shah Ismail II. The best masters were involved in the work of time, Sadik-bek Afshar, Siyavush-bek Kurchi, Mir Zeynalabdin Tabrizi, grandson of the mouth of Sultan Muhammad<sup>26</sup>.

The battle genre in the XVII century develops as part of the work of the Shah Kitabhana in Isfahan, as well as monumental painting (murals of the Chehel Soutun palace). Of particular interest us is a richly illustrated manuscript: the biography of Shah Ismail “Alam-arai-i Shah Ismail Safavi” of the beginning of the 17th century. The manuscript of the beginning of the XVII century contains one diptych and 19 miniatures, authored by artist Muin Musavvir. He was a close friend and student Isfahan's largest artist, Tabriz by origin, Rezai-i Abbasi. In almost all the miniatures of “Alam-arai-i Shah Ismail Safavi”, the background is

<sup>25</sup> Gasanzade J. Tebrizskaya miniatyurnaya jivopisi. Baku:Oscar, 2000, p. 591

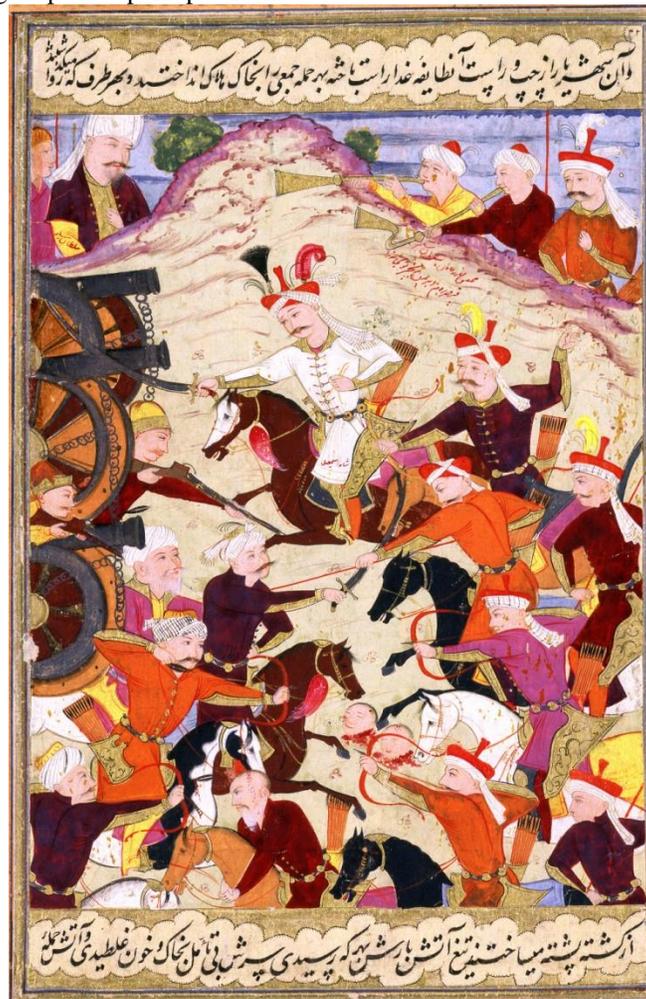
<sup>26</sup> Abbasli M. Sah Ismayilin heyat yolu miniaturlerde, Baki, isiq, 1981, p.25

a pale pinkish hill with lilac hollows in silhouette. The color is dominated by contrasting colors: white and black horses, purple and purple clothes of warriors, black contours of weapons, armor. The image of Shah Ismail in all miniatures is unified: he is a handsome young man, surpassing the others in size, in sparkling white robes (a sign of his religious leadership, holiness), in the wealth of gold jewelry in the picture, in the royal head a dress - typical of the Isfahan fashion of that time, a large white-red turban with a red Kyzylbash column, as well as a warm and plume.

These miniatures represent both historical and artistic value. Extremely curious is one of the miniatures depicting the battle of Shah Ismail with the son of Yagub-bek Ak-koyunlu, Sultan Murad, who owns both Iraqi: Iragi-Adzhemi and Iragi Arab. The battle took place near Hamadan in 1502. The miniature depicts the turning point of the battle, when the army takes to flight, and Shah Ismail cuts the Sultan Murad for gallop. But perhaps the most

interesting episode of the manuscript is illustrated by the miniature "Battle of Chaldyran": at the height of the battle, Shah Ismail bursts into the thick of the enemy army strikes at the enemy and, finally, cuts down the barrel of the gun in the heat (it's known that he despised firearms as inappropriate for a real man). Sultan Selim learning about his feat asks to send him this saber. But he doesn't manage to repeat it. He rebukes the Shah, saying that he changed weapons, to which Shah Ismail replied:

"The saber is the same, but the hand is not that!" One of the most spectacular, she draws a group of warriors that crowns in the upper half the figure of Shah Ismail on a horse striking a gun barrel. The central personality of the entire Safavid period, the image of Shah Ismail is captured in the wall paintings of the Chehel-Soutun palace in Isfahan, and in particular in the battle scene, the decisive battle with Sheybani Khan in 1502 (F.18.).



F.18. Figure Shah Ismail at the Battle of Chaldyran

Source: <https://www.flickr.com/photos/persianpainting/15090985738>

### III. CONCLUSION

In the art of the Ancient East, along with feast scenes, with genre themes, there was dominant place of importance and a battle genre. In the Muslim east, and in particular in the earliest phase of the book art miniatures, in works by the Arab-Mesopotamian the school, the battlefield genre was absent. The real story of a battle

plot, like one of the most important medieval the fine arts of Islam begin with the only complete manuscript of the early XIII the century - miniatures for Aiuki's poem "Varga and Gulshakh". Remaining in subjugation of the most ancient stereotypes, the artist in some of the miniatures makes an effort to overcome frozenness, develops and enriches the action, introducing additional characters into the composition. Remaining in the

subjugation of the most ancient stereotypes, the artist in some of the miniatures makes an effort to overcome frozenness, develops and enriches the action, introducing additional characters into the composition. Creating with the participation and editing of Rashidaddin was the first General History in the history of mankind, ordered by Gazan Khan and expanded at the time of Oljayt, preserved in two fragments, modern author.

Despite the fact that the illustration cycle of Arabic copy of Jami al-Tawarih and remains unfinished, its study is significant enriches our understanding of the art that has been in Tabriz 700 years ago.

The second half of the XIV century marks a period of final addition of all kinds of iconography battle scenes and related compositions of stereotypes. Having clarified in comparing the characteristics of the battle theme in the XV century, we can turn to the following, XVI the century that marks the highest phase not only Tabriz but also the entire miniature painting of the Muslim East. Since the XVII century the battalion genre, as well as art in general, has been experiencing a difficult process of long-term degradation in the region.

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# Biomass energy policy perspectives of Sri Lanka: A review

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**Abstract:** Nearly 69% of Sri Lankan household depend on biomass to meet their energy needs, while biomass meets 36% of country's energy supply. The users of biomass can be classified as households, institutions, industries, and power generation. There is a slow shift away from using biomass as a cooking fuel in the household sector adhering to the fuel stacking phenomena, as they tend to retain the practice of using biomass for cooking irrespective of using modern modes. Biomass use in industries is increasing and becoming more formalized and organized. Biomass based power generation is very minimal. The national policy related to biomass is encouraging. It emphasises on increasing growing biomass, supply chains, value addition, and conversion efficiencies. Some technological improvements on devices have taken place historically, while Sri Lanka has established national standards on improved biomass cook stoves and sustainably sourced fuelwood. The private sector has initiated to meet their entire thermal energy needs from biomass. Sri Lanka Sustainable Energy Authority and Ceylon Electricity Board have planned to add power generation capacity from biomass powerplants. Biomass sector could contribute significantly towards commitments on Sri Lanka's Nationally Determined Contributions (NDCs) as well as achievement of Sustainable Development Goals (SDGs) while ensuring energy security and reducing draining of foreign exchange on importation of fuels.

**Key words:** Energy, Biomass, Policy, Sri Lanka

## Introduction

Biomass is the second largest energy supply source in Sri Lanka. It meets more than a third of the energy demand of the country satisfying a greater portion of the cooking energy requirements of the domestic sector. Biomass comes in different forms, and the most common forms of biomass available in Sri Lanka are fuelwood (unprocessed logs and processed chips), and municipal, industrial and agricultural waste. However, due to the abundant availability, only a limited portion of the total biomass used is channeled through a commodity market. During 2017, the share of biomass in the primary energy supply and total energy demand were 36.5% (out of 528.9 PJ) and 45.1% (out of 423.8 PJ) respectively (SLSEA, 2019)

Biomass sector operate independently and informally over the history, with very little interaction with the energy sector governing structure (SLSEA, 2019). At the macro level, the users of biomass in Sri Lanka can predominantly be classified into 4 groups, the households, institutions, industries, and power generation.

The biomass supply and distribution network is quite simple, and in the case of most users, a formal network does not exist (SLSEA, 2019). The supply chains comprise of a large number of small suppliers. Few of them supply biomass to large-scale suppliers some of whom own delivery trucks or lorries. The commodities they transport alternate between biomass such as firewood and sawdust, and others such as rice, cement, sand, and bricks according to the varying demands, profits, and the seasonality. There are few bulk biomass suppliers who liaise with companies that demand for large quantities of biomass. They source them from small-scale suppliers. As the preference of some companies is the processed forms of biomass such as wood chips and split-wood, some of the medium or larger-scale suppliers add value by processing their supplies (SLSEA, 2016). Also, biomass generated in a province may not necessarily be used in the same province; for instance, all saw dust from central province are exported to eastern province while a significant portion of biomass remains underutilised by households within the province (Musafar et al., 2011).

## Biomass use in Household Sector

In the formal publication Sri Lanka Energy Balance, the values related to biomass are presented for the household, commercial, and other sectors (which include the institutions) together, and these sectors accounted for 67% of the country's energy

demand in 2017 which was 112.7 Petajoules (PJ) out of the total of 167.1 PJ. Abundant availability, especially in rural areas where the biomass usage is most common, has simplified the distribution of biomass in the country. For them, energy demand for cooking is in the form of biomass while it is in the form of either Liquefied Petroleum (LP) gas or electricity in the urban areas (SLSEA, 2019). The households who use biomass, use multiple fuel-wood sources and most widely used fuel-wood sources are from their own land, land which don't belong to them and fuel-wood bought commercially at markets. Other sources providing fuel-wood include private land, state-owned land and road side vegetation. Branch-wood and twigs are some widely used fuel-wood types (Wickramasinghe, 2013). For majority of the households, both the source and the point of use are within the same home garden. With the increase of household income levels, fuelwood used in cooking is reducing in volume (SLSEA, 2019).

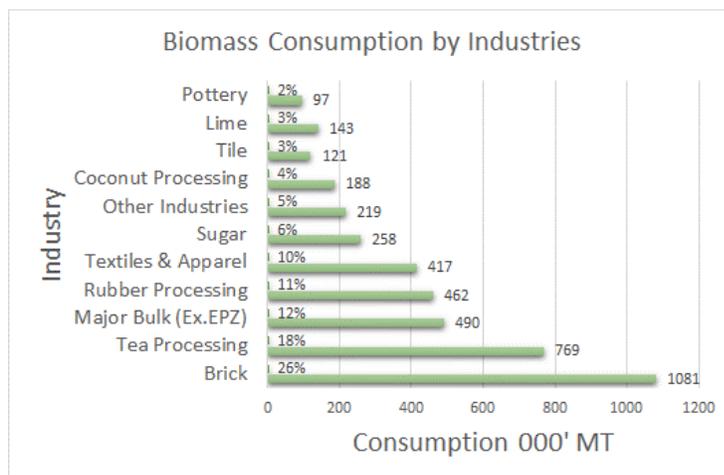
Stoves are used to cook from biomass. Different institutions contributed in the design, promotion, and commercialization of improved cookstoves in Sri Lanka since 1972 (Amarasekara & Atukorala). As per the national energy policy and strategies, the penetration of efficient, low soot and smoke biomass cook stoves are to be increased to 10% of households by 2022, while the processed, commercialized biomass based fuels used in such stoves will be made widely available across the retail market by creating an enabling environment (NEPS, 2019). The Sri Lanka Standard Institute released national standard SLS 1475: 2013 on two pot biomass clay cook stoves, which is for improved cook stoves (SLS, 2013) resulting in less soot and smoke. The National Engineering Research & Development Centre of Sri Lanka introduced two types of wood gasifier stoves which are more efficient, one a forced draft stove with a small electrically operated blower connected to it, and the other, a natural draft stove (Musafer, 2013), having a combustion efficiency of about 35% when compared with less than 8% in traditional 3-stone cook stove (Joseph, 2011).

The energy ladder hypothesis holds for Sri Lanka as opined by Rajmohan & Weerahewa (2010). This is a model used by resource economists to describe how households would advance to more 'sophisticated' domestic fuels with the improvements in their economic conditions, where the underlying premise behind this theory is that as households' economic status improves, they move up the energy ladder, replacing biomass fuels with the sophisticated fuels, and conversely they will move down the ladder as their economic status decreases (Maconachie et al., 2009). Sri Lanka is moving towards modern fuels such as liquefied petroleum gas (LPG) and electricity, the urban sector proceeding much faster than the rural sector (Rajmohan & Weerahewa, 2010). In 2016, 77% of the rural houses and 25% of the urban houses used firewood as their cooking fuel. This contributed to nearly 69% of the houses in Sri Lanka. In 2009/2010, 81% of houses used firewood as cooking fuel while use of gas increased to 29% of the houses in 2016 from 16% in 2009/2010 (CBSL, 2020). Further, the budget elasticity values of firewood demonstrate to be negative in the urban sector, indicating that they are inferior goods while LPG and electricity demonstrating positive budget elasticity values indicating that they are normal goods (Rajmohan & Weerahewa, 2010). However, there is a greater potential for a transition from traditional cooking stoves fuelled by firewood burning to improved stoves, but switching to cleaner energy will not be immediate due to the strangeness of non-income determinants where a mere increase in household income will not reduce the demand for biomass from the society. Most believe that the use of LPG for cooking is very costly compared to biomass (Damayanthi, 2018). This imply that Sri Lankans too disagree with the notion of complete fuel substitution given that most households tend to have a mix of energy sources for their activities (Adamu et al., 2020), being in line with the phenomena of fuel stacking (multiple resource use).

**Biomass use in the Industrial Sector**

The total energy demand in the industrial sector in 2017 was 103 PJ of which biomass accounted for 76% (78.4 PJ). In industrial use of biomass, distribution is a one-to-one arrangement, which links the source to the user through a direct biomass transport. However, with the advent of formal supply chains, biomass use in industrial thermal energy use is gaining rapid grounds, due to cost benefits (SLSEA, 2019). Due to disparity of prices between furnace oil and biomass, there is a business case for large industrial thermal plants to adopt fuel-switching and to be operational on biomass, further consolidating the biomass supply chains. This can result in further increase of the use of biomass for energy in the country, especially for thermal energy supply in the industrial sector (SLSEA, 2019).

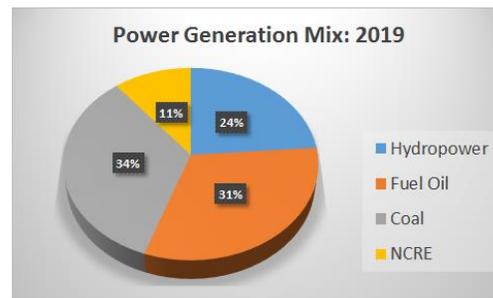
From the industries sector, the largest biomass (all forms) consumption is observed from the brick industry, followed by tea processing industries and bulk consumers such as industries from the export processing zones (EPZ) as depicted in the figure. When firewood, saw dust, paddy husk, are singled out, the biggest consumers of firewood are the tea, textiles, and brick industries respectively in Sri Lanka (SLSEA, 2016). It is also encouraging to note the initiatives taken by some private sector players to meet their thermal energy demands from biomass; for instance Elpitiya Plantations PLC targets at meeting 100% of thermal energy requirements from their estate grown sustainable biomass sources (EPP, 2020).



Early signs of organised biomass industry was witnessed in 2016, with some major fuelwood suppliers setting up pre-processing facilities that are in close proximity to end-user facilities. In the Export Processing Zones alone, it is estimated that about 500 - 700 tonnes of chipped fuelwood is used per day by individual thermal energy users. The first biomass energy terminal came into commercial operations in 2017 assisted by a development agency (SLSEA, 2019). There are around 400 biomass boilers operating around Sri Lanka consuming about 3,200 metric tons of biomass (Arachchige & Sandupama, 2019).

### Biomass use in Power Generation

Sri Lanka's had a national electricity grid of 4,217 MW of installed capacity, with a maximum demand of 2,669 MW in 2019. The country generated 15,879 GWh during this year. Her electricity sector is heavily reliant on carbon intensive primary energy sources, which contributed 66% of the total electricity generation in 2019, as depicted in Figure. The other sources are hydropower and Non-Conventional Renewable Energy (NCRE) which include Solar, Wind, Small Hydro, and Biomass. Sri Lanka imports all her coal & oil. In 2019, 45.4% of petroleum in Sri Lanka was used for power generation. Heavy dependency on imported fossil fuel for electricity generation has a major bearing on the trade balance and the exchange rate. In 2019, the country reported a minus trade balance of US\$ million 7,997 with exports and imports of US\$ million 11,940 and 19,937 respectively while the average exchange rate of LKR: US\$ was 178.78 (CBSL, 2020). Similarly, the Carbon Dioxide emission factor (total emissions of the power sector divided by the total number of units of electricity produced during the year) from electricity grid was 585g CO<sub>2</sub>/kWh in 2017, (an increase by 85% within seven years) which translates into 8.6 million metric tonnes of CO<sub>2</sub> emissions by the electricity sector during the year (SLSEA, 2019). Power generation from biomass, being an indigenous renewable resource, shall ease the country with her trade balance, stabilizing the exchange rate, and reduce corresponding greenhouse gas emissions too.



### Biomass Power Sector Economics

Sri Lanka's power generation is dominated by the state owned Ceylon Electricity Board (CEB) supported by the Independent Power Producers (IPPs). The installed capacity of the system in 2018 was 4,046 MW of which 72% was owned by the state owned utility CEB). Generating electricity using fuel oil is the most expensive source for CEB while price of electricity purchased from the IPPs exceed the average tariff charged from the consumers substantially as shown in the following tables.

Price, Cost, Tariff	Average Price, Cost, Tariff / kWh	
	LKR	US\$ Cents
Purchase price from IPPs	26.47	14.81
Cost at selling point	23.29	13.03
Consumer tariff	16.62	9.30

**Average purchase price, cost and tariff (2019)**

Source: CBSL, 2020

Source	Average Cost / kWh	
	LKR	US\$ Cents
Hydro	2.49	1.39
Coal	10.48	5.86
Fuel Oil	31.93	17.89

**Average cost to CEB to generate 1 kWh (2019)**

Source: CBSL, 2020

Sector	Average Tariff / kWh	
	LKR	US\$ Cents
Domestic (Households)	14.11	7.89
General Purpose (Ex. Offices)	23.91	13.37
Government Establishments	18.19	10.17
Industrial	14.72	8.23
Hotels	17.75	9.93

**Average electricity tariff (2019)**

Source: CBSL, 2020

By the year 2017, there were 10 grid connected biomass powerplants in the country with an installed capacity of 26 MW (CEB, 2018a). There were 14 Standardized Power Purchasing Agreements signed as at end of 2018 for biomass projects with a total capacity of 71 MW (CEB 2018a). The power generation from biomass in 2018 was 16 GWh (CEB, 2018a). The energy value of biomass directed for power generation was 0.67PJ (SLSEA, 2019). The performance of the biomass related power plants in the year 2018 of the country are given below. All of these powerplants are privately owned and operated.

#	Powerplant	Commissioned Date	Installed Capacity (MW)	Power Generation (GWh)	Average Unit Price (LKR / kWh)
<b>Dendro</b> (generation of electricity from sustainably grown biomass - fuel wood)					
1	Kottamurichchana	Sep 2011	0.50	0.000	-
2	Embilipitiya	Feb 2013	1.50	0.592	20.70
3	Batalayaya	May 2014	5.00	38.370	20.70
4	Batugamma	Aug 2015	0.02	0.000	-
5	Loluwagoda	Oct 2016	4.00	25.821	24.34
6	Loggaloya	Sep 2017	2.00	7.673	23.83
7	Panamure	May 2018	0.99	1.170	23.44
8	Kalawa Aragama	Dec 2018	10.0	0.000	-
<b>Total / Overall of Dendro</b>			<b>24.01</b>	<b>73.626</b>	<b>22.35</b>
<b>Biomass</b>					
1	Badalgama	Jul 2005	1.00	0.813	13.47
2	Tokyo (Trincomalee)	Dec 2008	10.00	10.858	8.57
3	Ninthawur	Feb 2014	2.00	1.830	14.25
4	Dikkanda (Biogas)	Sep 2015	0.08	0.000	-
<b>Total / Overall of Biomass</b>			<b>13.08</b>	<b>13.501</b>	<b>9.63</b>
<b>Total of Dendro &amp; Biomass</b>			<b>37.09</b>	<b>87.130</b>	<b>N/A</b>

Dendro & Biomass Installed Capacity, Power Generation, and average unit price in 2018

Source: CEB, 2019

Under the given backdrop, the average price electricity is purchased from privately owned oil based powerplants is exorbitantly high (LKR 31.93 in 2019) compared to the average tariff charged (LKR 16.62 in 2019) from the consumers. The power purchased from biomass and dendro powerplants at the average price of LKR 9.63 & LKR 22.35 respectively (CBSL, 2020) would ease the CEB, but again, purchasing from dendro powerplants is also higher than the aforementioned average tariff charged from consumers, which would impact the CEB in making a trade loss.

**Biomass & Energy Policy**

Ministry of Plantation Industries submitted a memorandum to Cabinet of Ministers in June 2005 and obtained approval to designate *Gliricidia sepium* as the 4th National Plantation Crop; Tea, Rubber and Coconut being the other plantation crops in Sri Lanka (Joseph, 2011). However, no major energy plantations are found in Sri Lanka. In the year 2008, National Policy and Strategies on Energy was gazetted, and this was subsequently superimposed by a new National Energy Policy and Strategies in 2019. This document presents how the country is planning to meet the challenge of developing and managing her energy sector to ensure delivery of reliable, cost-effective, and competitively priced energy services from diverse sources to fuel the social market economy. This policy has many favourable aspects pertaining to the promotion of biomass as a source of energy. It goes to the extent of claiming that biomass is probably the most important energy resource, and it will play a valuable role as a convenient fuel for the households and a dependable thermal energy supply for the industries. Under the implementing strategies, on enhancing self-reliance, it states 'availability of biomass will be enhanced by establishing dedicated energy plantations or plantations with residue as a potential fuel, in prescribed biomass energy development areas'. This policy encourages the commercial availability of biomass and biomass-based fuel products to be used in industrial thermal applications and household use, and to nurture fuel source supply chains with processed biomass with an efficient collection, processing, value addition, storage, and distribution system. Further, improved biomass conversion devices such as cook stoves, similar to experiences of commercial fuel-based cooking devices (smoke and soot free, and convenient to use) will be introduced and promoted for household use. This strategy is expected to help to retain the share of biomass as a fuel used for cooking applications and to discourage migration to petroleum fuels (NEPS, 2019).

Sri Lanka Sustainable Energy Authority (SLSEA) is to develop indigenous energy resources to the optimum levels to minimise dependence on imported resources, and it targets at prescribing a minimum of 10,000 hectare of unproductive land as biomass energy development areas, and lease them to developers for 5 years to transform them into commercial timber cum fuel wood plantations as a measure of enhancing self-reliance. Further, to ensure access to reliable, equitable, convenient, quality, and affordable energy services for citizens to enhance their living standards and to engage in gainful economic activities, it is expected to double the commercial supply of biomass and biomass-based fuel products through the establishment of 20,000 hectares of biomass plantations within the period 2020-2023. Soft financing and other fiscal incentives will be offered to businesses that provide fuel wood including dedicated energy plantations and other commercial plantations in this regard. It is also to support biomass supply chains in five regions by a pilot project through improved collection of biomass residues, mixed cropping, and certification of sustainable extraction for three years (until their commercialisation) by 2020. SLSEA shall ensure that fiscal incentives are provided to entrepreneurs who are engaged in the manufacture and distribution of equipment using technologies such as improved cook stoves and mini gasifiers by the end of 2020, towards ensuring a minimum 5% penetration of improved stoves that use commercialized biomass fuels by 2021 (NEPS, 2019).

## **Biomass & Forestry**

Logging in natural forests has been banned in Sri Lanka since 1990 (Premakantha et al., 2008). SLSI considers a naturally regenerated forest to include areas of agricultural land that are expected to reach a canopy cover of at least 10% and tree height of at least 5m; and forests with a mix of naturally regenerated trees and planted or seeded trees where the naturally regenerated trees are expected to constitute more than 50% of the growing stock at stand maturity whether or not they are legally protected (SLSI, 2016). Sri Lanka meets its timber and fuelwood demand mainly from tree resources outside the forests (Premakantha et al., 2008).

## **National Standards on Sustainably Grown Fuelwood**

This standard aims to promote the sustainable production of biomass to be adopted voluntarily by producers or users who are concerned about the sustainability of their fuelwood supply, and seek a sustainability certification auditable by an independent third party. This standard looks at trees coming out of the ground, and not what happens to them afterwards, and does not cover sustainability of the technology used in the industrial processes. For the certification, this standard describes the sustainability requirements for the production of fuelwood including basic chain of custody or traceability through the supply chain where their transport and pre-preparation also considered. Fuelwood from home gardens and trees used in agriculture systems such as intercropping, alley cropping and the support trees can be considered for certification. From the existing plantations such as tea and rubber, the uprooted tea trees, shade trees, or their branches and rubber plantations including intercropping systems can be considered. From the coconut plantations, the fuelwood intercrops, husks and other coconut by-products that can be used as fuel can also be requested for certification. Other specific plantations such as for timber, agro-energy plantations like *Gliricidia*, and dedicated fuelwood plantations also could be candidates. From the export agricultural crops, the woody agricultural by-products such as cinnamon sticks can be considered. The invasive species removed through sanitation programs, although may not be continuously supplied from the same locations can also be considered (SLSI, 2016).

### National Standards on Improved Biomass Cook Stoves

The national standards on two pot clay cook stoves provides guidelines for the manufacture of the stoves specifying their general, dimensional, physical, mechanical, and marking requirements used for domestic purposes. This standards further specifies the methods for inspection of general requirements, determination of dimensional, physical and mechanical requirements, and the criteria for conformity with the specification (SLSI, 2013).

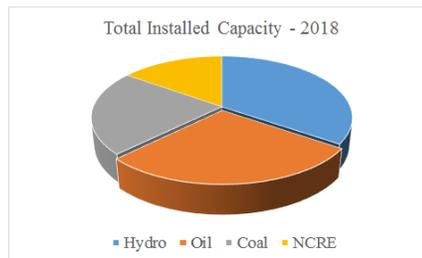
### Discussion

The demand for biomass from the households, industries, and power generation were 112.7 PJ, 103.0 PJ, and 0.67 PJ respectively in 2017. Therefore, biomass based power generation from the demand perspectives is negligible.

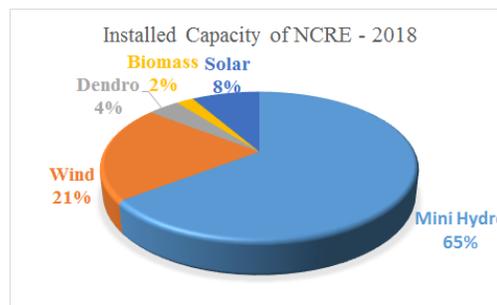
The details of the total installed power generation capacity and installed capacities of each non-conventional renewable energy (NCRE) sources during the year 2018 were as follows. The NCRE installed capacity is 15% of the total while biomass and dendro together make only 6% of the installed capacity of the NCRE. Accordingly, biomass is not a significant contributor to the power generation in the country too.

Source	Installed Capacity (MW)
Hydro	1,399
Oil	1,137
Coal	900
NCRE	610
Total	4,046

Total Installed Capacities of powerplants in 2018  
 Source: CEB, 2019



Source	Installed Capacity (MW)
Mini Hydro	394
Wind	128
Dendro	24
Biomass	13
Solar	51
Total	610



Installed Capacity of NCRE in 2018  
 Source: CEB, 2019

According to the Renewable Energy Development Plan Phase I: 2019-2025 of the SLSEA, 56 MW of biomass powerplants are planned to be added between 2019-2025 giving priority to the areas with high biomass energy resource potential as identified in the renewable energy resource inventory, including from the waste to energy projects. This plan considers designation of a 25 km radius around a 10 MW power plant as the prospective land area for biomass plantations in the determination of renewable energy resource development locations (SLSEA, 2019<sub>b</sub>). Further, Long Term Generation Expansion Plan (2020-2039: Draft) of the CEB recognises biomass to be a renewable energy based firm energy source, and it envisages the cumulative capacity from biomass to be 144 MW by 2039, providing for higher shares of renewable energy sources with the expectation of maximising the utilization of indigenous natural resources (CEB, 2020). Because biomass is a renewable source of indigenous firm power, it has a high potential to be a contributor to reduce greenhouse gas emissions and thereby contributing to climate change mitigation facilitation the nationally determined commitments (NDCs) and achievement of Sustainable Development Goals (SDGs), especially the 7th goal on ensuring access to affordable, reliable, sustainable and modern energy for all.

### Limitations

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The actual value of biomass is often misrepresented by its discounted price due to the simplified sourcing options (SLSEA, 2019). Accordingly, there can be a considerable tolerance of the data presented. The latest data used in this review include the Energy Balance for 2017, power generation and sales values for the year 2018, and overall power sector data for 2019. Although older data could have been used to make the comparison more justifiable, latest data were included in the review to reflect the most current scenario. Accordingly, the readers may find it some difficulty in absolute comparisons. The details of the surveys included in this review have been carried out in 2015, thus current situation may have undergone some changes.

## Conclusions

Biomass makes a significant contribution to the primary energy and energy demand in the country. The users of biomass can predominantly be classified as households, institutions, industries, and power generation. There is a shift towards use of LP gas for cooking in the household sector, but the rate at which this transformation takes place is slow and the way how it happens deviates from the phenomena of the energy ladder, but adheres to energy stacking or using of multiple source of energy concurrently. The use of biomass in the industries sector is increasing and getting more formalized and organized. The stake of biomass in the power generation sector is very minimal, despite it being a firm source of indigenous renewable energy contributing positively towards energy security and reduction of greenhouse gas emissions.

The national policy perspectives related biomass is quite positive paying attention to increasing of biomass supply by way of dedicating land, encouraging energy plantations, proposing for fiscal incentives, and streamlining supply chains and channels with interim value additions from one hand and on the improvement of energy efficiency and reduction of emissions from other hand. This is supported by some technological improvements taken place historically and establishment of national standards on improved cook stoves and sustainably sourced fuelwood. The private sector has taken their own initiatives to target for higher proportions of biomass to meet their thermal energy requirements. As for increasing power generation from biomass, both SLSEA and CEB have incorporated capacity additions from biomass in their planning horizons. Accordingly, it is very likely for biomass to remain as a main source of energy in Sri Lanka in the foreseeable future.

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# Rice Fish-Farming System (RFFS) Contribution To The Income And Food Security Of Farm Households

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**Abstract-** Indonesia is the country with the fourth largest population in the world, each year experiencing an increase in population at an increasing rate. The increase in population has always had an impact on increasing the number of food needs. In order to keep pace with the rate of population growth, an increase in agricultural production and productivity is a must for Indonesia. The irony is that the population continues to grow, but agricultural land is decreasing due to land conversion, and land damages due to environmental pollution which results in decreasing productivity and in a decrease in income especially of small farmers in the countryside. Various efforts have been made to increase food production, preserve the environment and improve food security, one of which is through "Rice-Fish Farming System (RFFS)" program. The RFFS program is an intensification program that aims to optimize the use of existing land to increase farmers' income and the food security of farm households. This study aims to determine the contribution of the RFFS income to farm households' income, analyze the level of household food security of RFFS farmers and analyze the affecting factors of Food Expenditure Share (FES). Primary and secondary data were analyzed using Microsoft Excel and SPSS version 19 for Windows. The level of food-secure of RFFS farm households was analyzed using the Food Expenditure Share (FES) value approach, which is a comparison between food expenditure and total costs derived from food and non-food expenditure; the value of food expenditure proportion <60% is categorized food-secure, while the value of food expenditure share  $\geq 60\%$  is categorized food-insecure. Multiple regression is used to analyze the factors affecting Food Expenditure Share of farm households. The results showed that : (1) the average income contribution of RFFS to the average income of farm households was 61 percent, (2) the number of RFFS farmers in the food-secure category was 83 percent and in the food-insecure category was 17 percent, and (3) the Food Expenditure Share of farm households is strongly affected by the income level of the farm family, value of rice, value of egg and value of sugar.

**Index Terms-** (1) Rice Fish Farming System (2) Income (3) Food Security (4) Farm Households

## I. INTRODUCTION

Indonesia is the country with the fourth largest population in the world, Indonesia's population growth rate of 1.2 percent per

year is estimated that the population in 2020 will reach 271 million (BAPPENAS, 2013). An increase in population has always an impact on increasing the number of food needs. In order to keep pace with the rate of population growth, an increase in agricultural production and productivity is a must for Indonesia. Unfortunately the population continues to grow but agricultural land decreasing due to land conversion, and land damage due to environmental pollution, decreased productivity, increase production cost and decreased farmer income.

The threat of conversion of agricultural land to non-agriculture is increasingly out of control. According to the Ministry of Agriculture (2011), in Java and Bali since 2010 the water deficit and the rate of land conversion have taken place without a solution, resulting in higher food supply uncertainty, this is due to Java and Bali contributing to the largest national rice production (60%).

The foregoing resulted in a decrease in income for small farmers in the countryside. Various efforts have been made to increase food production, preserve the environment and improve food security, one of which is a cultivation program Rice-Fish Farming System (RFFS). RFFS was developed with the aim of optimizing land use, increasing farmers' income and increasing the food security of farmers' household. Integrated rice-fish farming offers a solution to this problem by contributing to food and income (Ahmaed N et. al. 2011)

According to the Center for Rice Crop Research (2017), RFFS has advantages including indirectly applying the principles of Integrated Pest Management (IPM), increasing the efficiency of fertilizer and water use, increasing intercropping land use with rice plants and fish in rice fields, increasing efficiency labor that is devoted to the management rice-fish, especially in fertilizing, spraying, and weeding, then increasing the variety of animal potential and providing new employment. Cultivation of fish in rice fields is a form of integrated farming, ideally the results of cultivation with an integrated system or diversification will increase the income of farmers, because in it occurs intensification, increased resource efficiency, increased productivity.

According to Nhan et al. (2007), Integrated farming systems are very suitable to be implemented by small farmers who have limited resources so they can maximize their works. Characteristics of farmers in developing countries such as Indonesia in general have a narrow land area. Land becomes a very scarce resource, so land use really has to be efficient. In RFFS of

cultivation practices, fish are integrated with rice so that land and water use occurs at the same time, resulting in savings in water and land resources.

Based on the background above, this study aims to determine the contribution of RFFS income to farm household's income and analyze the level of food security of rice-fish farmer households and the factors that influence Food Expenditure Share.

## II. RESEARCH METHODS

The survey method was used in this study. Data were collected from 30 Rice-fish farmers who were in the center of the RFFS Development Area in Leuwisari District, Regency of Tasikmalaya through the Random Sampling Method. Data were analyzed using Microsoft Excel and SPSS for windows.

Analysis of the contribution of Rice-Fish Farm's income to the total income of farm households is calculated by the value of percent. Research on farm's household food security of rice-fish was analyzed by Food Expenditure Share (FES) by Ilham and Sinaga (2007) with the following formula:

$$FES = \frac{FE}{TE} \times 100\%$$

Description :

- FES = Food Expenditures Share (%)
- FE = Food Expenditure (Rp / month)
- TE = The Total of Household Expenditure (Rp/ month)

The factors that influence Food Expenditure Share are analyzed using multiple regression, the equation is as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10}$$

- Y : Food Expenditure Share (FES) (%)
- X<sub>1</sub> : Farmers' income (Rp)
- X<sub>2</sub> : Number of family members (person)
- X<sub>3</sub> : Farmer education (year)
- X<sub>4</sub> : Value of rice (Rp)
- X<sub>5</sub> : Value of vegetables (Rp)
- X<sub>6</sub> : Value of fish (Rp)
- X<sub>7</sub> : Value of eggs (Rp)
- X<sub>8</sub> : Value of cooking oil (Rp)
- X<sub>9</sub> : Value of sugar (Rp)
- X<sub>10</sub> : Value of LPG (Rp)
- α : Intercept
- b : Regression coefficient (i = 1,.....10)

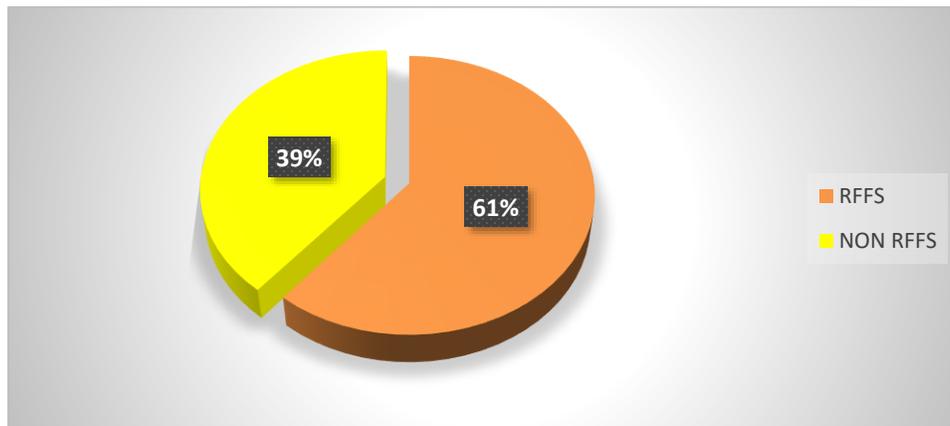
In this study, the hypothesis test used is a significant test on the test parameters simultaneously (Test -F) and partial testing (Test-t).

## III. RESULTS AND DISCUSSION

### *The contribution of Rice Fish Farmer's income to the income of farm households*

The source of household income is classified into two parts, namely income from rice-fish farming and non-rice-fish farming (non-farm income in agriculture and other income): income from home industry, trade, employees, non-agricultural labor services and labor from other non-agricultural subsectors.

The results showed that the contribution of rice-fish farming's income to farm household income was 61 percent (Figure 1). This illustrates that Minapadi farming has become a source of income for farmers. Non-rice-fish income of 39 percent comes from trade, services, non-rice-fish of agricultural workers.

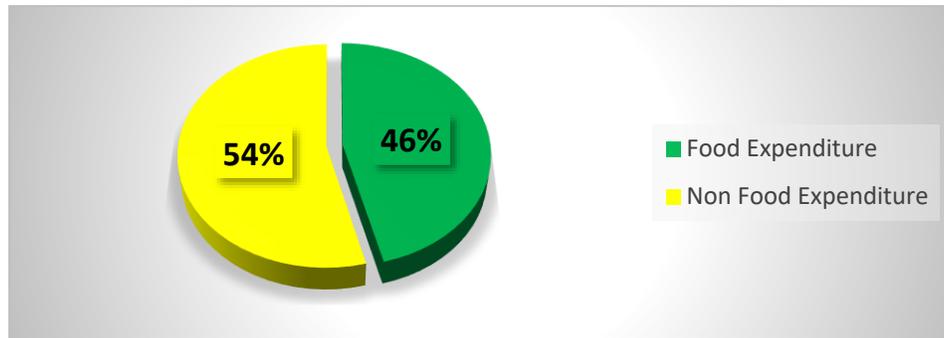


**Figure 1. The average contribution of RFFS income to the Farmer's household income (per month)**

In Figure 1 shows that the average RFFS household income is Rp.1,102,646 per month or contributes 61 percent of total household income. Then the average income from Non-Rice-fish is Rp. 704,971 per month or contribute 39 percent of total household expenditure.

### *Household Food Security of Farmers of Rice-Fish Farming System based on the Proportion of Household Expenditures*

The proportion of food expenditure is the percentage of the income of farmer households allocated for food needs. The amount of food expenditure on total expenditure is 46 percent, while non-food expenditure is 54 percent. The proportion of food, non-food expenditure is presented in Figure 2.



**Figure 2. Proportion of Farm Household Expenditures (per month)**  
Source: Primary data processed, 2018

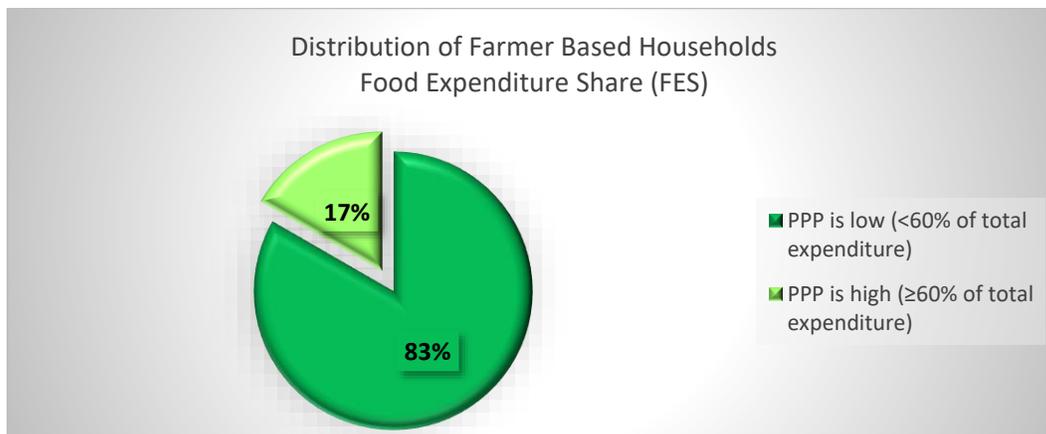
Based on the picture above it can be seen that the proportion of the average household expenditure of the total expenditure is Rp 1,807,617 consists of non-food expenditure of Rp. 976,687 or 54 percent and food expenditure which is Rp. 830,930 or 46 percent, it means that the respondent's household is in the category of food-resistant households. Because the proportion of food expenditure to total expenditure is lower than 60 percent. It can be used as an indicator to determine the level of welfare or household food security.

The most basic need for each person is the physiological need, namely the need to sustain life physically. These needs such as the need for food, drinks, shelter, sleep and oxygen (clothing, food, shelter). Physiological needs are the most basic and large potential for all fulfillment of their needs. Hungry humans will always be motivated to eat, not to find friends or be valued. Humans will ignore or suppress all other needs first until their physiological needs are fulfilled (G. Goble, Frank., 1987). Every human being, if his basic needs, especially food, have been fulfilled, will shift to meet other needs. The proportion of food expenditure that is greater than non-food expenditure shows that Rice-fish farmers still need to fulfill their basic needs, or are

referred to as food insecure households. Therefore, if households consume more luxury goods and other secondary needs, they are more prosperous households (Mor & Sethia, 2015).

The proportion of food expenditure is the ratio between food expenditure and total household expenditure per month. The proportion of food expenditure can be used as an indicator to measure household food security, if the expenditure proportion is  $<60\%$  then the household is resistant to food, but if the proportion of food expenditure is  $\geq 60\%$  then the household is vulnerable to food. Through the expenditure proportion, it can be explained that the higher the proportion of food expenditure, the lower the level of household food security. The proportion of food expenditure is less than 60 percent indicates that the respondent's household has a level of income that is able to meet non-food needs.

Based on the results of the research that has been conducted, it shows that households of rice-fish farmer have a lower share of food expenditure than non-food expenditures, so it can be said that farm households of rice-fish are food-resistant. Distribution of rice-fish farm households based on the level of food security is presented in Figure 3.



**Figure 3. Distribution of Farm Households Based on Food Expenditure Share (FES).**  
Source: Primary Data processed, 2018.

Based on the data obtained in this study households of rice-fish farmers with the proportion of food expenditure  $<60\%$  is 83 percent. This means that 83 percent of rice-fish farmers households are already food resistant, while 17 percent of rice-fish farmers households as still not food-resistant. Meaning that 83 percent of rice-Fish farmers have been able to meet food needs for

their families while 17 percent of farmers are still in a vulnerable position if farmers do not try to increase their income. (Figure 4). This is, in accordance with Law No. 18 of 2012, that food security is a condition of fulfilling food for the country up to individuals.

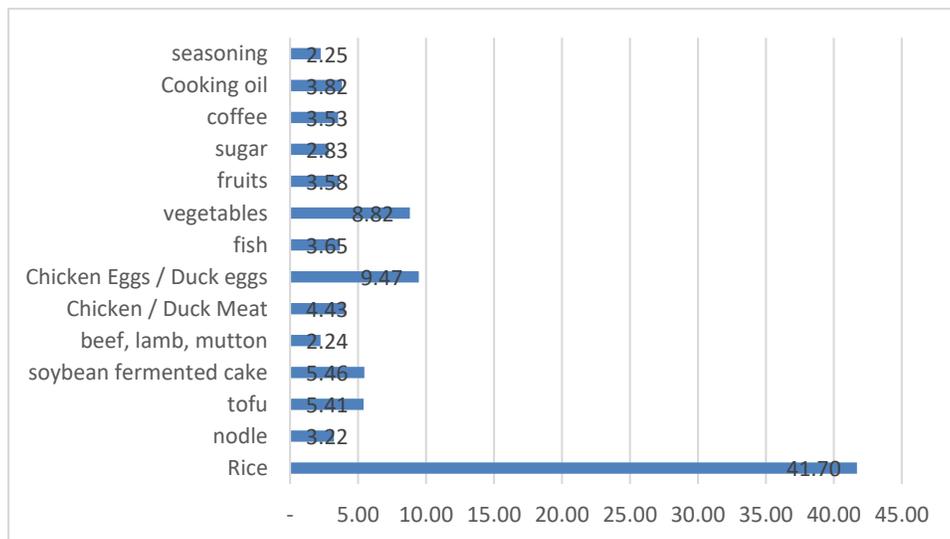
#### IV. PROPORTION OF EXPENDITURES BY FARMER HOUSEHOLDS

Household expenditure is the cost incurred for the consumption of all household members in one house. The expenditure of these households is classified into two categories, namely expenditures for food consumption and expenditures for non-food consumption. The following is the average percentage of food expenditure in the respondent's household (Figure 4)

The largest average expenditure on food in farmer households is to buy rice, eggs and vegetables. Tofu and *tempe* as a source of vegetable protein still remain an option for farmers compared to meat and fish. Expenditures to buy chicken meat are

still dominant compared to red meat and fish. The need for rice for rural farmers is still very dominant, the average rice need is 30 kg per month. The range of rice needs of farm households is between 15 - 60 kg per month. The high consumption of rice in farm families is because they assume that if they have eaten rice they will be full.

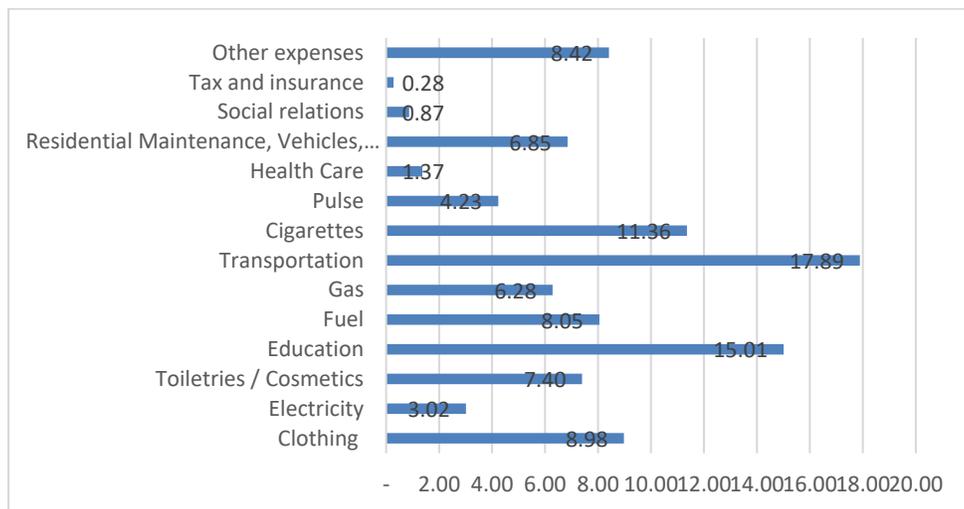
Farmers generally consume rice from their farms, the rice they produce is not entirely sold, they set aside rice to meet their family needs ranging from 10 to 15 percent of their production. Farmers and their families will feel safe if they already have rice. Farmers keep supplies in the form of grain. If necessary for consumption needs, the new family is ground into rice.



**Figure 4. Average Percentage of Food Expenditure in Households of Rice-fish farm (per month)**  
 Source: Primary Data processed, 2018

Rice produced from Rice-fish farming is healthy rice, because in the cultivation of Rice-fish systems, farmers do not spray with pesticides. So that the rice produced is rice that is safe for consumption. Fish produced from Rice-fish are seed fish with a size of 5-8 cm, 90 percent of farmers sell fish seeds to collectors, only 10 percent of farmers who use seeds to be planted again in their own ponds and are raised to consumption size.

Based on Figure 5, it can be seen that the largest non-food expenditure is for 18 percent transportation costs, which means transportation costs which are costs incurred by farm households to travel using public transportation, such as public transportation, and *ojeg*. The high cost of transportation is due to the accessibility of the location of farmers to public facilities that are not yet entirely affordable by public transportation so that they use *ojeg* services which cost much more expensive.



**Figure 5. Average Percentage of Farm Household to Non-Food Expenditures (per month)**  
**Source: Primary Data processed, 2018**

Education expenditure is 15.01 percent. These education expenses are used for school fees, pocket money, stationery, and other school supplies. Education expenses are quite high; this indicates that farmers are aware of the importance of education so that they are expected to send their children to higher levels of schooling, so that their lives will be better.

The third non-food expenditure is expenditure on cigarettes by 11.36 percent. The average consumption of cigarettes is one pack per two days. Smoking habits for farmers cannot be eliminated, cigarettes for farmers are psychological needs, they prefer not to eat rice rather than not smoking.

Non-food expenditure is clothing. Clothing needs for farmers and their families occupy the fourth expenditure position. Farmers and their families buy clothes generally at the time of Eid, while other months rarely intentionally buy clothes so that the expenditure value is low. Besides that, the next non-food expenditure is expenditure on electricity, followed by expenditures for social activities and the last is expenditure for taxes. The rest of the expenditure is under 10 percent.

Another interesting thing from farmers' expenditure is that the expenditure for purchasing pulses is 4.23 percent. The development of information and communication technology cannot be stopped anymore. At present, the need for communication facilities has become a primary need, even though farmers live in the countryside. The use of communication by farmers in addition to communication needs with the family is also

used for communication needs in other farmer groups. The smallest expenditure under 1 percent is expenses for taxes and insurance. Taxes issued by farmers are generally *PPB* ( Land and Building Taxes ) while insurance payments in agriculture are still rare. At this time there is insurance for rice, but not many farmers know.

#### V. FACTORS AFFECTING FOOD EXPENDITURE SHARE IN FARMERS HOUSEHOLD OF RICE-FISH FARMING

The results of the F test analysis in multiple regression show a Probability value of 0.000 smaller than alpha, which is 0.05, which means together with the factors of Income, Education Level, Number of Family Members, Education Costs, Rice Value, Tempe Value, Sugar Value, Vegetable Value, Fish Value, Egg Value and Oil Value. While the results of the t-test analysis show that the factors that influence the FES of the farm household in partial are income, rice value, egg value and sugar value. While the number of family members, education, LPG value, vegetable value, fish value, egg value, and cooking oil cannot be proven as a factor that affects the Food Expenditure Share of farmer households of Rice-fish Farming. The results of the Regression Analysis are presented as completely as in Table 1.

**Table 1. Results of Multiple Regression Analysis Factors that influence Food Expenditure Share for households of Rice-fish farm.**

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	50.169	7.116		7.050	.000
	Income	-.8183E-6	.000	-1.083	-6.459	.000***
	Farmer education level	1.094	.822	.188	1.331	.199
	Family member	-.456	1.424	-.040	-.320	.752
	Value of rice	2.526E-5	.000	.231	2.105	.049**
	Value_of_eggs	2.274E-5	.000	.254	2.169	.043**
	Value of fish	5.869E-5	.000	.105	.797	.435
	Value_of_vagatables	3.161E-5	.000	.089	.838	.412
	Value of cooking oil	2.532E-6	.000	.006	.026	.980
	Value_of_sugar	.000	.000	.601	3.121	.006***
	Value of LPG	-3.956E-5	.000	-.172	-1.282	.215

a. Dependent Variable: Food\_Expenditure\_Share\_FES

Description:

- \*\*\* : significant effect on  $\alpha$  1%
- \*\* : significant effect on  $\alpha$  5%
- \* : significant effect on  $\alpha$  10%

Income is very influential on the resilience of farm households, this can be explained that the higher the income, the higher the food security, all food needs will be covered by high income. The higher the level of income of the farm family, the more money spent on non-food needs, if food expenditure increases, it will certainly reduce the value of FES (Food Expenditures Share), indicated by a negative regression coefficient, smaller FES values indicate food security the higher. It is hoped that the increase in income from Rice-Fish Farming can increase food security because in addition to being able to access the food needs of farmers, they also obtain rice and fish from their farming products that are produced in a healthy, environmentally and friendly.

If the farm household income gets higher, then the farmer will allocate his income to non-food needs. Greater non-food expenditure illustrates that farmers are increasingly prosperous. Revenues will be allocated to food needs until sufficient. However, non-food expenditure will continue to increase in accordance with the level of income earned.

The value of rice expenditure influences the food security of farm households, the regression coefficient of the value of rice is positive, meaning that if the value of expenditure for rice is higher then the value of FES will be greater, the greater the value of FES, this indicates that food security will decrease. Because the portion of food expenditure is getting bigger.

Egg value is an expenditure that affects FES. Eggs are a cheap and easily available source of animal protein so spending on these eggs will still be a top priority for the fulfillment of the nutrition of the farm family. Whereas other sources of animal protein such as fish and meat are still not used to being consumed every day by the farm family because getting it is not as easy as

buying eggs. Eggs are available in small shops and can be stored longer without refrigerators. So the expenditure to buy eggs will certainly increase food purchases so that FES will increase and eventually affect the level of food security.

All coefficients of food variable regression are positive, meaning that the greater the expenditure on food expenditure, the higher the value of the share of food expenditure, which means that food security decreases, whereas the regression coefficient for non-food variables is negative. This means that the higher expenditures for non-food will reduce the share value of food expenditure or the higher non-food expenditure shows that farm households are more food-secure. Households that are food-secure means that they can meet all food needs, so that their income is allocated for non-food.

## VI. CONCLUSION :

Based on the research that has been done, it can be concluded that:

- (1) The contribution of rice-fish farming income contributes 61 percent to the income of farmer families.
- (2) The rice-fish farmer households are in the food-resistant category, namely 83 percent, and 17 percent are still in the category of not yet resistant to food.
- (3) Food Expenditure Share of farm households is strongly influenced by the level of income of the farm family, the value of rice, eggs, and sugar.

## VII. REKOMENDATION :

Based on the results of the study, the following things can be recommended:

- 1) Rice-Fish Farming System must be maintained because it is farming that contributes significantly to family income.
- 2) The pattern of high rice consumption in farmer households must be a concern, because food security can not only meet the needs of carbohydrates but also various other nutritional needs.
- 3) RFFS farmers households still food-insecure can increase their income through optimizing existing land use by planting various crops that can be harvested for a long time.

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# “leadership is everyone’s business” Can this not be true?

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**Abstract-** The purpose of this study is to debate what is meant by the phrase, “leadership is everyone’s business”-can this not be true. In debating this phrase, we shall define the term leadership. Various scholars have defined leadership in different terms and this paper shall attempt to look at the different leadership theories, types of leadership and their implications on the topic under debate. This purpose shall among others look at the following theories and types of leadership, situational leadership, transactional leadership, adaptive leadership and the path goal theory among others. The paper shall also look at the difference between leadership and management, leadership and followership, the various myths about leadership together with the various stages of leadership. This will all be in attempt to establish the meaning of the phrase, “leadership is everyone’s business” in full context. The topic under debate has wide reading material to such an extent that there are a lot of books with the same title under debate. The conclusion that appears to be in most of the literature is that everyone is a leader in their own spheres of influence; hence leadership is a duty for everyone, both the discerning and non-discerning individuals at whatever stage of the organization one is in.

**Index Terms-** Leadership, Management, Followership, theory, servant leadership, influence, superior, subordinate relationship, policies and practices, methods, management, employees,

## I. INTRODUCTION TO LEADERSHIP

To establish a good foundation for our debate, we shall define the main term which is leadership. Leadership has been traditionally defined as, “a process of social influence, which maximises the efforts of others towards achievement of a goal.” as stated by Amanchukwu, Stanley and Ololube, (2015). The further state the following key principles in defining leadership,

- i. That leadership stems from social influence, not authority or power;
- ii. That leadership requires others and that implies they do not need to be direct reports;
- iii. That there is no mention of personality traits, attributes or even a title;
- iv. That there are many styles and many paths to effective leadership;
- v. That it includes a goal, not influence with no intended outcome;

The above definition is however the conventional definition which has been adopted. Various authors and respected business

thinkers have defined it in different manners. We shall look at a few of those as follows;

Drucker (2010): “The only definition of a leader is someone who has followers.”

Bennis (2002): “Leadership is the capacity to translate vision into reality.”

Gates (1998); “As we look ahead into the next century, leaders will be those who empower others.”

Maxwell (2003): “Leadership is influence – nothing more, nothing less.”

There are also other authors who define leadership by comparing it with certain aspects, such as management, followership and influence among other factors.

## Leadership vs. Management

Traditionally leadership has been defined by its alleged opposite, that is management. Management is concerned with executing routines and maintaining organisational stability. It is essentially concerned with control. Leadership is concerned with direction setting and is essentially linked with change, movement and persuasion. Management is the equivalent of things that we have seen before whilst leadership is the equivalent of never seen this before.

## **Leadership**

There are many diverse definitions of leadership. Stogdill concluded that “there are almost as many definitions of leadership as there are persons who have attempted to define the concept”. While Drucker (2010) sums up that: “The only definition of a leader is someone who has followers. To gain followers requires influence but doesn’t exclude the lack of integrity in achieving this”. Yukl (1989) states that, some theorists believe that leadership is no different from the social influence processes occurring among all members of a group and others believe that leadership is everything someone is doing in order to lead effectively. These definitions present some important questions such as, is leadership a charisma thing or something that can be taught? The answer to this question varies. Although it is unexceptionable that leading isn’t easy, leaders should have some essential attributes such as vision, integrity, trust, selflessness, commitment, creative ability, toughness, communication ability, risk taking and visibility, Capowski (1994).

## **Management**

Some writers would define management as an art, while others would define it as a science. Whether management is an art

or a science isn't what is most important. Management is a process that is used to accomplish organizational goals, that is, a process that is used to achieve what an organization wants to achieve. What however may be interrogated is, do leaders and managers have the same role? Can organizations have only leaders or only managers? A well balanced organization should have a mix of leaders and managers to succeed, and in fact what they really need is a few great leaders and many first-class managers (Kotterman, 2006) Managers are the people to whom this management task is assigned, and it is generally thought that they achieve the desired goals through the key functions of planning and budgeting, organizing and staffing, problem solving and controlling. Leaders on the other hand set a direction, align people, motivate and inspire (Kotter, 2001). Other researchers consider that a leader has soul, the passion and the creativity while a manager has the mind, the rational and the persistence. A leader is flexible, innovative, inspiring, courageous and independent and at the same time a manager is consulting, analytical, deliberate, authoritative and stabilizing (Capowski, 1994).

The most important differences between leaders and managers concern the workplace and are concluded in table I below:

**Table I**

Process	Management	leadership
Vision establishment	<ul style="list-style-type: none"> <li>Plans and budgets</li> <li>Develops process steps and sets timelines</li> <li>Displays impersonal attitude about the vision and goals</li> </ul>	<ul style="list-style-type: none"> <li>Sets direction and develop the vision</li> <li>Develops strategic plans and achieve the vision</li> <li>Displays very passionate attitude about the vision and goals</li> </ul>
Human development and networking	<ul style="list-style-type: none"> <li>Organizes and staffs</li> <li>Maintains structure</li> <li>Delegate responsibility</li> <li>Delegates authority</li> <li>Implements the vision</li> <li>Establishes policy and procedures to implement vision</li> <li>Displays low emotion</li> </ul>	<ul style="list-style-type: none"> <li>Align organisation</li> <li>Communicates the vision, mission and direction</li> <li>Influences creation of coalitions, teams and partnerships that understand and accept the vision</li> <li>Displays driven, high emotion</li> </ul>

	<ul style="list-style-type: none"> <li>Limits employee choices</li> </ul>	<ul style="list-style-type: none"> <li>Increases choices</li> </ul>
Execution	<ul style="list-style-type: none"> <li>Controls processes</li> <li>Identifies problems</li> <li>Solve problems</li> <li>Monitor results</li> <li>Takes low risk approach to problem solving</li> </ul>	<ul style="list-style-type: none"> <li>Motivates and inspires</li> <li>Energizes employees to overcome barriers to change</li> <li>Satisfies basic human needs</li> <li>Takes high risk approach to problem solving</li> </ul>
Outcome	<ul style="list-style-type: none"> <li>Managers vision order and predictability</li> <li>Provides expected results consistently to leadership and other stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Promotes useful and dramatic changes, such as new products or approaches to improving labor relations</li> </ul>

Table I: Comparison of Management and Leadership Process Differences in the workplace (Kotterman, 2006)

**Theories of Leadership**

Because there is no single correct definition on leadership, there have been attempts to theorise leadership. We shall briefly look at the various leadership theories that are in place in an effort to discuss the topic under research herein. There are as many different views of leadership as there are characteristic that distinguish leaders from non-leaders. While most research today has shifted from traditional trait or personality-based theories to a situation theory, which dictates that the situation in which leadership is exercised is determined by the leadership skills and characteristics of the leader, Avolio, Walumbwa, & Weber, (2009), all contemporary theories can fall under one of the following three perspectives: leadership as a process or relationship, leadership as a combination of traits or personality characteristics, or leadership as certain behaviours or, as they are more commonly referred to, leadership skills. In the more dominant theories of leadership, there exists the notion that, at least to some degree, leadership is a process that involves influence with a group of people toward the realization of goals, Wolinski, (2010). Charry (2012), noting that scholarly interest in leadership increased significantly during the early part of the twentieth century, identified eight major leadership theories. While the earlier of these focused on the qualities that distinguish leaders from followers, later theories looked at other variables

including situational factors and skill levels. Although new theories are emerging all of the time, most can be classified as one of Charry's eight major types:

### "Great Man" Theory

Great man theories assume that the capacity for leadership is inherent, that great leaders are born, not made. These theories often portray leaders as heroic, mythic and destined to rise to leadership when needed. The term great man was used because, at the time, leadership was thought of primarily as a male quality, especially military leadership. Ololube, (2013).

### Trait Theory

Similar in some ways to great man theories, the trait theory assumes that people inherit certain qualities or traits make them better suited to leadership. Trait theories often identify particular personality or behavioural characteristics that are shared by leaders. Many have begun to ask of this theory, however, if particular traits are key features of leaders and leadership, how do we explain people who possess those qualities but are not leaders? Inconsistencies in the relationship between leadership traits and leadership effectiveness eventually led scholars to shift paradigms in search of new explanations for effective leadership.

### Contingency Theories

Contingency theories of leadership focus on particular variables related to the environment that might determine which style of leadership is best suited for a particular work situation. According to this theory, no single leadership style is appropriate in all situations. Success depends upon a number of variables, including leadership style, qualities of followers and situational features, Charry, (2012). A contingency factor is thus any condition in any relevant environment to be considered when designing an organization or one of its elements, Naylor, (1999). Contingency theory states that effective leadership depends on the degree of fit between a leader's qualities and leadership style and that demanded by a specific situation Lamb, (2013).

### Situational Theory

Situational theory proposes that leaders choose the best course of action based upon situational conditions or circumstances. Different styles of leadership may be more appropriate for different types of decision-making. For example, in a situation where the leader is expected to be the most knowledgeable and experienced member of a group, an authoritarian style of leadership might be most appropriate. In other instances where group members are skilled experts and expect to be treated as such, a democratic style may be more effective.

### Behavioural Theory

Behavioural theories of leadership are based on the belief that great leaders are made, not born. This leadership theory focuses on the actions of leaders not on intellectual qualities or internal states. According to the behavioural theory, people can learn to become leaders through training and observation. Naylor (1999) notes that interest in the behaviour of leaders has been stimulated by a systematic comparison of autocratic and democratic leadership styles. It has been observed that groups under these types of leadership perform differently: Autocratically led groups

will work well so long as the leader is present. Group members, however, tend to be unhappy with the leadership style and express hostility. Democratically led groups do nearly as well as the autocratic group. Group members have more positive feelings, however, and no hostility. Most importantly, the efforts of group members continue even when the leader is absent.

### Participative Theory

Participative leadership theories suggest that the ideal leadership style is one that takes the input of others into account. Participative leaders encourage participation and contributions from group members and help group members to feel relevant and committed to the decision-making process. A manager who uses participative leadership, rather than making all the decisions, seeks to involve other people, thus improving commitment and increasing collaboration, which leads to better quality decisions and a more successful business Lamb, (2013).

### Transactional/Management Theory

Transactional theories, also known as management theories, focus on the role of supervision, organization and group performance and the exchanges that take place between leaders and followers. These theories base leadership on a system of rewards and punishments (Charry, 2012). In other words, on the notion that a leader's job is to create structures that make it abundantly clear what is expected of followers and the consequences (rewards and punishments) associated with meeting or not meeting expectations (Lamb, 2013). When employees are successful, they are rewarded and when they fail, they are reprimanded or punished (Charry, 2012). Managerial or transactional theory is often likened to the concept and practice of management and continues to be an extremely common component of many leadership models and organizational structures Lamb, (2013).

### Relationship/Transformational Theory

Relationship theories, also known as transformational theories, focus on the connections formed between leaders and followers. In these theories, leadership is the process by which a person engages with others and is able to "create a connection" that results in increased motivation and morality in both followers and leaders. Relationship theories are often compared to charismatic leadership theories in which leaders with certain qualities, such as confidence, extroversion, and clearly stated values, are seen as best able to motivate followers Lamb, (2013). Relationship or transformational leaders motivate and inspire people by helping group members see the importance and higher good of the task. These leaders are focused on the performance of group members, but also on each person to fulfilling his or her potential. Leaders of this style often have high ethical and moral standards Charry, (2012).

### Skills Theory

This theory states that learned knowledge and acquired skills/abilities are significant factors in the practice of effective leadership. Skills theory by no means refuses to acknowledge the connection between inherited traits and the capacity to lead effectively, but argues that learned skills, a developed style, and acquired knowledge, are the real keys to leadership performance.

A strong belief in skills theory often demands that considerable effort and resources be devoted to leadership training and development. Wolinski, (2010).

## II. CHARACTERISTICS OF A LEADER

The main characteristics that leaders should possess include but are not limited to the following listed:

- i. Being technically/academically/practically proficient: As a leader, you must know your job or area of influence and have a solid familiarity with the tasks of your different employees;
- ii. Develop a sense of responsibility in your workers: Help to develop good character traits that will help them carry out their professional responsibilities;
- iii. Ensure that tasks are understood, supervised, and accomplished: Communication is key. A leader must be able to communicate effectively. Leaders should spend most of their day engaged in communication. Older studies, in fact, noted that organizational leaders (managers) spent 70 to 90 per cent of their time each day on communication and related activities Barrett et al, [2014]);
- iv. Keep your workers informed: Know how to communicate with not only junior staff, but senior staff and other key people as well;
- v. Know your people and look out for their well-being: Be well versed in basic human nature and recognize the importance of sincerely caring for your workers;
- vi. Know yourself and seek self-improvement: In order to know yourself, you have to understand what you are, what you know, and what you can do (attributes). Seeking self-improvement means continually strengthening your attributes. This can be accomplished through self-study, formal education, workshops, reflection, and interacting with others;
- vii. Make sound and timely decisions: Use good problem solving, decision making, and planning tools;
- viii. Seek responsibility and take responsibility for your actions: Search for ways to guide your organization to new heights. When things go wrong, do not blame others. Analyze the situation, take corrective action, and move on to the next challenge;
- ix. Set the example: Be a good role model for your employees. Employees must not only be told what is expected of them, but see leaders embodying organizational qualities and ethics. Leaders must embody what they wish to see in their employees;
- x. Train as a team: Do not focus on just your department, section, or employees, but envision the whole organization as an entity that must learn and succeed together; and
- xi. Use the full capabilities of your organization: By developing a team spirit, you will be able to employ the abilities of your entire organization towards organizational goals. Bennis (1989).

## III. LEADERSHIP STYLES IN A MODERN DAY ORGANISATION

Under this heading we shall briefly touch on two main prominent leadership styles that show fully how leadership is everyone's role, that is transactional style and the transformational style of leadership.

### **Transactional Leadership.**

Transactional leadership style comprises three components that are contingent reward, management-by-exception (active) and management-by-exception (passive). A transactional leader follows the scheme of contingent rewards to explain performance expectation to the followers and appreciates good performance. Transactional leaders believe in contractual agreements as principal motivators Bass, (1985) and use extrinsic rewards toward enhancing followers' motivation. A basic example of where transactional leadership is actively performed is sale by commission basis where an employee is rewarded higher based on good performance compared to poor performance. The situations entailing high degree of precision, technical expertise, time-constraints, particularly in technological intensive environment, we shall prefer transactional leadership whereas, in human-intensive environment, where focus is on influencing the followers through motivation and respecting their emotions on the basis of common goals, beliefs and values, preferable option is transformational leadership style (MacGregor Bums, 2003).

## IV. TRANSFORMATIONAL LEADERSHIP

Transformational leaders emboldens followers to attain higher-order needs like self-actualization, self-esteem (Bass, 1985), and are influential in surging followers' motivation in the direction of "self-sacrifice and achievement of organizational goals over personal interests (Bass, 1995). Leaders with Idealized Influence demonstrate heightened concerns and cognizance of followers' needs and generate a sense of shared risk-taking" (Jung et al., 2008). This leadership style, however, does not embrace all of the factors that influence innovation. As per Cummings, Midodzi, Wong, and Estabrooks (2010), "leadership style alone could not be linked to patient mortality". Instead, the researchers examined that when the organization had associated and consistent organizational culture, patient mortality was on downward trajectory. Cummings et al., (2010) observed that regardless of style, "leaders who practiced relational and transformational styles had better quality outcomes than those who demonstrated autocracy".

## V. INTERACTION WITHIN AN ORGANISATION

Organizational interaction or communication refers to a relational approach between two or more individuals on the basis of social and organizational structures aimed at achieving goals Olorube, (2012). Given that uncertainty surrounds many situations in organizations, leaders need to be involved with their staff. In this way, leaders can keep focused on key issues and ensure that organizational learning takes place. The quantity and quality of interaction in an organization tends to influence the style of organizational management with the main issue being that employees must work together in order to accomplish tasks.

According to Naylor (1999), for organizations to be effective, managers must constantly share information and have open channels of communication. There must be information of sufficient potential to demand regular attention from leaders at all levels in the organisation. Interpretation of complex data/information should be done in face-to-face discussions with staff where Managers must debate the nature of the data/information and the possible assumptions and actions that results from it Naylor (1999).

#### VI. THE DUTY TO LEAD

Every employee or individual in an organisation that is result based is a leader in their own respects. Each individual has key result areas that they are supposed to meet. In performance of those key result area tasks, one will also be performing leadership duties. Leadership is not only for those with big office portfolios but it is for everyone. According to Bennis (2002) a leader is one who can transform a vision into a reality. So everyone has a vision and it is that vision which, when translated to reality becomes a leadership. Even a minor child is also a leader in their own right, everyone with a vision is a leader and as such, "leadership is everyone's duty.

#### VII. CONCLUSION

Having looked at the definitions, theories and also looked at various principles of leadership, it is now critical for us to look at the question, who is the leader in the modern day organisation. When one talks of leadership, it is easy for one to think of the organisations directors, chief executives and the management. However in the modern day organisation, looking at the various definitions put forward, everyone is a leader in their own right. If you are not a leader, in terms of supervising others, you are a leader in terms of organisational goal setting. From the highest level in an organisation, everyone has obligations and duties to perform. A chief executive officer in a company may appear to be the top most and important employee in a company with the biggest perks and benefits, but he can never perform his leadership role effectively if the lowest cleaner is not performing his duties.

A chief executive officer is responsible for the day to day running of the organisations, while a cleaner is responsible for making sure the organisations premises are clean and well kept. Duties and obligations in an organisation may differ, but the leadership roles and duties are the same. The same principles of leadership which apply to the top most employee in an organisation also apply to the lowest ranked employee. What is required will be the synergies between all the various individuals and departments within an organisation. Failure to play leadership roles by either of the individuals in the organisations will result in the whole organisation being affected negatively. So to sum it all up, "**leadership is everyone's business.**"

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# Selected Growth Indicators of Public Universities of Bangladesh from 2009 to 2018

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**Abstract-**The aim of the study is to highlight the growth indicators of the public universities in Bangladesh. The study has used basically secondary data as well as primary data which were collected over the phone from the country's various scholars. Bangladesh government is trying to make more available higher education for majority of the students towards vision 2021, SDG 2030, vision 2041 and delta plan 2100. To implement quality higher education, government has taken various initiatives to spread higher education with both public and private universities. The public universities already have taken huge steps to align with government decisions. This study shows the remarkable progress in public universities in terms of budget, teacher numbers, officers- staff numbers and student numbers. Though there are huge scopes to progress, public universities have advanced in many physical indicators. This study will help the decision makers of government and others to identify the priorities in public universities of Bangladesh.

**Keyword:** Public University, Growth, Higher Education, Bangladesh

## 1. INTRODUCTION

A public university is a university that is in state ownership or receives significant public funds through a national government, as opposed to a private university. The first public university (also first university) in Bangladesh territory is Dhaka university, established in 1921. The University started its activities with 3 Faculties, 12 Departments, 60 teachers, 877 students and 3 dormitories (Halls of Residence) for the students ([https://www.du.ac.bd/main\\_menu/the\\_university/about](https://www.du.ac.bd/main_menu/the_university/about), 2020). Bangladesh started her journey with six public universities in 1973, just after independence. Islamic University and Shahjalal Science and Technology University were established in 1985 and 1986. Khulna university was established in 1991 and national University was established in 1992. Science and Technology University Act was passed in 2001 to establish 12 science and technology universities in 12 old greater districts. Till 2018, there were 154 universities in Bangladesh. Of Them, 49 were public, 103 were private and 02 were international universities. There were 39 lakhs students in the universities of Bangladesh in 2018. UGC has already prepared the *Strategic Plan for Higher Education in Bangladesh: 2018-2030* to optimize the higher education and research and started to implement it. If the youth society is equipped with modern knowledge and skills, the challenges of fourth industrial revolution will be faced successfully by utilizing demographic dividend. If those huge youths are turned into skilled man powers, then the government 2021, 2030 and 2041 visions will be implemented. At present government is giving much more importance on science and technology university to meet the 21<sup>st</sup> century challenges (University Grant Commission (UGC), 2018). At present, there are 46 public universities in operation, 3 public universities yet to go for operation and 5 public universities approval in consideration (Bangla Tribune Report, 2020).

## 2. LITERATURE REVIEW

There are huge researches on higher education and on public universities worldwide and Bangladesh. "The development of a modern society depends to a large extent on the nature and standard of higher education. Higher education has enormous potential to promote prosperity in the developing nations. Throughout the World, universities change the society and remain the center of change and development." (Monem and Baniamin, 2010). "This time around, it would be fair to say that the issue of access to education, not least higher education, has never been at a more critical stage. Looking back over the past year, Covid-19 has wreaked havoc across the higher education sector, forcing universities in all corners of the world to adapt to new ways of teaching, learning and researching. Almost overnight, institutions demonstrated both their resilience and capacity for rapid innovation, shifting to online and blended learning, enabling students and staff to study and work remotely." (Symonds, 2020). "In Southeast Asia, ASEAN's policies, such as reducing the economic gap within the region and creation of a single market, and member countries' policies to internationalise higher education institutions have brought about a strong need to improve the quality of higher education and to foster harmonisation of higher education systems, which have been the driving force behind this regional quality assurance activity." (Umemiya, 2008).

“Well-established physical and technological infrastructure also provide universities a competitive edge on a global scale.” (Altaf and Andaleeb, 2020).

“According to UGC, Bangladesh (2016), the university students enrolled in different higher educational program has been classified into 12 broad categories., total number of students enrolled in higher education in Bangladesh is 3234845 out of which 803516 students are enrolled in different areas of business and management education which covers 25% of the total. Maximum number of students’ study in different areas of arts & humanities (969088) that covers 30% of the total. Arts & science and humanities jointly cover 55% (30% + 25%) of the total students. In public universities, the percentage of business students is relatively lower than that of private universities. Unlike the public universities, private universities primarily focus on business (33%) and engineering and technical education (33%). Colleges affiliated with National University (NU), Bangladesh Open University (BOU) and Islamic Arabic University (IAU) mostly focuses on arts and humanities, social sciences and business education. Public universities provide only 13% of their total attention on business education whereas private universities provide 33% of their total attention on it.” (Islam, Tarafdar and Amin, 2016). “Every public university in Bangladesh has sufficient recreation and sport facilities for their students. The universities arrange various cultural and festival events (such as food festival, theater show), so that students can enjoy their campus life. Moreover, the universities arrange inter-university and intra-university sports events on a regular basis. These arrangements of the universities contribute to achieve higher level of students’ satisfaction.” (RAHMAN et al., 2014). “In Bangladesh the trend of online education is comparatively new though probably distant learning began with live class conducted by Open University through Bangladesh Television years before. This trend has got momentum as soon as the coronavirus pandemic hit hard the country as no alternative was left in the arena of teaching-learning without going online.” (Alam, 2020). “Nineteen general, science and technology universities of the country are scheduled to hold admission tests for the 2020-2021 academic year in a cluster system.” (Tribune Desk, 2020).

### 3. METHODOLOGY OF THE STUDY

This study uses secondary data from various sources like websites, newspapers, publications of University Grant Commission (UGC) and other researchers’ articles. Some facts and data are reorganized like in percentile, portion of total and comparison using researcher knowledge. Though it is qualitative research, quantitative data and facts are also used. Some opinions of scholars are collected over the phone calls. Various types of tables, bar diagrams and line charts are used to present the data and facts.

### 4. FINDINGS OF THE STUDY

The study found the trend of public higher education sector growth in Bangladesh from 2009-2018. The following facts and findings will help us to understand the growth trend of public higher education sector in Bangladesh.

#### 4.1 Growth in the number of public universities:

The following data are found from UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)* about public universities number from 2009-2018. The table and chart clearly showed upward trend in public universities number in Bangladesh in this decade.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
University Numbers	31	33	34	34	37	40	40	40	40	44

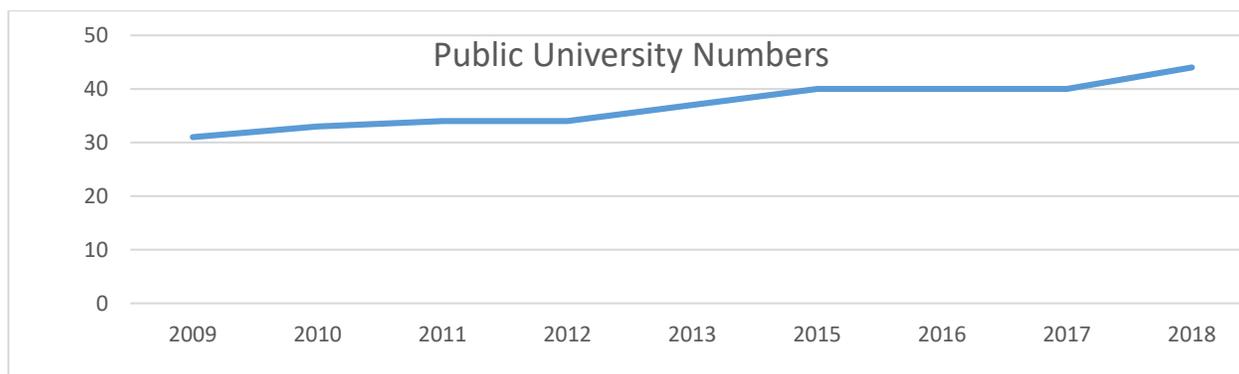


Figure 4.1: Public Universities Number from 2009-2018

Source: UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)*, Page No.03

**4.2 New approval of public universities:**

Those data are about the approval of public universities from 2009-2018 according to university categories. Bangladesh government approved eighteen public universities within this time.

Category/ Type	General University	Science & Technology University	Specialized University	Medical University
University Numbers	07	06	02	03

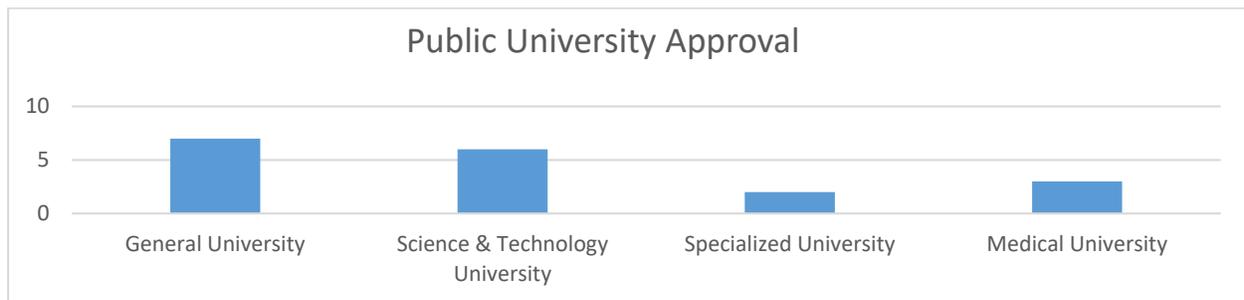


Figure 4.2: Public Universities Approval Number from 2009-2018

Source: UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)*, Page No.04

**4.3 Growth in the number of students of public universities:**

The table and line chart showed how the numbers of public university students changed from 2009-2017 with public university numbers. There is an upward growth trend except 2012 and 2016.

Year	Public Universities	Total Students	Change (%)
2009	31	1382216	+17.44
2010	31	1736887	+25.65
2011	34	2170472	+24.96
2012	34	1890543	-12.90
2013	34	2020549	+6.87
2014	35	2849865	+41.04
2015	37	3206435	+12.51
2016	37	3150409	-1.75
2017	37	3606137	+14.13

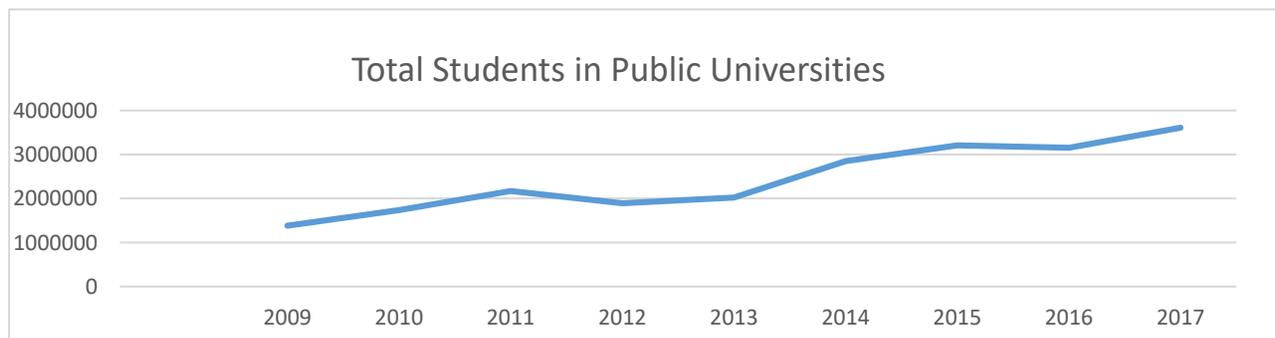


Figure 4.3 Public Universities Student Growth from 2009-2017:

Source: UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)*, Page No.04

#### 4.4 Public and Private Universities Students Percentage Growth Comparison 2009-2017:

Although this study is about public university related, those following data about public and private universities students' percentile change will help us to understand the students' growth in higher education sector from 2009-2017. There are handsome growth rates from 2009-2017 except negative growth in 2012 and 2016 both in public and private universities in Bangladesh.

Year	Public Change (%)	Private Change (%)
2009	17.44	10
2010	25.65	9.86
2011	24.96	27.21
2012	-12.9	12.04
2013	6.87	4.48
2014	41.04	0.61
2015	12.51	5.87
2016	-1.75	-3.7
2017	14.13	5.09

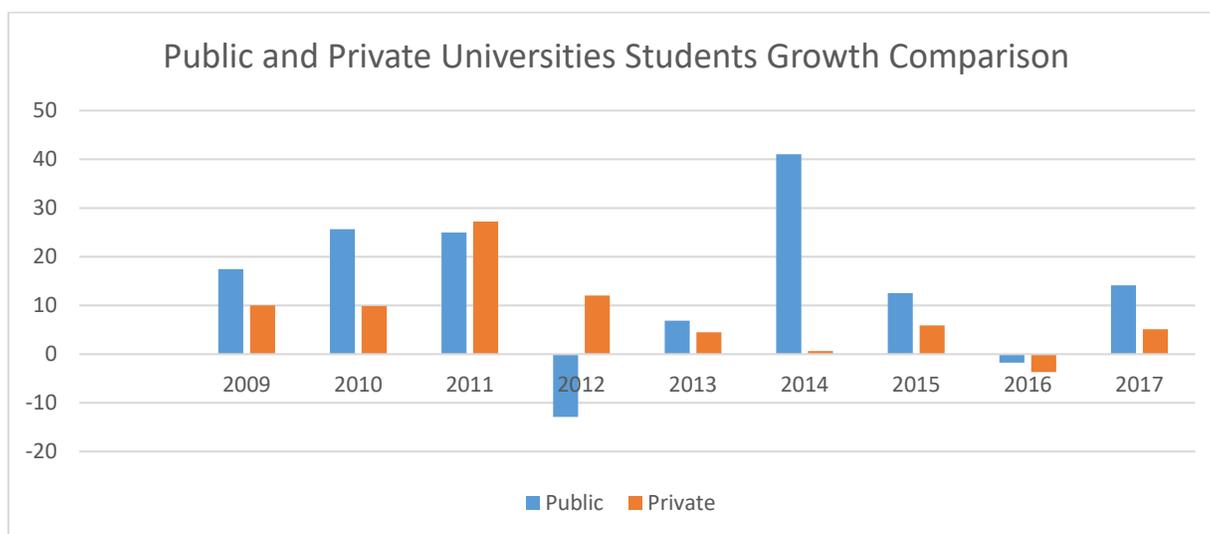


Figure 4.4 Public and Private Universities Students Percentage Growth Comparison 2009-2017  
Source: UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)*, Page No.07

#### 4.5 Government Budget for Public Universities and UGC:

The majority portion of the public universities and UGC (University Grant Commission) budgets come from the tax money of the general people of Bangladesh. The following data indicate huge positive changes in monetary budgets of public universities and UGC. The biggest positive change goes to public universities' research sector, 902%. That is a good sign for the public universities development in terms of financial power.

S.L No.	Description	2009-2010	2018-2019	Change	Change (%)
1	University Numbers	31	44	13	42%
2	For Public Universities' Non development Expenses	851.48 Crore Taka	3922.44 Crore Taka	3070.96	361%
3	For Public Universities' Research	6.14 Crore Taka	61.55 Crore Taka	55.41 Crore Taka	902%
4	For UGC's Non development Expenses	8.97 Crore Taka	36.29 Crore Taka	27.32 Crore Taka	305%
5	For UGC's Research	1.57 Crore Taka	5.25 Crore Taka	3.683 Crore Taka	234%

Figure: 4.5 Government Budget for Public Universities and UGC

Source: UGC report Titled *Higher Education Achievement in Bangladesh (2009-2018)*, Page No.10

**4.6 Designation-wise number of faculty members employed in public universities:**

The following table indicates that there are positive changes in teachers' positions based on numbers in three years. This table also indicates percentile segments of positions year by year.

Year	Professor	Associate Professor	Assistant Professor	Lecturer	Others	Total
2016	3699	2108	4357	2736	172	13072
	28%	16%	33%	21%	1%	100%
2017	3906	2175	4738	2738	252	13799
	28%	16%	34%	20%	2%	100%
2018	4160	2320	4941	2803	208	14556
	29%	16%	34%	19%	2%	100%

Figure: 4.6 Public Universities' Teachers Number according to Positions

Source: UGC report Titled *45<sup>th</sup> Annual Report 2018*, Page: 142

**4.7 Growth in teachers' educational qualification:**

This table is about numbers and percentiles of teachers in public universities based on the highest educational degree obtained by them. The table has a clear indication about the increment PhD and MPhil holding teacher numbers in public universities for three years.

Year	PhD	MPhil	Others	Total
2016	4299	959	7814	13072
	33%	7%	60%	100%
2017	4766	989	7829	13580
	35%	7%	58%	100%
2018	5015	766	8538	14322
	35%	6%	59%	100%

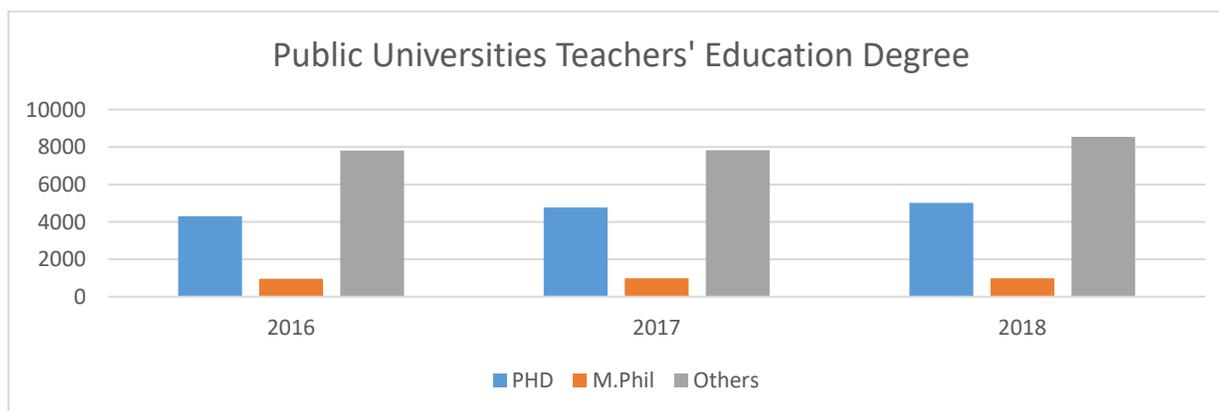


Figure: 4.7 Public Universities Teachers according to obtained Higher Degree

Source: UGC report Titled *45<sup>th</sup> Annual Report 2018*, Page: 143

**4.8 Teacher-student ration in the public universities over the years:**

The student and teacher numbers are increasing in every year in public universities. This table indicates that there are almost constant ratio of teacher and student numbers which is very crucial for quality education.

Year	Teachers	Students	Ratio
2016	13072	264084	1:20
2017	13580	283866	1:21

2018	14322	284322	1:20
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\*Excluding National University, Open University, Islamic Arabic University and with other universities affiliated college and Madrasah Students

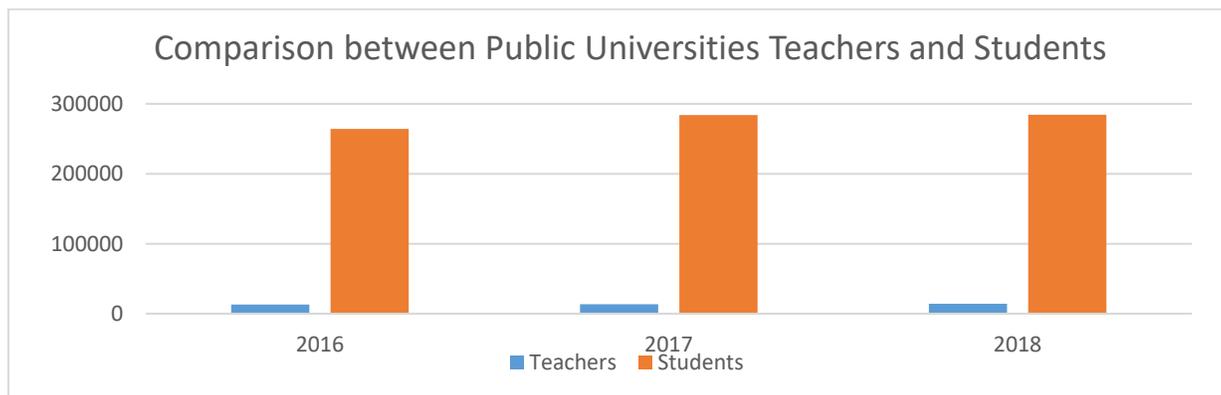


Figure: 4.8 Comparison between Public Universities Teachers and Students

Source: UGC report Titled 45<sup>th</sup> Annual Report 2018, Page: 147

#### 4.9 Comparison between Public Universities Officers-Staffs and Students:

This table is about officers-staffs and students' numbers in public universities for five years. Although both are increasing in numbers, the ratios were constant for 2014, 2015 and 2016. The students' ratios for 2017 and 2018 are slightly high compared to previous years but those are still in optimum level.

Year	Officer-Staffs	Students	Ratio
2014	26882	231690	1:9
2015	28341	244363	1:9
2016	29410	264084	1:9
2017	29722	283866	1:10
2018	30568	284322	1:11

\*Excluding National University, Open University, Islamic Arabic University and with Other Universities' affiliated Colleges and Madrasahs

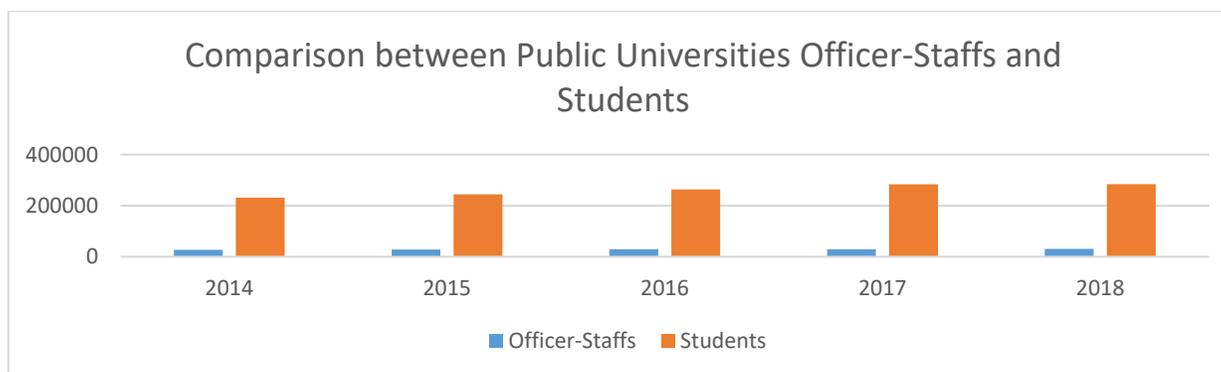


Figure: 4.9 Comparison between Public Universities Officer-Staffs and Students

Source: UGC report Titled 45<sup>th</sup> Annual Report 2018, Page: 148

#### 4.10 Foreign Students in Public Universities:

This table indicates an ups and downs in foreign students' numbers in public universities. Though there are positive signs in irregular way, the university authorities should give more concentration in this matter.

Year	Students	Change	Change (%)
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2010	359	-	-
2011	210	-149	-70.95
2012	525	315	60.00
2013	326	-199	-61.04
2014	432	106	24.54
2015	593	161	27.15
2016	355	-238	-67.04
2017	461	106	22.99
2018	804	343	42.66

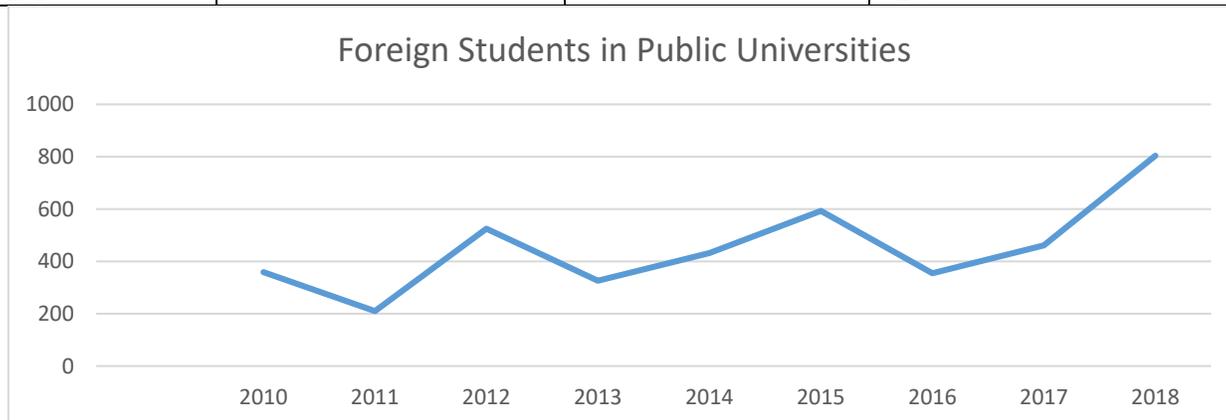


Figure: 4.10 Foreign Students in Public Universities

Source: UGC report Titled *45<sup>th</sup> Annual Report 2018*, Page: 137

## 5. CONCLUSION

The study is about the public university growth indicators from 2009-2018. There are so many positive signs in this sector for last decade although this sector has some challenges. There are significant positive changes in student, university, teacher and officer-staff numbers. Government is also giving much more emphasis on quality education by allocating more funds for universities' general expenses as well as research. This study has some limitations. This study works with only public universities quantitate growths for 2009 to 2018. There are lots of scopes to work with this sector.

## 6. RECOMMENDATIONS

Though there are many positive indicators in public universities' growth in 2009 to 2018, there are still a good numbers challenges in this sector. To overcome those challenges, researcher of this article suggests following initiatives.

- Government and Universities should give emphasis more on quality education besides quantity.
- Government should increase education sector budget as well as public universities' to the UNESCO standards (6% budget for education of total national budget).
- More modern research centers and laboratories should be established to enhance research works.
- Innovations and new ideas from universities should be encouraged from government. Those innovations and ideas should be applied for greater national interests.
- Researchers should be rewarded significantly for their intellectual works.
- Researchers and Teachers of public universities should be engaged in national and local strategies making and implementation.
- Separate pay scale should be implemented for university teachers.
- Residence crisis for teachers, officers, staffs and students should be mitigated immediately.
- 360 degree evaluations system for all employees can be introduced.
- All types of ragging, gender, color and religious discrimination should be strictly prohibited in public universities.
- More stipends and rewards should be introduced for students who innovate new ideas.
- The lessons of public universities should be towards to career orientation of the students.
- Strong career network should be established in public universities so that the students can be skilled according to market demand.

- The administrative works of the public universities should be digitalized like app based services for students.
- Separate training institute for public universities' teachers should be established to enhance the skills.

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# Effects of Irrigation Frequency and Nutrient Solution Volume on the Growth and Yield of Ginger (*Zingiber Officinale* Roscoe) Cultivated Using Soilless Culture System

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**Abstract-** Ginger or *Zingiber officinale* Roscoe has been cultivated for use as a spice and a medicinal herb. Irrigation frequency and volume are cultivation practices that influence the plant yield. This study was conducted to investigate the effects of irrigation frequency and nutrient solution volume on ginger plant growth and rhizomes yields soilless culture system. The experiment treatments included three irrigation frequencies (two, four and six times a day applications) and three volumes of nutrient solution (300 mL, 600 mL and 1200 mL). There were significant different between each treatment in terms of plant growth and rhizomes yield after nine months of cultivation periods. Combination of 6 times per day of irrigation frequency and 1200 mL nutrient solution gave the best ginger plant growth performance and rhizomes yield in the soilless culture system. This paper helps to elucidate the daily irrigation frequency and nutrient solution amount allowed for consistency production of ginger rhizomes.

**Index Terms-** ginger, soilless substrate, irrigation frequency, nutrient solution, rhizomes

## I. INTRODUCTION

Ginger (*Zingiber officinale* Roscoe) belongs to a tropical and sub-tropical Zingiberaceae family, which originated from Southeast Asia. Ginger is a perennial plant with pungent aromatic rhizomes which has been cultivated for use as a spice and a medicinal herb [1]. Ginger usually is consumed as young ginger or mature ginger. Ginger is one of the most widely used herbs that contains several interesting bioactive constituents and possesses health promoting properties. 6-gingerol is a major pungent ingredient in ginger, also possesses potent anti-oxidant, anti-cancer, analgesic, anti-pyretic, anti-inflammatory, cytotoxic, anti-diabetic, anti-obesity, anti-nausea, anti-gastric and anti-proliferative activities [2].

Soilless culture system is the most intensive production method in agriculture industry. This technology can result in higher yields even under limited and adverse growing environment. Planting chillies, rock melons and tomatoes using soilless culture system has shown increase yields up to 3 – 5 times compared to those using conventional planting method [3]. Previous studies have been done to cultivate rose flower, tomato, gerbera, begonia, primrose (*Primula* spp) and cabbage using various types of organic substrates including coir dusk [4]. Important factors influencing plant growth in containers are water availability, nutrient content, air retention, moisture and soil aeration [5]. Ginger growth improved under constant elevated moisture root and water availability to the plant [6]. Furthermore, other studies reported that ginger growth enhancement under high irrigation frequency is due to availability of nutrients [7]. High irrigation frequency favours the vegetative growth, the fruit yield and the fruit quality of tomato [8]. The efficiency of the soilless culture system greatly depends on the application design and the way nutrient and water are managed. The main objective of this study is to analyze the effects of irrigation frequency and nutrient solution amount on the ginger plant growth and the rhizomes yield under soilless culture system.

## II. RESEARCH METHODOLOGY

Ginger var Bentong was selected and used in this study. Prior to sowing, 10-month-old ginger rhizomes were bought from a ginger plantation in Bentong, Pahang. Each of the rhizomes was cut into smaller pieces of about 7 cm long and 100 g in weight. Each of the seed rhizomes contained 2 – 3 point buds. The seed rhizomes were treated with Previcur-N prior to planting. 100% of coir dusts were used as growth media. The growth media were thoroughly mixed in a 10-litre pail before filling into 60 cm × 60 cm black polyethylene bags. One seed rhizome was planted 5 cm deep in the polyethylene bags. Each polyethylene bag was placed randomly on four irrigation lines under the side-netted rain shelter and individually irrigated with nutrient solution via a dripper on the surface of the growth medium.

The research was conducted in rain shelter at MARDI Station, Serdang, Selangor, Malaysia. A side-netted rain shelter of 30 m long × 10 m wide × 4.5 m high were used in the study. All structures were made of galvanized steel frame and insect repellent net (0.1 × 0.1 mm<sup>2</sup>) side cladding. The rain shelter oriented in north-south direction for maximum sunlight exposure. Entrance into the shelter must be through double doors to reduce the chance of insect entry.

The experiment treatments included three irrigation frequencies (WF) (WF<sub>2</sub> = two times a day applications, WF<sub>4</sub> = four times a day applications and WF<sub>6</sub> = six times a day applications) and three volumes of nutrient solution (A) (A<sub>1</sub> = 300 mL, A<sub>2</sub> = 600 mL and A<sub>3</sub> = 1200 mL). The irrigation water was applied through drip system. The amount of nutrient solution applied for each time of irrigation frequency was 150 ml. The twice daily application was carried out at 9.30 am and 4.30 pm, meanwhile the four times a day applications were applied at 9.30 am, 10.30 am, 12.30 pm and 4.30 pm and the six times a day applications were given at 9.30 am, 10.30 am, 11.30 am, 12.30 pm, 1.30 pm and 4.30 pm. The irrigation regimes were carried out until one week before harvesting time. Irrigation water applied were from tap water with electrical conductivity value of 0.4 μS m<sup>-1</sup>. A split plot experimental design with three replications for each treatment was applied in the experiment. Each treatment consisted of 300 polybags or samples. Before the experiment began, the growth media were irrigated equally or close to field capacity.

The irrigation system, which was built in the side-netted rain shelter, consisted of a 1,500-litre tank, 1.5 Hp water pump, water filter, pressure meter and four lateral lines (28 m each) which looped to each other. Each of the lateral lines was equipped with 100 drippers that were placed into 100 polyethylene bags, side by side. The distance between each line was 1.5 m and the distance between each dripper point in the lateral line was 0.3 m. A valve was attached to an inlet to control the amount of the irrigated solution to be pumped in. A small valve was also attached to each lateral line to maintain the flow through the drip line. The nutrient solutions were supplied through 0.3 m micro tubes and arrow drippers.

All fertilizer components were water soluble. The fertilizer stocks were prepared according to [9]. The macro and micro nutrients were prepared separately as A and B stock solutions respectively, at 100× dilution. Solution A contained calcium nitrate and iron, while solution B contained all other components. All components were added one by one to ensure that they dissolved completely in the water. In preparing stock A solution, calcium nitrate was added into the container containing tap water (pH 5.5 – 6.5) and stirred until it dissolved. Then, the solution was poured into a 100-litre vessel. Iron powder was added into another container that contained tap water, stirred until it dissolved completely, and then added into the vessel. The same procedure was applied in preparing Stock B solution. The irrigation solutions were prepared in a 1,500-litre tank. Stock A and Stock B were added into the tank at 1:1 ratio until the needed electricity conductivity (EC) was achieved. The EC of the fertigation solution was between 1.8 μS cm<sup>-1</sup> and 2.4 μS cm<sup>-1</sup>. The growth of the ginger plants was measured monthly by measuring the height of plant, the number of tillers and the fresh and the dry weight of leaves/shoot and rhizomes. The ginger plants were randomly selected and the rhizomes were harvested after 3 – 9 months of sowing to determine the yield and the growth of rhizomes. The weight was measured immediately after harvest to prevent desiccation and water loss from the rhizomes. Data obtained were subjected to statistical analysis using analysis of variance (ANOVA) procedures to test the significant effect of all the variables investigated using SAS version 9.1. Means were separated using Duncan Multiple Range Test (DMRT) as the test of significance at  $p \leq 0.05$ .

## III. RESULTS AND DISCUSSION

### 3.1 Plant growth performance

Table 1 shows the interaction of irrigation frequency and nutrient solution volume in relation to plant height, shoots and leaves biomasses and tillers number. There were significant different at 5% between each treatment in terms of plant growth performance after nine months of cultivation periods. Various combinations of treatments produced different results for each characteristic. The best plant growth performance was obtained from WF<sub>6</sub> × A<sub>3</sub> treatment. Experiment data showed WF<sub>6</sub> × A<sub>3</sub> treatment was the best parameter that provided good growth for ginger crop compared to other treatments. All plants that irrigated with 6 times per day resulted in higher plant height, shoots and leaves biomasses, and tillers number, followed by the media irrigated with a frequency of 4 and 2 times per day. Similarly, nutrient volume applied at 1,200 ml per day led to higher plant height, shoots and leaves biomasses and tillers number. The reason for this can be attributed to better water availability to the root zone. The plants attained the highest heights

in WF<sub>6</sub> x A<sub>3</sub> treatment but the lowest in WF<sub>2</sub> x A<sub>1</sub> treatment. Combination of 1,200 ml of nutrient solution and 6 times per day of irrigation frequency was the best parameter to grow ginger in the soilless culture system. Overall, irrigation restriction on the plant decreases the photosynthetic and the stomatal conductance levels that further, affecting the plants vegetative growth [10]. Previous studies have shown that water restrictions reduced the plant vegetative growth of pomegranate, olive and cherry plants [11]. Lower plant vegetative growth resulted in plant yield reduction. Since the root volume is restricted and readily available water quantity is low, frequent irrigation in small amount is required to maximize the crop productivity in soilless culture [12]. Therefore, irrigating 20 – 30 times a day may be necessary to maintain moisture in root zone in summer time, especially for rapidly growing crops [13]. Generally, delivering constant volume of nutrient solution during each irrigation and varying the number of irrigations are better than keeping the number of irrigations constant and varying the volume [14]. However, in some cases, frequent irrigations may reduce oxygen availability to plant roots owing to excessive moisture content in root zone [12]. The development and the quality of pomegranate fruits are also affected by deficient irrigation [15].

**Table 1: Effect of irrigation frequency and volume on growth parameter of ginger plant after nine months of cultivation period**

Treatment	Plant height (cm)	Shoot and leaves biomass (gm)	Number of tillers	Diameter of tillers	SPAD value	Number of leaves
WF <sub>2</sub> x A <sub>1</sub>	57 ± 2 <sup>f</sup>	560 ± 96 <sup>f</sup>	6 <sup>f</sup>	7 <sup>c</sup>	50 <sup>f</sup>	7 <sup>e</sup>
WF <sub>2</sub> x A <sub>2</sub>	77 ± 6 <sup>d</sup>	867 ± 130 <sup>d</sup>	9 <sup>e</sup>	8 <sup>b</sup>	52 <sup>e</sup>	10 <sup>c</sup>
WF <sub>2</sub> x A <sub>3</sub>	105 ± 11 <sup>b</sup>	1,120 ± 220 <sup>b</sup>	10 <sup>d</sup>	7 <sup>c</sup>	55 <sup>c</sup>	13 <sup>b</sup>
WF <sub>4</sub> x A <sub>1</sub>	60.5 ± 4 <sup>e</sup>	640 ± 109 <sup>e</sup>	9 <sup>e</sup>	8 <sup>b</sup>	52 <sup>e</sup>	8 <sup>d</sup>
WF <sub>4</sub> x A <sub>2</sub>	84 ± 8 <sup>c</sup>	885 ± 140 <sup>d</sup>	10 <sup>d</sup>	8 <sup>b</sup>	53 <sup>d</sup>	11 <sup>c</sup>
WF <sub>4</sub> x A <sub>3</sub>	114 ± 12 <sup>a</sup>	1,280 ± 240 <sup>b</sup>	11 <sup>c</sup>	9 <sup>a</sup>	56 <sup>c</sup>	14 <sup>a</sup>
WF <sub>6</sub> x A <sub>1</sub>	62.5 ± 5 <sup>e</sup>	680 ± 115 <sup>e</sup>	10 <sup>d</sup>	8 <sup>b</sup>	52 <sup>e</sup>	8 <sup>d</sup>
WF <sub>6</sub> x A <sub>2</sub>	86.25 ± 9 <sup>c</sup>	907.5 ± 123 <sup>c</sup>	12 <sup>b</sup>	8 <sup>b</sup>	54 <sup>d</sup>	11 <sup>c</sup>
WF <sub>6</sub> x A <sub>3</sub>	115 ± 16 <sup>a</sup>	1,360 ± 255 <sup>a</sup>	13 <sup>a</sup>	9 <sup>a</sup>	58 <sup>a</sup>	14 <sup>a</sup>
WF <sub>2</sub>	80.6 ± 7 <sup>d</sup>	849 ± 125 <sup>d</sup>	8 <sup>e</sup>	7 <sup>c</sup>	52 <sup>e</sup>	10 <sup>c</sup>
WF <sub>4</sub>	86.2 ± 9 <sup>c</sup>	935 ± 142 <sup>c</sup>	10 <sup>d</sup>	8 <sup>b</sup>	53 <sup>d</sup>	11 <sup>c</sup>
WF <sub>6</sub>	87.92 ± 10 <sup>c</sup>	982.5 ± 159 <sup>c</sup>	12 <sup>b</sup>	8 <sup>b</sup>	54 <sup>d</sup>	11 <sup>c</sup>
A <sub>1</sub>	60.5 ± 4 <sup>e</sup>	626.67 ± 78 <sup>e</sup>	8 <sup>e</sup>	7 <sup>c</sup>	51 <sup>f</sup>	8 <sup>d</sup>
A <sub>2</sub>	82.6 ± 9 <sup>b</sup>	886.5 ± 165 <sup>d</sup>	11 <sup>c</sup>	8 <sup>b</sup>	53 <sup>d</sup>	10 <sup>c</sup>
A <sub>3</sub>	112 ± 12 <sup>a</sup>	1253 ± 222 <sup>b</sup>	11 <sup>c</sup>	8 <sup>b</sup>	56 <sup>b</sup>	14 <sup>a</sup>

Mean values with the same letter are not significant different at  $p < 0.05$  Duncan Multiple Range Test (DMRT)

### 3.2 Rhizomes yield

Table 2 presents the interaction of irrigation frequencies and nutrient solution volume on rhizomes yield, and rhizomes to shoots ratio after nine months of planting periods. There were significant different between each treatment in terms of rhizomes yield after nine months of cultivation periods. The plants attained the highest yield from WF<sub>6</sub> x A<sub>3</sub> treatments. Plants from WF<sub>2</sub> x A<sub>1</sub> treatment gave rise to the lowest rhizomes yield. Irrigation frequencies of 4 – 6 times per day managed to give rhizomes yield above 1 kg provided the nutrient amount supplied were between 600 – 1,200 ml per day. Meanwhile, application of irrigation at 6 times per day resulted in better rhizomes yield regardless the nutrient volume. Similar results also were observed in the cherry tomato plant that resulted in the higher yield, the number and the weight of fruits with the application of 1,500 ml of water per day [16]. Overall, the highest irrigation frequency is more efficient for plant growth and yield regardless of the nutrient level, with four – six times a day and has significant effect on fruit yield compared to twice a day [17]. [18], stated that the frequency of fertigation has an important influence on plant yield. For crops grown in containers, it is important to consider the tendency of most root systems to grow gravitropically to form a dense layer at the bottom of the containers [4]. These conditions are able to create conducive growth area that increase aeration in the substrate and reduce drying of the surface by lifting the moisture higher up in the polyethylene bags. This increases the volume of the mix that is suitable for root development and improves access to moisture and fertiliser. This redistribution of moisture is perhaps one of the reasons for plants to have higher rhizome yield. The highest rhizome to shoots ratios were obtained from WF<sub>6</sub> x A<sub>3</sub> treatments. Increase irrigation frequency resulted in high rhizomes to shoots ratio. The lowest rhizomes to shoots ratio was obtained from WF<sub>2</sub> x A<sub>1</sub> treatment. The experimented data showed that water irrigated at 2 times per day reduced the rhizomes to shoots ratio drastically

compared to other 4 and 6 times of irrigation per day. The high ratio of underground biomass to aboveground biomass reflects that the roots were well able to supply the top of the plant with water, nutrient, stored carbohydrates and certain growth regulators [19]. These results were similar with the study conducted by [20], who found that ginger rhizome yield increased significantly when grown using soilless system.

**Table 2: Effect of irrigation frequency and nutrient solution volume on rhizomes yield and ratio parameters with different substrate and irrigation frequency.**

Treatment	Rhizomes yield (g)	Rhizomes to shoots ratio
WF <sub>2</sub> x A <sub>1</sub>	632 ± 11 <sup>k</sup>	1.13 <sup>n</sup>
WF <sub>2</sub> x A <sub>2</sub>	1510 ± 39 <sup>g</sup>	1.74 <sup>i</sup>
WF <sub>2</sub> x A <sub>3</sub>	3800 ± 75 <sup>c</sup>	3.39 <sup>c</sup>
WF <sub>4</sub> x A <sub>1</sub>	870 ± 24 <sup>j</sup>	1.36 <sup>k</sup>
WF <sub>4</sub> x A <sub>2</sub>	1240 ± 30 <sup>h</sup>	1.40 <sup>j</sup>
WF <sub>4</sub> x A <sub>3</sub>	4820 ± 87 <sup>b</sup>	3.77 <sup>b</sup>
WF <sub>6</sub> x A <sub>1</sub>	910 ± 28 <sup>i</sup>	1.34 <sup>l</sup>
WF <sub>6</sub> x A <sub>2</sub>	2290 ± 50 <sup>e</sup>	2.52 <sup>e</sup>
WF <sub>6</sub> x A <sub>3</sub>	5560 ± 98 <sup>a</sup>	4.09 <sup>a</sup>
WF <sub>2</sub>	1980 ± 48 <sup>f</sup>	2.33 <sup>g</sup>
WF <sub>4</sub>	2310 ± 55 <sup>e</sup>	2.47 <sup>f</sup>
WF <sub>6</sub>	2920 ± 65 <sup>d</sup>	2.97 <sup>d</sup>
A <sub>1</sub>	804 ± 18 <sup>j</sup>	1.28 <sup>m</sup>
A <sub>2</sub>	1680 ± 41 <sup>g</sup>	1.90 <sup>h</sup>
A <sub>3</sub>	4726 ± 82 <sup>b</sup>	3.77 <sup>b</sup>

Mean values with the same letter are not significant different at  $\rho < 0.05$  Duncan Multiple Range Test (DMRT)

#### IV. CONCLUSION

Irrigated nutrient solution 6 times per days is the best irrigation frequency to obtain high plant growth performance. Nutrient solution at 1,200 ml per day is the best amount to apply to the ginger plant. However, combination of 6 times per day of irrigation frequency and 1,200 ml of nutrient solution is the best parameter to grow ginger in the soilless culture system. The present study has shown that constant delivering volume of nutrient solution during each irrigation was able to provide conducive environment for root to growth. Otherwise, frequent irrigations can reduce oxygen availability to plant roots because of excessive moisture content in root zone. Water restrictions reduced the plant vegetative growth thus lowering ginger plant yield. There were significant different between each treatment in terms of rhizomes yield after nine months of cultivation periods. Combination of 6 times per day of irrigation frequency and 1,200 ml of nutrient solution was the best parameter to obtain higher ginger rhizome yield in the soilless culture system. Ginger plant showed positive rhizomes yield responding to application of irrigation at 6 times per day regardless the nutrient volume. Higher rhizome yield may be due to increase irrigation frequencies can create conducive growth area that increase aeration in the substrate and reduce drying of the surface by lifting the moisture higher. Application of 6 times per day of irrigation frequency and 1,200 ml of nutrient solution can be applied to obtain high plant growth performance and rhizome yield. The understanding of daily irrigation frequencies and nutrient solution amount allowed for consistency production of ginger rhizomes.

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# Heterotopic Pancreas In Gall Bladder Associated With Chronic Cholecystitis- Is A Rare Combination

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**Abstract-** Pancreatic heterotopia is a rare pathologic entity, previously reported in the stomach, duodenum & jejunum. The placement of ectopic pancreatic tissue in an organ outside the pancreas known as heterotopic pancreas. It is an embryological abnormality. Pancreatic heterotopia is discovered incidentally in 2% of autopsies. The etiology of ectopic pancreatic tissue is not yet clear. It is mostly asymptomatic & rarely gives rise to complications. Histologically identified outside the normal tissue without any anatomical, vascular or neural connection with the gland. Ectopic pancreatic tissue is most commonly seen in the stomach & duodenum, GB is a very rare location. We report here, a case of pancreatic heterotopia of the GB in an 45-year old female, suffering with right upper quadrant abdominal pain with a clinical diagnosis of chronic cholecystitis.

**Index Terms-** Ectopic, Pancreas, Gallbladder, Cholecystitis, Heterotopia.

## I. INTRODUCTION

Ectopic pancreas is an abnormality of embryological origin & is defined as the presence of pancreatic tissue histologically identified outside the usual anatomic site without any anatomical, vascular, or neural connection with the gland. Ectopic pancreas on the wall of the gallbladder is very rare. The first ectopic pancreatic tissue was described in 1729 by Jean Schultz in the ileal diverticulum & Klob first confirmed its histopathology in 1859 [1, 2, 3, 4]. Otschkin, in 1916, published the first case of pancreatic heterotopia localised in the GB, & since then, only 34 cases of HP in the GB have been reported in a review of the literature [1,2]. The incidence of pancreatic heterotopia generally ranges from 0.55% to 13.7% in autopsy series & 0.2% in laparotomy [1, 2, 4, 5, 6]. Few cases have been reported regarding the presence of ectopic pancreas in the gallbladder, most of them being an incidental finding after cholecystectomy for cholecystitis [6]. In this article, we report a case of heterotopic pancreas of the Gall bladder associated with chronic cholecystitis.

## II. CASE REPORT

A 45-Year old male presented to the department of General Surgery, Era medical college and Hospital, Lucknow. Our patient

presented with history of mild yellowish discoloration of the sclera & skin. On physical examination tenderness was noted in the right upper abdomen, no rebound tenderness was present, no medical or surgical history was present.

**Diagnostic assessment:** Laboratory results showed alkaline phosphatase, 106 U/L (40-129 U/L);  $\gamma$ -glutamyl transferase, 56 U/L (8-61 U/L); total bilirubin, 19.0  $\mu$ mol/L (0-18.1  $\mu$ mol/L); & bilirubin, 7.4  $\mu$ mol/L (0-7  $\mu$ mol/L) in patient's serum. Serum amylase level was 94 U/L (normal range: 28-100 U/L). Serum lipase was 34 U/L (normal range: 13-60 U/L).

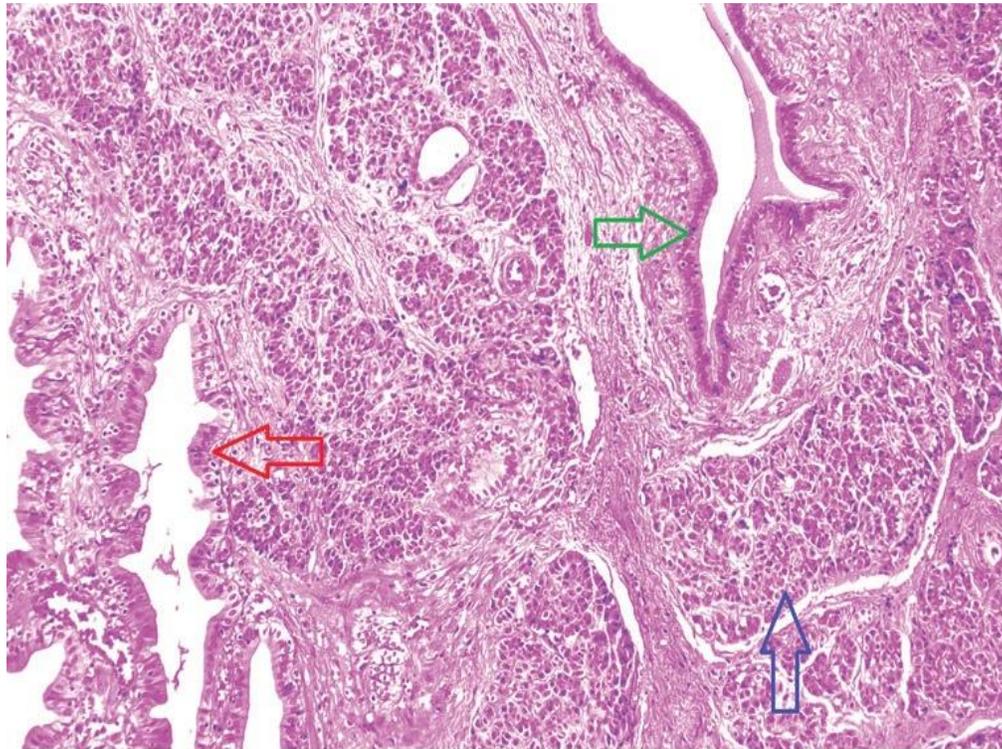
**Abdominal ultrasound** revealed multiple very small stones present in the lumen & minimal edema. A preoperative diagnosis of chronic cholecystitis was done.

## III. DISCUSSION

The ectopic pancreatic tissue commonly found in the stomach, (25-40%) duodenum (30%), jejunum (15%) & spleen; it is very rarely found in the ileum, liver, gallbladder, bile ducts, mesentery, lungs, & fallopian tubes [1,2,5,6,7]. Nearly 90% of the cases are located in the upper G.I.T [2]. In the ileum, the ectopic pancreas usually associated with Meckel's diverticulum, intestinal obstruction, or intussusception [7]. Only 34 cases of ectopic pancreas in the GB have been reported till now [5].

A review of 212 cases of ectopic pancreatic tissue in the Mayo Clinic found only one case in the gallbladder [8]. Ectopic pancreas can be diagnosed at all ages, although more frequent in male; however, a higher incidence of ectopic pancreas in the gallbladder is found in female [3]. Can occur in all age groups, but 50% of cases are found between the fourth and sixth decades of life [7, 8]. The embryologic basis of HP is unknown, but the theory of misplacement describes pancreatic tissue is deposited in developing areas of the GIT. Two additional theories are described in the literature [4,9].

**The misplacement theory** proposed that during rotation of the foregut, several elements of the primitive pancreas become separated & eventually form mature pancreatic tissue along the length of the GI tract & **The metaplasia theory** proposed that EP arises from areas of pancreatic metaplasia of the endoderm which migrate to the sub-mucosa during embryogenesis.



H&E Stain, 10X sowing: Surface epithelium of GB (red arrow), Pancreatic acini (blue arrow) , Pancreatic duct(green arrow).

Histologically, both exocrine & endocrine components of the pancreas can be found in pancreatic heterotopic sites, including full differentiation of the islet in one-third of cases [1, 2, 3, 6]. The most common symptoms include epigastric pain (78%), abdominal distension (32%), melena (25%), & vomiting (16%) [6]. Symptomatic lesions generally have a size greater than 1.5 cm [6]. Patients with ectopic pancreas may present with clinical symptoms of acute pancreatitis, peritonitis, cholecystitis etc [9]. Abdominal pain explained by inflammation of perilesional secondary tissue hormone & pancreatic enzyme secretion [6]. Soto et al. found high levels of amylase & lipase in bile. o pancreatic ectopic tissue present in the gallbladder. They proposed that exocrine activity might be associated with acute or chronic cholecystitis & the development of malignant lesions in the biliary tract [6]. Imaging studies used to evaluate the GB, such as USG, CT scan & MRI, usually cannot aid in the diagnosis of ectopic pancreas in the gallbladder, & the diagnosis is usually made on the basis of the findings on histopathological analysis [1, 2, 7, 9]. Lesions are macroscopically firm & round, with a size ranging from a few millimeters to centimeters [6]. 50% of ectopic pancreatic tissue is found in the colon & gallbladder & can be located in the mucosa, muscularis propria/serosa [3]. Microscopic examination can identify the presence of pancreatic tissue and classify it based on the modified Von Heinrich classification, as follows [6, 7, 9,].

Type I: Pancreatic acini with tissue, ducts, islets, and pancreatic gland.

Type II: Canalicular variant pancreatic ducts.

Type III: Exocrine pancreas with acinar tissue.

Type IV: Endocrine pancreas with islet cells.

In most cases, surgery is the treatment of choice not only for the presence of symptoms, but also for purposes of diagnosis & exclusion of malignancies [1,6].

#### IV. HISTOPATHOLOGY AND DIAGNOSIS

**Macroscopic examination:** Gallbladder measuring 76 mm x 24 mm. The wall thickness was 2.8 mm. Outer surface is grey white , cut surface showed focal ulceration & a single solid , whitish, nodule measuring 5.8 mm in the neck region. Thick bile & multiple tiny stones were present in the lumen. Multiple representative sections were submitted for analysis.

**Microscopic examination:** Sections from the tissue showed mucosa lined by tall columnar epithelium with basally placed nuclei & eosinophilic cytoplasm . Lamina propria showed foamy macrophages, underlying muscularis propria infiltrates by chronic inflammatory cells predominantly lymphocytes & plasma cells. Few congested blood vessels are also seen. Focal area showed well-circumscribed , aberrant pancreatic tissue consisting of acini & ducts forming lobules, these lobules are separated by thin septa. The acini composed of cluster of duct cells with apex projecting towards the lumen, these cells having basally located nuclei & basophilic granular cytoplasm. The ducts are lined by cuboidal epithelium. Our case was classified as type III according to the modified von Heinrich classification of ectopic pancreas . No evidence of dysplasia or malignancy was found in the sections examined.

#### V. CONCLUSION

Pancreatic heterotopia is a very rare entity, when it is located in the gallbladder wall. But with the potential to cause severe

symptoms sometimes attributed to idiopathic causes. Heterotopic pancreas can be mimic a tumor & lead to over diagnosis of malignancy. Pathologists should be familiar with this rare, incidental finding. A careful examination is needed to rule out potential complications & wrong diagnosis.

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# The Impact of the Advertising Discourse on Consumer Persuasion

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**Abstract-** This study examines the discourse analysis of advertisements and the nature of its impact on consumer engagement. Nowadays it is not wrong to identify advertising as a huge flow of information that happens endlessly. Support for marketing is the main purpose of an advertisement, but current advertisements support this purpose with themes of fantastic story concepts. By studying most of the advertisements, you can identify the various design effects that they contain. Looking at the many advertisements that can be seen in Sri Lanka today, it is clear that some of the advertisements have a very cordial relationship with the consumer. Among the various media outlets that advertise, television can be identified as having a special place. "So many advertisements adapted to new behaviors in Consumers. All the advertisements are Cultural values reconstruction to Consumers in other hand".(Liyanage, 2016) In the study of discourse, it can be seen that the concept can be well analyzed to study the impact of television media advertising on the consumer.

The primary function of an advertisement is to attract and retain both parties, whether interested or not. Although this process may seem simple at first glance, what is hidden here is a somewhat complicated but beautiful, exaggerated process. It is not wrong to call that process "beautiful" because it is an artistic stimulus. Advertisements are like a magician. This is because the bond that builds between certain advertisements and the viewer is sometimes not for the purchase of any product or service. But that bond is as complex as remembering a Brand Name. Sometimes advertisements remain in a person's memory as a work of artistic sensibility. It focuses on the unconscious preferences of the consumer as well as the way in which that motivation takes place through thought. It also investigates the consumer's thought process. It identifies how targeted groups and their tastes are activated in cultural discourse, individual discourse, and social discourse.

Discourse analysis deal with the effects of language, lighting, camerawork, color, background, music, animation, costumes, voice, actors and ect.. in advertising. "Main focus of discourse analysis is on language, it is not concerned with language alone" (Cook, 2001). Cultural and intercultural peculiarities of the language of advertising are also studied. We used the method of content analysis in this study. We based on Two selected advertisements from Sri Lankan Telecommunication Company Such As Lankabell in this analysis. The main conclusion of the study is that the discourse in advertisements has a powerful effect on attracting the consumer.

**Index Terms-** Advertisements, Consumer, Discourse, Impact, Persuasion,.

## I. INTRODUCTION

Discourse refers to a written or oral communication or such controversial discussion. The use of this discourse can be seen in the Discourse analysis and semantics. Discourse is a word that has a strong connection with semantics. In semantics, oral analysis is used to provide a more in-depth analysis of signs and meanings brought about by semiotics. Discourse analysis can be used in sociology, linguistics, a topology, social work, psychology, social psychology, international relations, as well as the study of human geography, communication studies, and translation methods. According to semantics, a linguistic unit is a discourse formed by a number of sentences.

The discourse of the philosopher Michael Foucault (Michel Foucault,1926) describes the sequence of objects and their hidden signs. (Arribas-Ayllon and Walkerdine, 2017) Foucault's theories primarily address the relationship between power and knowledge and the way they are used as a form of social control through social institutions. The word "discourse" is derived from the French word "Discourse" It simply means conversation, speech, and discussion. In the Oxford English Dictionary, discourse refers to "a long and serious discussion of a speech or text." (Oxford learner's dictionaries, 2020)

In society, people often live with commonalities about certain things as well as personal tastes. Sometimes those agreements are based on cultural factors, social factors, political factors, gender and such factors. It becomes these personal discourses. At the same time, the unconscious consensus that exists between individuals has influenced the creation of these discourses. It is through these agreements that individuals generate different social discourses, with different causes arising. Factors such as ideology and power influence the individual unconsciously.

In the study of media and communication, Discourse is interpreted as analysis, as any signaling that can produce meaning. Fair Claude (1995) states that discourse is constantly evolving in conversational content based on the language patterns of each medium, such as film, video photography, and television. Discourse is always built on the beliefs and tastes of certain human beings, as well as certain traditional beliefs. An in-depth examination of the word discourse reveals that it is, on the other hand, specific uses of language for social or psychological purposes. Ferdinand de Saussure - Dichotomy in the language introduced by 1857 is at the forefront of the discourse investigation. In that case Saussure discusses language in two ways: language as an authority of language itself, and the use of language. Discourse is then defined as the unique moments in the use of language. (Danesi, 2015)

A new thematic revival of discourse analysis began with the work of the Russian literary critic Mikhail Bakhtin (Bakhtin, 1981). Conversation is a definite expression of the discourse. It is governed by large social frameworks and belief systems that the individual shares, such as social class, gender, and so-called social variables. The language of these social frameworks can be identified as the form of discourse that imposes unconsciously. This is why one can interpret and analyze through academic discourse or sports discourse the language used to reveal the values, worldviews, beliefs, biases, etc. that are exchanged by certain individuals or groups. The discourse usually contains what is often heard and seen in the society in which the relevant verbs are used. The power of discourse is based on cultural preconceptions and the ability to exchange meanings within a text.

## II. ADVERTISING

Advertising is one of the most powerful means of communication in today's commercial world. It constantly carries a variety of marketing messages to the consumer. Different types of advertising can be seen to embellish that advertising message. Sometimes these ads are very artistically advertised in electronic or print media. The primary purpose of an advertisement is to somehow persuade the consumer to the relevant product or service. Selling to the consumer no matter what the need for the goods or services is.

These advertisements have unequivocally added that the decision-maker regarding the goods consumed by all human beings. Unilateral advertising represents the needs of the consumer. That's the ultimate goal of marketing. "Advertising is not just a business expenditure undertaken in the hope of moving some merchandise off the store shelves, but is rather an integral part of modern culture. It's creations appropriate and transform a vast range of symbols and ideas; its unsurpassed communicative powers recycle cultural models and references back through the networks of social interactions. ". (Leiss et al., 2005) may be due to the closeness between these ads and the human. Because it changes the consumer's thinking, albeit not completely.

## III. ADVERTISING AND DISCOURSE

As previously described, advertising can be identified as the primary form of promotion. " In his research book on written discourse in this regard, Bhatia, 2004 describes advertising as the "primary and most dominant" form of "promotion discourse" (Abdullah, 2016). Advertising discourse belongs to the category of intertextual analysis. Because most of the ads are themed. The simple meaning of the above is that advertisements are based on cultural facts as well as being imprisoned within frames that can greatly influence another such person. Various commentators have provided interpretations of what should be included in the intertextual analysis of advertisements as well as various works of art. Among them, Torres introduces the following six main functions in intertextual analysis. (Torres, 2015)

1. The phatic function of calling the viewer's attention
2. The reinforcement of the poetic function in the advertisement
3. The appropriation of the aesthetic value of the work of art
4. The appropriation of the prestige and authority of the work of art
5. The concealment of the advertising nature of the message
6. To supply the reader's pleasure in recognizing and/or identifying with the work of art

Advertising discourse is also inter discursive. Because it contains a variety of discourses. That is because advertisements address a person's class, background, and many other variables at different levels of the consumer. That is, by studying the text of an advertisement, one can study the social class, social background, politics and many other such variables. And the study of discourse depends entirely on the context. Because beyond the words that people speak through a conversation, it also includes the local knowledge that leads to it. Often, meanings that arise from an exchange of words cannot be simply quoted in verbal terms. There are many definitions of Authentic Communication that emerge from that conversation. It appears that the study of the meaning of words as well as the conversational information that is constructed by words can give a deeper understanding of the discourse.

Barnum (P.T. Barnum, 1810-1891), one of the earliest popular advertising designers, used extremely colorful language to attract consumers. There Exaggeration, Hyperbole and other language complimenting techniques were used to motivate the consumer. Those

words are by far the most popular vocabulary of advertising discourse used in advertising dictionaries. He cites the following as examples of that vocabulary. (Danesi, 2015)

- Don't miss this once-in-a-lifetime opportunity
- Limited edition at an unbelievable low price
- All items must go
- Not to be missed

Clear definitions by Barnum show that this rhetorical language is the basis of fan-friendly advertising. This mindset is sharply motivating people to buy products. He points out that there is nothing wrong with calling the identifiable consumer an ordinary person as well as an interesting one. It is sometimes easier to capture the consumer by evoking pleasure. "Other scholars have pointed out that this metaphorical language is the key to the success of advertising" (Goddard, 2001) In 1922, Walter Lippmann, a well-known journalist in the United States, points out that the growth of the media advertising culture has a profound effect on people's minds, politics, family relationships, interpersonal relationships, and the general worldview. (Lippmann, 1998)

As discussed earlier, advertising has a huge impact on convincing the consumer of many things. In analyzing the discourse, it is possible to compare and study advertisements with this persuasive process. The process of persuasion can be divided into four main parts. That is, understanding, accepting, changing attitudes, and retaining the message. (Hermerén, 1999) The idea can also be identified by studying the process of attracting consumers to an advertisement. Although it may seem that it is a personal choice of the consumer to buy or respond to advertising, which is the general process of making a product or service available to the consumer, most research has shown that the process is beyond the control of advertisements design. (Sedivy and Carlson, 2011) where the consumer's mental imagination has a powerful influence on the purchase of a product or service.

Because in the process of convincing the consumer of an advertisement, the consumer always fails to see the advertisement as an advertisement. It simply stays in the consumer's mind as information. Thus, advertisements, regardless of the form in which they reach the consumer, whether verbal or non-verbal, can be identified as a more critical media discourse because of its use of language and hidden ideology. This is because advertising is a part of our daily lives and it carries a lot of messages. "Consumers are engaged in the exchange of values, attitudes, and knowledge that have come into harmony with culture through advertising." (Abdelaal, 2014)

The reason for this can be pointed out that advertisements gather a lot of things in an advertisement at once. Among them goals, symbols, power, communication etc. are paramount. Today, the message of most advertisements is that it is impossible to separate them from the culture. Looking at the art of advertising in Sri Lanka, for example, it appears that the story concepts based on advertisements are largely nurtured by cultural storytelling. No matter what type of product you are selling, this is a good thing when you look at the ads. It's a sign of sharing at some point. Respect for a different cultural identity. It is a deep focus on an ancient cultural identity nurtured by folklore.

In this way a strong cultural tendency can be identified in the languages of identification. As a result, advertisements can be advertised in a very short and short period of time, but they can also lead to complex and interdisciplinary studies. "That advertisements are complex and interdisciplinary although they are very short and scanty" (Woods, 2006) and (Bloor and Bloor, 2015). The world generates a large number of advertisements daily. Advertising can be identified as being created to satisfy consumer demand as well as to create new needs for the consumer at other times. This is a somewhat complicated process that takes place when the consumer sees the ads being created and they buy the products or services. Discussion analysis can be used very effectively in understanding this hidden message and in identifying the impact it has on the consumer. This will give you an in-depth look at the processes that take place between the consumer and the product (Bloor and Bloor, 2015).

As researcher "Cook" points out, in order to understand the context of an advertisement, one must pay attention to the following elements.

1. Substance (The physical material which carries or relays text
- 2 music and pictures)
- 3 Paralanguage (voice, gestures, type and size of letters, etc.)
- 4 Situation ("the properties and relations of objects and people in the vicinity of the text, as perceived by the participants")
- 5 Co-text ("text which precedes or follows that under analysis")
- 6 Interest ("text which the participants perceive as belonging to other discourse, but which they associate with the text under consideration, and which affects their interpretation")
- 7 Participants: senders, addressers, addressees and receivers.
- 8 8. Function: ("what the text is intended to do by the senders and addressers, or perceived to do by the receivers and addressees") (Cook, 2001)

#### IV. CONNECTION BETWEEN DISCOURSE AND IDEOLOGY

There is also a connection between discourse and ideology. The irreversible relationship between this ideology and discourse in the consumer buying process can be understood. Several levels of analysis related to ideology and discourse can be identified, through

which the individual can "study how ideologies and discourse are constructed". Can point to several levels of its analysis in identifying ideology and discourse. (VanDijk, 1995)

Ideologies and discourse: Levels of analysis

### 1 Social Analysis

- Overall societal structures, e.g., parliamentary democracy, capitalism
- Institutional/Organizational structures, e.g., racist political parties
- Group relations, e.g., discrimination, racism, sexism
- Group structures: identity, tasks, goals, norms, position, resources

### 2 Cognitive Analysis

#### 2.1 Social cognition

- Sociocultural values, e.g., intelligence, honesty, solidarity, equality
- Ideologies, e.g., racist, sexist, anti-racist, feminist, ecological ...
- Systems of attitudes, e.g., about affirmative action, multiculturalism ...
- Sociocultural knowledge, e.g., about society, groups, language, ...

#### 2.2 Personal cognition

##### 2.2.1 General (context free)

- Personal values: personal selections from social values
- Personal ideologies: personal interpretations of group ideologies
- Personal attitudes: systems of personal opinions
- Personal knowledge: biographical information, past experiences

##### 2.2.2 Particular (context-bound)

- Models: ad hoc representations of specific current actions, events
- Context models: ad hoc representations of the speech context
- Mental plans and representation of (speech) acts, discourse
- Mental construction of text meaning from models: the text base
- Mental (strategic) selection of discourse structures (style, etc.)

### 3 Discourse Analysis

- The various structures of text and talk

Ideology and the tastes and dislikes of individual psychic activism in the context of narrative analysis point out the above. Maintains a strong connection with this activism for the creation of a discourse. Thus, it appears that the discourse guides the individual psychologically to interpret that social environment for the cognitions it perceives. The way in which a person's external as well as internal relationships work to shape that ideology. It also appears that social cognition also has a strong connection to the formation of discourse.

Ideology contributes to the formation of discourse in a variety of ways when dealing with team members in social cognition. "Social cognition is a definite system. Psychological representations and activities with team members, (Jordan, 2009) Television advertising is also a process of affirming these discourses as well as building new discourses. Here the discourse is produced by advertisements. They organize and create public discourses on the tastes, preferences, passions, identities, aspirations, values, etc. of the common people. The end consumer becomes a participant in the same discourse and receives the goods. It can sometimes be pointed out as a process that takes place unconsciously without the consumer's knowledge.

## V. TYPES OF DISCOURSE

"Explains how discourse and conventions work in a way that makes us aware of the uses of the television production process. (Fiske, 2009) What is clear here is how public social discourses become the discourse of the media and build broader social discourses in society. In semantics, this discourse and the person have developed a kind of activism associated with the absorption of sign symbols by the individual. It is possible to observe how a person absorbs signals according to the discourse created by the ideology built on the social knowledge and culture of the individual. There are also several aspects involved in discourse analysis. This discourse analysis

can be done in terms of tone, lyricism, gestures, syntax, vocabulary, beauty, aesthetics, idea, way of speaking, interactions, and strategy. There are also several types of discourse. Politics, media, education, science, business, etc. are among them. Also, discourse analysis can point out several key areas that are relevant at all times.

- Conjunction of terms
- The relationship between discourse and context
- The relationship between discourse and power
- The relationship between discourse and interaction
- The relationship between speech and cognition and memory

In creating the discourse in this way, several aspects of the discourse can be pointed out. Through this, the discourses that are created in the society can be identified as the activation of the psyche of the people. Discourse analysis is a deep and broad curriculum because many relationships work to build it. In this way different discourses are built in the media using different methods. Through this we can see the creation of these various discourses for the intervention of the public and private sectors of the society. Advertising can be introduced as an example. Through it, we can identify the motivation of the consumer by creating different discourses. There are also several methods of performing speech analysis. Basically the discourse analysis can be done as follows.

01. Conversational analysis
02. Psychological analysis  
(Memory and Attitudes)
03. Critical discourse analysis  
(Social Power)
04. Speech analysis

## VI. CRITICAL DISCOURSE ANALYSIS

Critical discourse analysis is especially important in the study of sign symbols, which are primarily associated with semantics. It is easy to understand consumer motivation through signal codes by analyzing the texts. Some of the key features can be pointed out in this way during critical discourse analysis. That is, (Meyer, 2001)

- 01 Critical Discourse Analysis (CDA) addresses social problems
- 02 Power relations are discursive
- 03 Discourse constitutes society and culture
- 04 Discourse does ideological work
- 05 Discourse is historical
- 06 The link between text and society is mediated
- 07 Discourse analysis is interpretative and explanatory
- 08 Discourse is a form of social actions

In this way the parties involved in the critical discourse analysis can be identified. This makes it easier to uncover the meanings behind the meanings of the deeper hidden passages. It also gives the ability to look at many of the objects that exist in social philosophy from a broader perspective. Text analysis of advertisements also has the ability to interpret invisible dimensions in depth. "Critical discourse analysis can uncover the hidden reality of hidden ideas. (McGregor, 2003) Discourse analysis in the language of advertisements can be done successfully, revealing basically invisible, unwritten, forms, social patterns, rules, functions, meanings and conventions.

Language speech analysis in an advertisement in a television commercial or any other medium also identifies the invisible signs in the text. Thus it appears that discourse maintains and interacts with the external and spiritual psychics of men. It is associated with wealth, power, politics, racism, gender, culture, and so on. Also the discourse may vary from person to person. Spoken analysis in the language of an advertisement will enable us to understand the relationship between the plurality of the unspoken meaning of the language and consumer attraction.

## VII. THEORETICAL FRAMEWORK

Studying the discourse of an advertisement cannot be done by focusing only on the language of that advertisement. This is because a set of creative features that nurture the language of advertising are integrated around the ad in order to deliver the language

interpretation of an ad more effectively to the consumer. It is difficult to analyze the discourse without studying its music, backgrounds, actors, voice acting and a host of other features. Isolation does not happen by studying only its text. Many scholars have expressed differing views on the issues to be considered in understanding the context of advertising. Meanwhile, in this research, the discourse in this ad is studied according to the note identifying the interactions of the elements of the advertisements pointed out by Cook. (Cook, 2001)

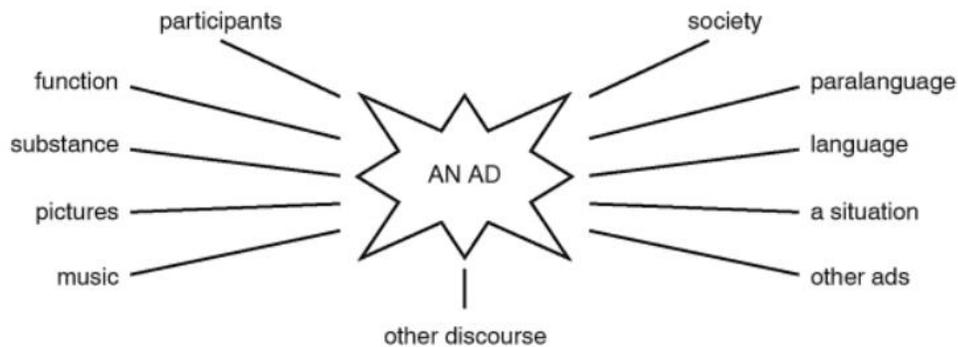


Figure 1: Interaction of Elements in ads

As he points out, all of these elements of advertising influence the consumer to understand the advertisements.

#### VIII. MATERIALS AND METHODS

The main research methodology based on this study is the content analysis methodology. What is being done here is to influence the advertising discourse to motivate the consumer? Is to study. It is a content analysis of selected 02 advertisements of Lankabell Telephone Services Company, a well-known telephone service provider in Sri Lanka. This content analysis is the most appropriate research methodology for this study. Content analysis is a method of communication. This content analysis can produce more effective results than all other research methods. The advertisements of this telephone service company are studied by dividing the content into categories as follows. That is,

1. Lighting
2. Camera
3. The use of color
4. Backgrounds
5. Edition
6. Animation
7. Music
8. Language
9. Voice
10. Actors and actresses

Etc. analyzes the effect of speech on usage. Due to these factors, a research methodology called content analysis is used for this study. When studying the discourse of a visual media advertisement on the contribution of the consumer to the market, it is difficult to do so without paying attention to the visual imagery as well as all the technical and creative effects used, from the language used in the advertisement. Therefore, it is very difficult to understand the linguistic interpretations of its contents if its subtle uses are not well studied. For this reason, content analysis is one of the most important research methods that can be used to study the discourse of advertising in a systematic and clear manner. Through it, the semantic study of these advertisements can be done well. The linguistic diversity of the selected advertisements of this telephone service company, as well as the meanings conveyed by it, are perfectly as well as accurately grasped.

IX. DATA ANALYSIS

Sample 01

Lankabell Telephone Services Company -01

Identifying the Discourse of advertising  
Slogan – “People in our country are different”  
Summary of Advertisements (Shots)



Figure 01– Selected Lankabell advertisement

Source - <https://www.youtube.com/watch?v=ZALZluWNgKg>

- Carrying an elderly grandfather on a bicycle

These ads start with the sound of a bicycle bell ringing. A sandy road in the middle of a paddy field. A young man riding a bicycle on that road. An elderly grandfather also walks in the same footsteps. Eventually the young man on the bike passed Grandpa, turned around, and Grandpa kept the bike and rode on.

Here you can identify the use of language for advertising and how it has a conversational effect on the consumer.

Here is the transcript of the ad:

Young man – “Come on uncle climb”

"People in our country are different from the rest of the world."

We at Sri Lanka Bell respect that change

It expresses semantics has greatly facilitated the use of the entire language.

“Enna maame naginna” Come uncle – get on (to the bicycle)". There are many symbols that are evoked by that word. The reciprocal respect of those rural elders is a fine milestone. That statement is an appeal made with respect and The use of all other technical and other creative effects in the study of the use of language for this advertisement and the way in which sincerity. Feelings of intimacy, respect, and so on are evident in those words. The concept behind all the design effects of the ad seems to be a successful way of bringing the ad closer to the consumer or viewer. "Maame" (uncle) is a beloved and respected address in the village.

The young man returns to pick up the old man on his bicycle after passing him. The signal that it also evokes is the recollection of a human being who is about to be forgotten or missed. That is unforgettable. Then the phrase in the background of the ad reads, "People in our country are different from the rest of the world." There are a lot of signals that are highlighted through that phrase. It stimulates unconscious desires directly through the signals to the viewer. This leads to a broader discussion of how people in our country are different than the rest of the world. There has been some reminder throughout the ad about that change. This phrase in the ad then generates a variety of semantics for the consumer about the difference. The meanings generated about "difference" are as follows.

Our country is different from other countries in terms of cultural values and ethics, commonality instead of selfishness, mutual support and culture is not degraded. These words evoke a variety of signs, such as social norms, superiority, and mutual respect. Through it, attempts have been made to constantly awaken the underlying attitudes and feelings that exist in the thinking of the individual. The multiplicative ideas created by words constantly evoke multiple connotations through different thoughts. Images, backgrounds, etc. are all semantic curves that are evoked by this language.

The ad then goes on to say, "We respect that change, Sri Lanka Bell." The ad, which honorably introduces the uniqueness of Sri Lanka among rest of other countries, highlighting the cultural moral and values of the country, then goes on to say, “We (Lanka bell – company) respecting that uniqueness”

Advertising can also be introduced as an advocate for image development. That is to say, the Lanka Bell Telephone Service Company has always respected these social ethics as well as such good deeds. The last appearance in the consumer memory pre-built by the ad is the second one that respects the values, customs and traditions associated with it.

The name states Sri Lanka Bell. The only thing that the trading company can say about its name and image through the cultural, social and personal meanings that are spontaneously created in the psyche of the individual is that Sri Lankabell respects that change in our country where people live full of humanity that is not found in other countries. In this way, the sign system that is built through it can be identified as the construction of the signs of the individual psyche in various ways.

It identifies the conversation that is building in the minds of the consumers about Lankabell Telephone Services as follows. It is seen as a trading company that respects all aspects of life, such as customs, mutual respect, and mutual support. Differentiation is a choice to be remembered in the consumer psyche. Then the brand name Sri Lankabell appears on the screen. This implies that the service company that built the image through language is Sri Lankabell.

The main light used for advertising is natural light. No artificial light was used for advertising.

Signs such as reality and vitality are created in the viewer's psyche, and those signals subconsciously influence the consumer to look at the ad for a moment or a realistic impression. What can be identified here is a distant image. It is the only image frame used for advertising. The connotations brought about by that usage diagram can also be identified as follows. The medium distance image used is intended to capture the consumer's attention and attraction of this advertising opportunity.

Unconsciously, the viewer's attention is filled with curiosity as to what this event is all about. This screenshot has been used to capture that attention. It is also expected to provide the viewer with a description of the relevant environment through it. Also, the general angle used for this purpose shows the mental preferences of the person.

Green color backgrounds are used for the ad. It is colorful with natural light. Under the natural light, the green color illuminates a serene, quiet and rural environment. There are a number of signals that are highlighted by the green color. The color green signifies fertility / hope / life / confidence / life / rurality. The consumer who sees the green color of the advertisement in a way can receive these signals in his mind at a certain moment and see that there is an unconscious connection between the advertisement and it can be pointed out as a process that never happens on purpose or on some knowledge.

Its special feature is that the green color that is scattered throughout the entire background of the advertisement is constantly illuminated by the sun. It also identifies how the ad signal is further stabilized. In addition, the sky is blue and white. It is also the natural color of the sky.

The backgrounds are used to give a good cultural identity to the advertisement and the backdrop of the paddy field and the mountain range where the paddy field ends. It is also a sandy road that runs through the middle of the paddy field. All of this contributes to consumer attraction as well as semantic stimulation. Rural environment, fertility / self-sufficiency The natural beauty gives the impression of being rural / remote from the city, sand road village / undeveloped urbanization etc.

Advertising music is also used as background music. It's a song with a deep voice that says 'or ... or ...'. Music can also be used to identify the meanings that sound in attracting the consumer to an ad. Sensitivity can be identified as a way of constantly evoking signals such as friendliness as well as pride. Use of the voice for this advertisement is powerful for the signals conveyed by the language. The use of voice addresses the heart. Through it, the concept created by the advertisement is brought to the heart of the semantic person who is reminded of the advertisement in the psyche of the semantic person who brings it. It also confirms that the voices used for youth have different meanings.

The use of the young man's voice conveys subtle connotations such as rurality, heart feltness, intimacy, and conviction through the use of the voice of the background announcement. From the young man's statement, the consumer is born with the attitude that he is a hearty man who grew up in a rural environment as well as a village. Also, the signals brought by the visual alarm are confirmed by the use of the background announcer voice.

The costumes used for the actors in the commercial can also be used to identify cultural meanings. The ideas evoked by the costumes used primarily for the young man and grandfather can be identified as follows. Grandpa's dress is a white sarong, vest, and umbrella. This also means rusticity / simplicity. The youth's clothes also illustrate the subtle urbanization of the village.

Popular actors are not used to advertising. Just because they are not always a TV presenter and a representative of the star concept, it also makes sense that their role in advertising is also brought to the consumer. The young man represents the modern generation and he portrays realism as well as indelible human traits. Grandpa interprets the depths of the older generation. Not only are these actors unpopular, but their use can also be seen as a sign of two generations of difference. They can also be pointed out as being unknown actors, contributing to the viewer's realization and generalization of the event.

## X. ANALYZING THE DISCOURSE BY ADVERTISING

### 1. *Cultural discourse*

The cultural discourse is constantly interpreted throughout the ad. Cultural discourse constantly signals cultural emotions through these visual images. That is, the old village, the paddy fields, the mountains and the sand road, as well as the people who live in it, are all culturally and strongly intertwined with the cultural discourse throughout the whole ad.

Cultural discourse constantly signals cultural emotions through these visual images. That is, the old village, the paddy fields, the hills and the sand road, as well as the people who live in it, have all become discourses that are strongly associated with culture. The visuals in the ad are reminiscent of that discourse. Through it, we can see that the feelings and satisfactions associated with the culture in the minds of the consumer group are gradually expressed.

The advertisement is committed to saturating the consumer spirit by portraying the unity of the people's thinking about culture as well as the background of the village culture. Paddy field is a standard symbol of culture. It is the standard symbol that beautifies the symbol of the village. Its sandy roads and boundless mountains are all concepts that the person unconsciously saturates in the cultural discourse.

Language further reinforces each cultural discourse. "We" is the absolute unity of culture. Respect is also a cultural thing. All words and background are related to culture. It's something that has been around for a long time through the standard cultural discourse.

Advertising has also given a powerful opportunity to the group interactions that are represented in the rural culture. Through it, patriarchy and values have been well expressed through cultural discourse.

### *II. Personal discourse*

It is possible to identify how personal discourse has also influenced the semantic study brought by this advertisement. Here the viewer is connected with personal knowledge, opinions and preferences. In advertising one can study the semantics that characterize public social life and mutual respect. It describes the "ability to take care of a man" that can be identified in personal discourse. It involves the young man riding his elderly grandfather on a bicycle. It also gives a signal of masculinity. It is related to the thinking of the man in the social discourse. In this case, the power, strength, etc. of the man is unconsciously expressed by this. It also confirms the common social thinking, the discourse on the "youth of our country".

This personal discourse can also be understood through personal values and attitudes about groups and personal knowledge. The young man rides his grandfather on a bicycle because it comes to his mind that he should do such a thing. The same conversational effect occurs subconsciously to the viewer of the ad.

### *III. Social discourse*

Here, the focus on external social relations as well as the absence of racism or religiosity all appear in the semantic study of the social discourse of advertising. In this case, the advertisement is an attempt to force the essential desires of the socially living person into the minds of the consumers. The language as well as the background confirms the authenticity of the values of this village life and motivates the consumers. This social discourse has also been instrumental in signaling that "the people of our country are different." Living in groups and supporting others when the opportunity arises are the social discourses that this add focuses on

#### Sample 02

Lankabell Telephone Services Company -02

Identifying the Discourse of advertising

Slogan – "People in our country are different".

Summary of Advertisements (Shots)





Figure 02 – Selected Lankabell advertisement

Source - <https://www.youtube.com/watch?v=AF14-Zoaj5g>

- Giving a king coconut to a guest who came to hear the road A rural woman sweeps the yard.

An adult walking on the sand road asks a woman about the road to school in Hiripitya (a name of the rural village). The woman then re-examines the question asked by the adult from her husband inside. Her husband tells the adult on the way to school. The adult leaves. The woman's husband then brings a king coconut and declares to the adult that he is tired and presents it.

The concept behind this ad is as follows: Its design uses and technical applications can be categorized as follows. In the analysis of the advertising discourse, more attention should be paid to the language used for it.

Here the language is used as follows.

Version:

Old man – Please tell me the way to school in Hiripitya?

Woman: Hey... (Calling her husband) (This person) asking the way to school in Hiripitya

Husband – As you continue along this road you will come across a narrow road at the top of the lake. The school is located there.

Husband - "This man looks like very tired"

Woman: "Hey uncle ... Let's go having drink a king coconut"

The manner in which the language is used in this advertisement can be used to identify the semantic validation given to the consumer or audience attention by all the technical and design effects that are built into it. The first linguistic expression is made by the woman. That was after the adult secretly asked for something. She then addresses the issue directly to her husband. That's the problem Hey... (Calling her husband) (This person) asking the way to school in Hiripitya

In this way, the mutual understandings of the rural family corporation are beautifully symbolized. The woman who does not answer the question asked directly by the stranger refers it to her husband. There "mē...". (Hey..) (Can be seen addressing her husband with the word. It can be traced back to a number of references to the way of life of the rural population. There are a number of signals that are highlighted by "mē...". Through it, affection, as well as the form of rural addresses, etc., are evoked even in that letter. It also shows humility). Then her husband in the house answers,

"As you continue along this road you will come across a narrow road at the top of the lake. The school is located there."

That answer is very restrained. Enthusiasm is also done to provide a clear and accurate description of the path through it. The adult then nods and leaves. Eventually the woman's husband approaches the man from inside,

"The man looks very tired"

He also holds a king coconut in his hand. There are several connotations in this statement.

“That man is looks like Very tired”

As well as focusing on each other's feelings, the semantics of care are implied. If one feels the fatigue of another, it is a representation of a heartfelt relationship. Through it, the signals of human emotions are constantly evoked.

"That man ..."

Is the closest term in a rural environment? The signals it brings are also multifaceted. The language of this mutual understanding in the representation of society as individuals also transcends human meanings.

The woman then addresses the adult.

“Hey uncle ... Let's drink a king coconut”

It's a very heartfelt word. The sentence ends with let's drink ("Yamu".)

The interpretation it brings is an attempt by the word let's drink (yamu) to evoke feelings of cultural discourse. Unselfish feelings, Hospitality, empathy, rural coexistence. Etc. This ad is also based on the heartfelt rural address of "Uncle". Then you will see the ad text. “People in our country are different from the rest of the world”

That's it. It also generates various signals. Full of hospitality, People who are unselfish, devoid of heartfelt empathy, who know the sorrows and fatigue of others Unselfishness indirectly awakens the disdain for the analysis that the people of Sri Lankans are recognized as a nation with the hospitality.

Etc. This advertisement explains the difference between Sri Lankans and people in other parts of the world. It validates and stimulates semantics through visual imagery. The ad then generates signals by posing as its service provider.

"We respect that change, Sri Lanka Bell"

Builds the image of their service organization by declaring Visual imagery makes a powerful contribution to that category of language. There are a lot of signs building up there. That is, among the signals brought for the image of the relevant merchandising agency,

It signifies that a service company is full of hospitality, mutual help, and friendly so on. It is a tactic used for image development. The relevant brand will then appear on the screen at the end of the ad. Fully natural light is used for advertising. The main signal that it brings is that it is natural. That is, it is able to make this a reality in the minds of consumers.

Basically a medium distance image is used here. It is the only image frame used for the entire ad. The use of this medium distance image helps to draw the consumer's attention to the overall story context of this ad. It also aims to give the consumer some insight into what is happening in the background.

Also a normal angle image is used here. It also signals the need to focus on an event the most commonly used colors for advertising are green, yellow, blue and brown. Natural light introduces these colors well. At first glance, the signal generated by this is a signal that a village has a beautiful environment. And the use of these colors in advertising has a lot of signals. You can see how the color green has always been a priority in the background. The color green allows the consumer to subconsciously detect the evocation of live emotion signals about the scenes he or she is seeing.

The brown color amplifies the signals brought by that blue color. That is because brown further substitutes naturalness for the background. People are also concerned with unconsciously engaging with these colors and further unconsciously motivating the consumer through the signals it conveys.

The advertisement used is for the front porch of a village house and the lake in front, the mountains as well as the large sky background. There is also a sand dune in the background. All of these backgrounds evoke semantics, thereby attracting the viewer or consumer to the ad. The fertility / rurality / stump (stump in Sri Lankan village culture is a barrier in front of the house like the gate)

Considering the cultural and ethnic values, this hut consists of two or three main timbers and most of the ancient Sri Lankans have communicated definitively by the way the wood of the hut is laid down, communicating that the occupants of that house are present at that moment in the manner in which one all (two) of the hut is lowered), Evokes a person's preferences for being resident, rural and non-urban, etc.

Also, the countryside by the mountain range evokes desires for rural beauty. In this way, the context itself can be seen to generate a conversational bond through nonverbal communication. The consumer unconsciously interacts with each of these background elements. The semantics evoked by advertising influence the unconscious tendencies that exist in the mind of every person about such things.

During the use of advertising music, the music blends with the use of a deep voice, such as "or ... or ... or ...". The voice used for the actors in this voice is used with a rural touch. Signs such as rurality / intimacy, sincerity, intimacy, trustworthiness, persuasion, etc. are generated. The woman's accent signifies that she is a very rural, heartfelt wife.

She also recognizes her husband's voice as being heartfelt and intimate with his wife. This advertisement generates a sense of authentic, beautiful, mutually respectful life in a married life in a rural environment. The use of this voice has also confirmed the concept brought about through visual imagery. Advertising generates semantics through visual imagery and characters' expressions.

And the use of clothing for advertising models most semantics are excited. There, primarily the focus on this rurality has been on the use of clothing in a way that highlights the more affirmative signs. The woman wears a cheeththa on top of the gown (Cheeththa is a piece of cloth worn by traditional Sri Lankan village women) which gives the impression of a traditional rural woman. The man wore a sarong (a men's suit) and the way the blanket is pulled also depicts a grim look. The adult is wearing a white sarong, a white shirt, a bag and an umbrella. They give the signal that this adult is a traditional but genuine person. Actors and actresses who appear in commercials are not very popular at the same time. Built through it, the fact that all of these people are characters that are not regularly seen on television at the same time has also greatly influenced the realism of advertising. The signal it brings is that this description is a genuine as well as a regular occurrence in a rural environment.

## 2.1 ANALYZING THE DISCOURSE BY ADVERTISING

### A. Cultural discourse

Throughout this ad, there is a constant flow of cultural discourse. Cultural discourse broadly analyzes the cultural elements contained in the entire ad. The lake and the rural environment, the sand road, all these are the way a person thinks about the cultural and rural environment. This lake shows the close connection of the rural people with the village. There, the context of the ad itself repeatedly interprets that cultural discourse. At the same time, visual imagery also unconsciously works to assert that cultural discourse.

At the same time, the language used in the advertisements pays close attention to the thoughts and aspirations of the rural people who grow up in such a cultural environment. It also analyzes the cultural discourse on rural life and their aspirations, with respect for each other by the rural people. Also, words like 'Uncle, let's drink a king coconut' further confirm that cultural discourse and make it more realistic about the signals it evokes. In this way, the cultural thought patterns and cultural discourses that have been built up in the individual psyche over time can be well explained. The cultural discourse of the general society is recreated through the visual images and language of this advertisement and the semantics are evoked through it.

### B. Personal discourse

Here we can identify a further confirmation of the discourse on rural women and men. That is, a traditional woman appears here. She is a Vanni who is constantly protected under patriarchy and the care of her husband. When the adult asks her for directions, she refers the issue to her husband. Among the features represented by her there,

- A woman should live a life of constant male care.
- Nothing should be done without the permission of the husband.

The thought of femininity in the personal discourse is well illustrated. That is the zone of action of the traditional woman. "He is asking the way to school in Hiripitya" It is because of that patriarchy. It's a sign that she's still living under protection. Also, the woman tells the adult to drink the orange only after receiving some encouragement from the man. All of this is the standard discourse of the rural community about women. At the same time, the standard male image of the society is also explained by the personal discourse. That is, the man is a powerful person who must protect and care for the woman. Here, the standard discourse on the man also generates semantics unconsciously. In addition, personal values and attitudes towards groups also play a role.

### C. Social discourse

The focus here is primarily on external social relations. Ideas about the social thoughts that the unconscious person has are well signaled here. The phrase "that man is looking very tired" implies the external social connections that can be identified in this social discourse. This social discourse focuses on the needs of individuals as well as mutual understanding in this unique external society of the Sri Lankan people. This social discourse also focuses on the group life, the inclination towards it, and the feelings for a collaborative life.

## XI. CONCLUSIONS

In order to attract the consumer, the discourse of the advertisements have a strong influence on the language meanings. Nor can the study be done in terms of the words used for the language of advertising in the study of the narrative analysis of television commercials. This is because the language of an ad always works by blending with the overall technical effects as well as the design effects used for it.

The consumer who grasps the ad forms an unconscious bond with the ad through the narrative analysis that builds on the impact of its creative features. There, different groups of people, their way of thinking, and their social class as a whole are associated with this conversational process. Words used for the language of advertising also have phrases that have a sensitive, cultural identity that most people remember. Even if the product or service is not purchased, the brand or through it is deeply remembered.

Through the use of such story concepts, advertisements can socialize even the most valuable socio-cultural values. The illusion can be retained in the ad by presenting it through semantics rather than directly. It is a fairly complicated process. Also, in television commercials, interpreting advertising concepts with traditional values gives the consumer an in-depth socio-cultural and economic discourse.

Love, compassion, kindness, and sharing, as well as nationality, are still ingrained in the hearts of the people. If an advertisement conveys the concept of modernity through traditional values such as human qualities as well as well-being and aspirations, the consumer will be more attracted to those advertisements. Also, presenting the ad story through methods such as rurality, such backgrounds, music, etc. is the most effective way to motivate the viewer to do so.

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# Impacts of Climate Change and Variability on Smallholder Dairy Cattle Production in Bungoma, Kenya

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**Abstract:** Climate change is becoming one of the most serious challenges to Kenya's achievement of its development goals as described under Vision 2030. Kenya is already highly susceptible to climate-related hazards, and in many areas, extreme events and variability of weather are now the norm; rainfall is irregular and unpredictable; while droughts have become more frequent during the long rainy season and severe floods during the short rains. Dairy farming is highly sensitive to climate change and variability, and rain-fed agriculture systems, in particular, are especially susceptible to unpredictable weather. Agricultural production is intricately linked to animal feed provision and hence, small holder dairy herd productivity. Small holder dairy farming faces a high risk of reduced productivity resulting from extreme weather occasioned by climate change and weather variability. Therefore this study sought to determine the impacts of climate change and variability on smallholder dairy cattle production in Bungoma, Kenya. Data were analyzed using both quantitative and qualitative data analyses approaches. Quantitative approach was descriptive, where frequencies and percentages were used. Correlation analysis was conducted to show the relationship between rainfall (mm), temperature (oC), dairy cattle population and milk production (kgs.) in Mt. Elgon, Tongaren and Kimilili sub counties. The finding indicates that there was decreasing acreage under fodder and pasture production. Farmers owned less than 5 dairy cows that produced a daily average of 5-8 litres and 2-5litres per cow during the wet and the dry season respectively. During the dry season, farmers used preserved feed, crop residues or feeds purchased from neighbours. While the tick borne diseases, pneumonia and lumpy skin incidences had increased in the county, foot and mouth disease had decreased during the past ten years. Extreme weather changes especially dry spell was associated with increased incidences of tick borne and Foot and Mouth diseases, shortage of feed resources and reduced milk production in the three study sites. Changes in climatic patterns especially the decreasing dry spell, droughts, and unpredictable precipitation has contributed to increased livestock diseases incidences such as East coast fever, foot and mouth diseases, shortage of feed resources hence, increased cost of food and feeds, and overall reduction of milk production in the Bungoma County. Therefore, there existed a significant relationship between the changing climatic patterns and smallholder dairy herd productivity in the county. Climate change and variability effects are on great increase and quickly eroding the gains of dairy technologies adapted in the recent times in the county to boost smallholder dairy cattle production in the county. The study recommends on both policy formulation and investment adaptations by the county government to address to minimize losses and damages incurred by smallholder dairy cattle farmers, occasioned by increased frequency of extreme rainfall over the three sites.

**Key words:** *Climate Change, Variability, Smallholder Dairy Cattle, Bungoma County, Kenya*

## 1. Introduction

Dairy farming is highly sensitive to climate change and variability, and rain-fed agriculture systems, in particular, are especially susceptible to unpredictable weather. Agricultural production is intricately linked to animal feed provision and hence, small holder dairy herd productivity as discussed by Volenzo (2013). Kenya has a long tradition in dairy production which was mainly non-commercial milk production from the indigenous cattle (zebu). The commercial dairy industry in Kenya dates back to 1920 when white settlers imported purebred dairy cattle from Europe. The commercial dairy farming developed in two distinct phases. Firstly, large-scale dairy farming that was on farms operated by Europeans on the Kenyan Highlands; and secondly from the 1950's on African smallholdings (Ishaya & Abaje, 2018). It is, therefore, important to evaluate the impact of climate change on smallholder dairy herd productivity in Bungoma County which strives to reduce poverty levels and prevalent food insecurity situation in the current climate.

Climate change is becoming one of the most serious challenges to Kenya's achievement of its development goals as described under Vision 2030. Kenya is already highly susceptible to climate-related hazards, and in many areas, extreme events and variability of weather are now the norm; rainfall is irregular and unpredictable; while droughts have become more frequent during the long rainy season and severe floods during the short rains. The climate is changing and that this change is different from natural variability. They identified variation in rainfall patterns reflected by a change in distribution, duration, and amount of rains as the key indicator of climate change; participants also cited temperature change, but less often, with most farmers referring to an increase in temperature (Ishaya & Abaje, 2018).

In Kenya, climate change and variability are evidenced by irregular and unpredictable rainfall, intense downpours, rising temperature and generally extreme and harsh weather (GOK, 2018). Since the 1960s both minimum and maximum temperatures have been on an increase or warming trend (GOK, 2018). The maximum temperature has generally risen by 0.7-2°C and the minimum by 0.2-1.3 °C depending on region and season (GOK, 2018). Western Kenya has had an increase in temperature of 0.8 -2.9 °C (GOK, 2018). Total annual precipitation projection in the country suggest an increase of approximately 0.2- 0.4 per cent per year (NCCRS, 2010). The country experienced major droughts every decade and minor ones every three to four years (Mutimba et al, 2010; NCCRS, 2010; KMD, 2018). The change in climate has a mainly adversarial impact upon agricultural production because it affects climatic factors such as temperature and precipitation (Muchemi 2015; Barasa et al., 2015).

Small holder dairy farming faces a high risk of reduced productivity resulting from extreme weather occasioned by climate change and weather variability. Overall, dairy products yields may fall by 10 to 20% to 2050 because of warming and drying, but there are places where yield losses may be much more severe as indicated in the Agricultural Sector Development Support Programme (ASDSP) Report (Bungoma County Government, 2014). The annual milk production is estimated at 97 Million litres, and is mainly produced in the upper sub-Counties of this County mainly Tongaren, Kimilili and Mt. Elgon (Bungoma County Government, 2018). Bungoma County is food insecure and also records a poverty index of 52.9% compared to the National index of 46%, while the food insecurity stands at 43%, KNBS (2010). Many families in the County take one meal a day, in contrast to the recommended three meals per day (UNICEF, 2019).

With the fast-growing demand for milk and other dairy products resulting from increasing population and urbanisation, the dairy industry in Bungoma has great potential to enhance the generation of household income mainly among smallholder farmers as well as to create employment opportunities for the local population. Livestock and in particularly dairy farming is critical in the county with income generated from the sale of dairy products and livestock accounting for about 31% of the total household income Bungoma County Government (2018). Among other challenges facing the smallholder dairy in Bungoma County are climate change and

variation related that have contributed to the high cost of dairy cattle herd production. The low dairy herd productivity in East Africa is attributed to limited use of production technologies and inadequate exploitation of the existing environmental influences. Mapiye *et al.* (2016) alluded that the low quantity and quality of feed resources affected the productivity of dairy animals in sub-Saharan Africa. It is because of the above that the current study sought to evaluate the impact of climate change and variability on smallholder dairy cattle production in Bungoma, Kenya.

## 2. Literature Review

In Bungoma County, the annual milk production is estimated at 97 Million litres, and is mainly produced in the upper sub -Counties of this County mainly Tongaren, Kimilili and Mt.Elgon. The livestock sector in Bungoma County comprises the following sub sectors; dairy, poultry, beef pig, sheep and goat, beekeeping, rabbit, emerging livestock and donkey production Bungoma County Government (2015). Dairying refers to rearing of dairy animals purposely for milk production with the main aim selling milk to the consumer (IDF, 2014).

Animal products contribute substantially in stabilizing the food security trend in the rural poor for their daily survival (Van jink & Wilkes, 2015). From exotic breeds totalling 129,000 and with 30% in lactation, Bungoma County produces 270,900 litres of milk daily with another production of 75,795 litres daily from the zebu breeds.

Dairy farming is vulnerable to climate change through increased temperatures and changes in rainfall patterns. These factors affect feed and water availability, animal health and breeds, and in turn milk production. Warmer and drier conditions increase the likelihood of heat stress in cattle. Heat stress adversely affects reproductive performance in dairy animals (Bruckner, 2018). There is normally a decrease in milk production for cows under heat stress (Bruckner, 2018). Changes in rainfall patterns affects pasture growth patterns thereby affecting the quality and quantity of both feed grains and fodder produced outside dairy areas. Droughts lead to water shortage which in turn leads to a decrease in milk production (Kasulo, et al., 2012).

The low dairy herd productivity in East Africa is attributed to limited use of production technologies and inadequate exploitation of the existing environmental influences. Mapiye *et al.* (2016) alluded that the low quantity and quality of feed resources affected productivity of dairy animals in sub-Saharan Africa. There is also ample evidence that climate change and variability has an impact on livestock disease prevalence (BCDP, 2013). Gale, *et al.*, (2018) gave three examples of disease outbreaks that are believed to be related to climate change: the unprecedented spread of avian flu; the rapid spread of bluetongue across Europe; and the spread of Rift Valley Fever in parts of Africa which resulted from severe floods. The other consequence of climate change has been highlighted as increased risk that geographically restricted rare breed populations have due to climatic disturbances (Fosu-Mensah, *et al.*, 2010).

Breeding goals may therefore have to be adjusted to account for higher temperatures, lower quality diets and greater disease challenges. Breeds that are well adapted to such conditions may become more widely used (Kasulo, *et al.*, 2012). The study also looks at the changes in rainfall patterns and its impact on water availability, parasite and disease occurrences, pasture production, and milk production within Bungoma County in Western Kenya. The increase in dairy animals is in line with Government's policy in dairy production whose goal is to ensure adequate supply and consumption of milk and milk products. Climate change models paint a bleak picture for Kenya. Global warming is projected to increase temperature by 2 to 3°C by 2050, with a decline in rainfall and water availability (Fosu-Mensah, *et al.* 2010). Recent climate change projections over the south eastern Sub-Saharan Africa (including Kenya) predict shorter rainfall seasons associated with a later start to the season, earlier rainfall cessation, increases in mean dry spell length and reductions in rain day frequency (Deressa, *et al.*, 2018).

Climate projections for the period 2010 to 2075 exhibit a decrease in mean cumulative rainfall over most parts of Kenya ranging from -4.8 to -0.7% in annual rainfall changes. The rainfall change is predicted to be worse in some parts of western Kenya but with little

change for most parts of the western Kenya (Deressa, et al., 2018). Indeed other empirical studies have shown that smallholder farmers in Kenya are experiencing changes in climate which is reducing productivity (Mudavadi, et al., 2011). For instance changing rainfall patterns and higher temperatures have led to shorter growing season and farmers are forced to switch from local crop varieties to more expensive hybrid crops (Chase, 2016). These events have led to loss of lives, diminished livelihoods, reduced crop and livestock production, and damaged infrastructure, among other adverse impacts. The torrential rains and severe flooding that were witnessed in the country from March to May 2018, which devastated communities, most of which were already struggling to recover from a prolonged drought, are an example of these events (NCCAP, 2018-2022).

Dairy farming is vulnerable to climate change through increased temperatures and changes in rainfall patterns (Kasulo et al. 2019) and thus affect feed and water availability, animal health and breeds, and in turn milk production. Further, warmer and drier conditions increase the likelihood of heat stress in cattle. There is normally a decrease in milk production for cows under heat stress. Changes in rainfall patterns affects pasture growth patterns thereby affecting the quality and quantity of both feed grains and fodder produced outside dairy areas. Droughts lead to water shortage which in turn leads to a decrease in milk production (Siemes, 2018). Bruckner (2018) indicated that climate change has an impact on the increase or decrease in animal disease risk. Examples of diseases which were related to climate change included avian influenza which spread over 4 continents since the beginning of the new millennium; bluetongue which spread across Europe; and the Rift Valley fever which spread in Africa as a result of severe floods.

### **3. Methodology**

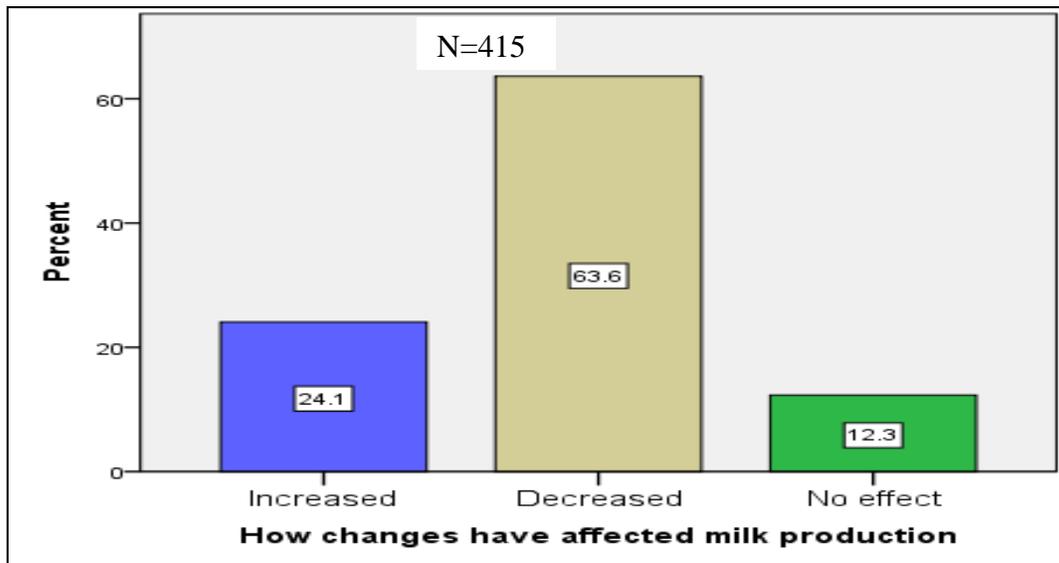
The objective of the study was to determine the impacts of climate change and variability on smallholder dairy cattle production in Bungoma, Kenya. Data were analyzed using both quantitative and qualitative data analyses approaches. Quantitative approach was descriptive, where frequencies and percentages were used. Data from questionnaire were coded with the help of Statistical Package for Social Science (SPSS). The processed data were summarized using tables and figures and presented in frequencies and percentages. The researcher used the thematic analysis method to identify, analyse and report the patterns or themes and other details within the data, as the interpretation of various aspects of the research topic guided by Fowler and Floyd (2000). Correlation analysis was conducted to show the relationship between rainfall (mm), temperature (oC), dairy cattle population and milk production (kgs.) in Mt. Elgon, Tongaren and Kimilili sub counties. The mean score for each of the independent variables was calculated and the Pearson's correlation obtained using SPSS

Secondary information was sourced from published and unpublished sources with literature on the impact of climate change on farming as and with specific focus on smallholder farmers in Bungoma County. These included textbooks, journals, government policy documents, government annual reports on the topic, seminar papers, conference proceedings, business journals, newspapers and periodicals and other relevant literature. Historical metrological data obtained from KNMD was analyzed.

### **4. Results and Findings**

#### **Effect of Climate Change on Milk Production in Bungoma County, Kenya**

Small holder dairy farmers' household heads were asked to indicate whether changes in climate had affected their cattle milk production. The results are as shown in Figure 1.



**Figure 1: How Climate Changes have Affected Milk Production**

**Source: Researcher (2019)**

From the results, 24.1% respondents indicated that the milk had increased, 63.6% said it had decreased yield while 12.3% indicated that there was no effect. A chi- Square test conducted on the changes in climate indicated that there was a highly significant ( $<0.01$ ) variation in the responses ( $\chi^2_{3,0.00}=130.943$ ) in changes in climate. Many farmers indicated there has been a decline in milk resulting from climate change effects. Focus group discussions observed that prolonged rainfall experienced in the county has resulted in increased fodder for cattle feeds; however, it has all exacerbated disease causing vectors to multiply rapidly, hence rampant disease outbreaks. In their opinion foot and mouth disease is the most common of all other cattle diseases. This has caused the entire cattle market sector within Bungoma County to be close down. They further, attributed low milk productivity witnessed to poor animal health because of disease infestation.

Dairy production in the county is dependent on weather, which is unpredictable and erratic. This leads to milk production fluctuation with serious decline during drought periods and glut during wet seasons (Bungoma County Government, 2018). Corroborating this finding, Baumgard (2013) confirms that up to 50% drop in milk production in dairy animals is due to reduced feed intake and rest due to metabolic adaptations to heat stress as heat stress response markedly changes post-absorptive nutrient metabolism.

**Effect of rainfall variability on production of milk in Bungoma County, Kenya**

Further, the study determined whether there was an association between rainfall pattern in the county over the last 15years (2004-2019) and production of milk in liters per cow per year.

**Table 1: Effect of rainfall variability on production of milk in Bungoma County, Kenya**

		Milk in litres produced per cow per year				Total	Chi square
		Increased	Decreased	Constant	999		
Rainfall pattern in the county last 15years	Very regular	Count	1	0	2	0	X <sup>2</sup> =72.532 <sup>a</sup> df=12 p=0.000
		%	33.3%	0.0%	66.7%	0.0%	
	Regular	Count	56	47	12	3	
		%	47.5%	39.8%	10.2%	2.5%	
	Irregular	Count	51	169	28	2	
		%	20.4%	67.6%	11.2%	0.8%	
	Very irregular	Count	0	0	1	0	
		%	0.0%	0.0%	100.0%	0.0%	

	<b>999</b>	Count	2	0	0	1	3
		%	66.7%	0.0%	0.0%	33.3%	100.0%
Total		Count	110	216	43	6	375
		%	29.3%	57.6%	11.5%	1.6%	100.0%

Source: Researcher (2019)

Table 1 summarizes results of chi-square test carried out. The findings show that there was a statistically highly significant ( $p < 0.01$ ) relationship between rainfall pattern in the county over last 15 years (2004-2019) and production of milk in liters per cow per year. According to the Director of livestock and fisheries development of Bungoma County, this increase in milk production may be attributed to a number of factors; i.e. farmers motivated by good milk prices, improved breeding selection, improved extension services and increased pastures due to increased rainfall in the county. Respondents were asked to give their views regarding the effects of the changes in the rainfall pattern on the availability of pasture in this sub-county. The results were recorded in Figure 2.

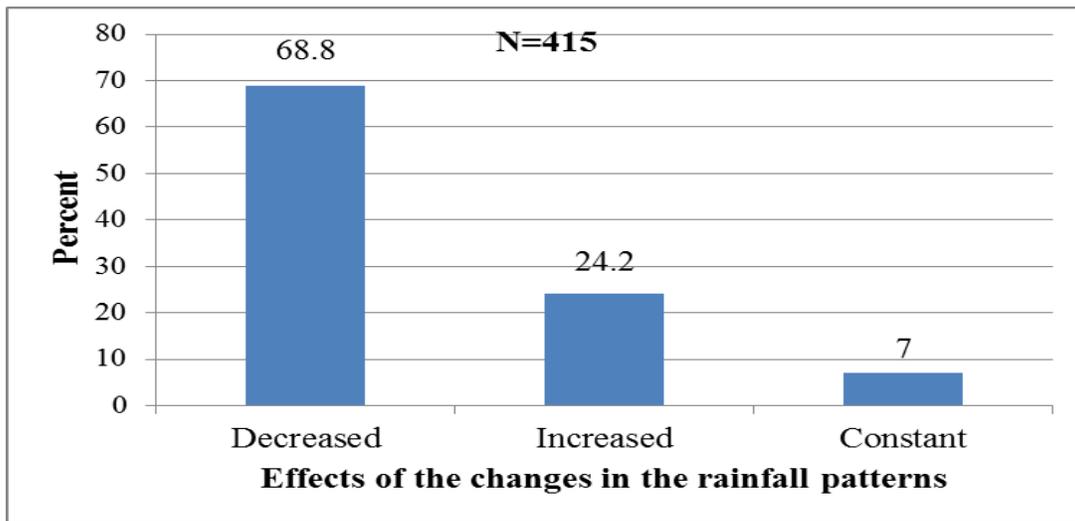


Figure 2: Effect of rainfall variability on pasture in Bungoma County, Kenya

Source: Researcher (2019)

From the results, 68.8% indicated that the amount of pasture had decreased, 24.2% indicated that it had increased while 7.0% indicated that it was constant. The observed decrease in pastures could have been occasioned by various factors, climate change and weather variability, increase in numbers of livestock to cushion adverse climatic effects or normal scramble of scarce land resource utilisation i.e. population pressure for settlement, cash crop and food crop needs. More importantly, food security seems to hold priority position in land use allocation said key informers. There is a highly statistically significant ( $p = 0.01$ ) relationship between rainfall patterns and milk production. This is because the calculated ( $\chi^2_{3,0.00} = 32.320$ ) is greater than the critical  $\chi^2_2$  which is 15.507. In addition, the p-value (0.000) is less than the significant level (0.05). The results recorded from the smallholder dairy cattle farmers indicated that rainfall was significantly decreasing and very unpredictable over the last fifteen years. They further observed that the county is becoming drier and facing water shortages for dairy farming and crop cultivation.

**Effect of Climate Change on Dairy Cattle Milk and Crop Pest Infestation in Bungoma County, Kenya**

Small holder farmers were asked to indicate their level of agreement on whether or not climate change had led to crop pest infestation. The results were recorded in Figure 3.

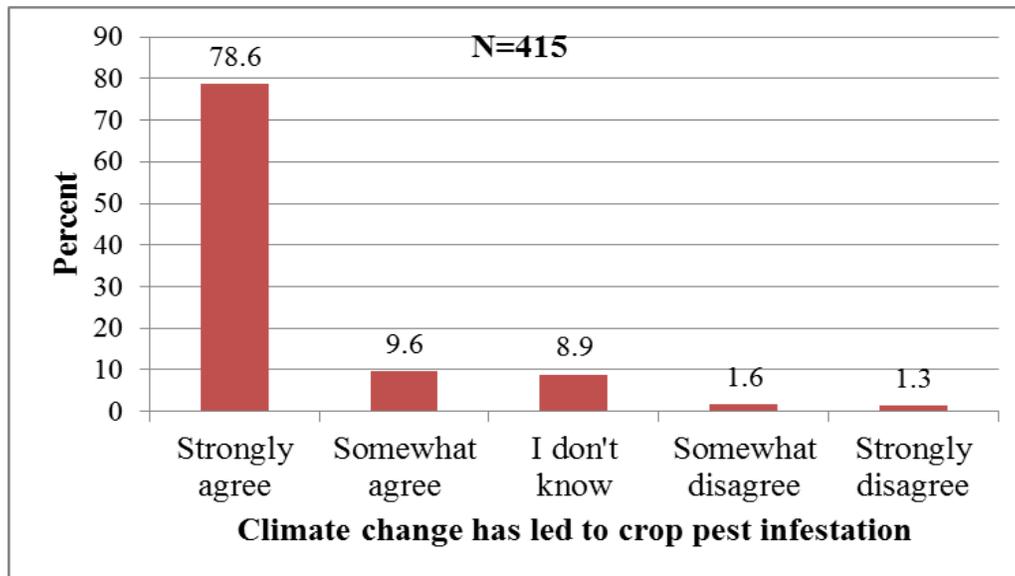


Figure 3: Effect of Climate change on crop pest infestation in Bungoma County, Kenya

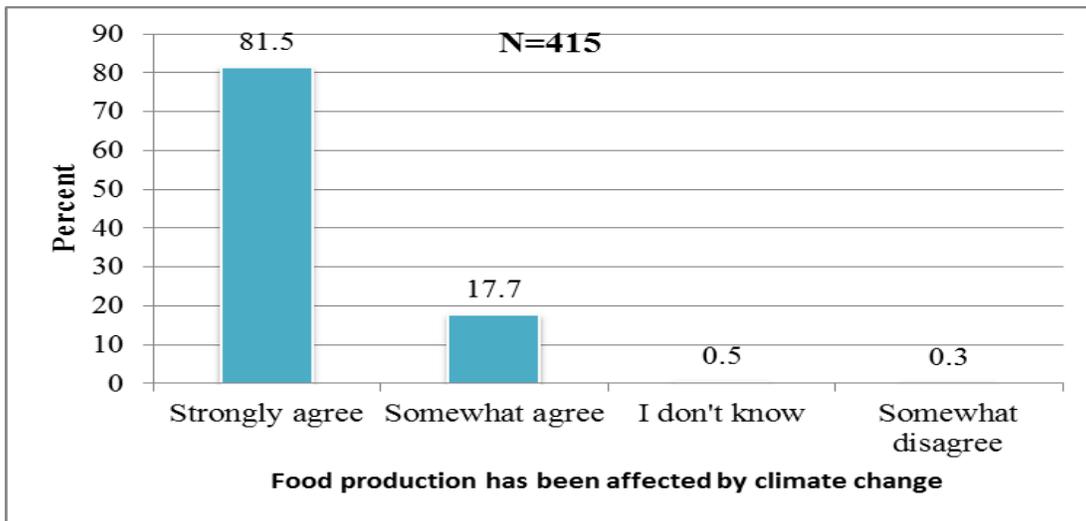
Source: Researcher (2019)

Majority (78.6%) strongly agreed, 9.6% somewhat agreed, 8.9% didn't know, 1.6% somewhat disagreed while 1.3% strongly disagreed that climate change has exacerbated crop pest infection. Chi square test indicated a significant relationship ( $p < 0.01$ ) between climate change and milk production as shown by as shown by a calculated  $\chi^2_2 = 68.094$  which is greater than the critical  $\chi^2_2 = 51.106$ . Further, the p-value (0.000) was less than the significance level (0.05). This finding collaborates with Gautam *et al.*, (2013) and West *et al.*, (2015), that plant diseases are also estimated to cause up to a 20 per cent reduction in the yield of principal food and cash crops worldwide. In agreement, Abang *et al.* (2014), noted that aphids are the most recurrent insect pests in vegetable crops. In Focus group discussions a participant stated that;

“the re-occurrence of *Chikhungu* (meaning armyworms in local language) has resulted in perennial crop failure and losses.”

### Climate Change on Food and Dairy Cattle Milk production in Bungoma County, Kenya

As to whether crop production has been affected by climate change, the results were recorded in Figure 4.



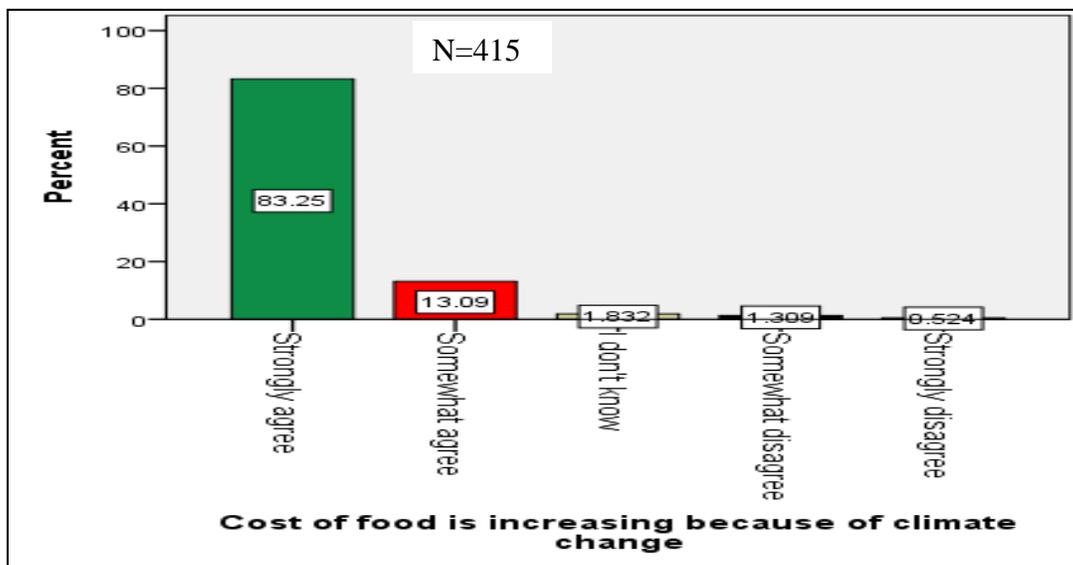
**Figure 4: Climate Change and Food production in Bungoma County, Kenya**

**Source: Researcher (2019)**

From the results, 81.5% strongly agreed, 17.7% somewhat agreed, 0.5% did not know, 0.3% somewhat disagreed. Chi square test indicated a significant relationship ( $p < 0.01$ ) between food production and milk production as shown by a calculated  $\chi^2 = 55.08$  which is greater than the critical  $\chi^2 = 42.425$ . Further, the p-value (0.000) was less than the significance level (0.05). The result is in agreement with Zagst (2011) who asserted that farmers experiencing frequent droughts, excessive rains in the wet season and subsequent crop failures and decline in livestock productivity which increases their vulnerability to food insecurity and poverty. Also, a study done on food security in Bungoma County by Muyesu (2013) revealed that households do not access sufficient food for their dietary requirements.

**Effect of Climate change on Cost of food and Dairy Cattle Milk in Bungoma County, Kenya**

As to whether the cost of food is increasing because of climate change, the results were recorded in Figure 5.



**Figure 5: Climate Change influencing Cost of food in Bungoma County, Kenya.**

**Source: Researcher (2019)**

From the results, 83.25% strongly agreed, 13.09% somewhat agreed, 1.8% did not know, 1.3% somewhat disagreed while 0.5% strongly disagreed. Chi square test indicated a significant ( $p < 0.01$ ) relationship between cost of food and milk production by a p-value (0.000) which was less than the significance level (0.05). Key informant interviews and Focus group discussions said that there was a close relationship between climate change effects and food prices. Crop failure resulting from adverse effects of climate change, is mated with hikes in food price. The results concurs with Barriopedro *et al.* (2011), Watanabe *et al.* (2013) and Hoag (2014) that 2010–2011 food price spike was initially triggered by the exceptional heat in summer 2010, with an extent from Europe to the Ukraine and Western Russia. Mann *et al.* (2017) confirms that there is evidence that these effects were both linked and made more likely through climate change. .

**Relationship between frequency of drought and the quality of calves delivered in Bungma County, Kenya**

Further, the study sought to determine the relationship between the frequency of experiencing drought and the quality of calves delivered per cow. The results were as shown in Table 2.

**Table 2: Relationship between frequency of drought and the quality of calves delivered per cow**

			Number and quality of calves delivered per cow				Total	Chi square
			No reduced and quality decreased	No increased and quality improved	No change, don't know	999		
Frequency of experiencing droughts	Very often	Count	26	5	0	0	X <sup>2</sup> =319.031 <sup>a</sup> df=9 p=0.000	
		%	83.9%	16.1%	0.0%	0.0%		
	Often	Count	101	13	5	0		
		%	84.9%	10.9%	4.2%	0.0%		
	Rarely	Count	97	37	17	1		
		%	63.8%	24.3%	11.2%	0.7%		
	999	Count	5	4	1	57		
		%	7.5%	6.0%	1.5%	85.1%		
Total	Count	229	59	23	58	369		
	%	62.1%	16.0%	6.2%	15.7%	100.0%		

Source: Researcher (2019)

As indicated in the Figure 5.19, there is a statistically significant relationship between the frequency of experiencing drought and the quality of calves delivered per cow. This is because the calculated  $\chi^2_2 = 319.031$  is greater than the critical  $\chi^2_2$  which is 297.956. In addition, the p-value (0.000) is less than the significant level (0.05). Key informant interviews and Focus group discussions stated that increased drought experiences leads to decrease in the quality of calves due to inadequate, imbalanced nutritional quotient of feeds provided to the cattle during gestation. In some cases, calves growth curve shows stagnation. The growth of such calves is seriously endangered as they are prone disease infection and slow recovery process. These findings concurs with those of Herrero, *et al* (2010) who established that increased drought frequencies to more than a drought every five years could cause significant, irreversible decreases in livestock numbers and hence the milk production in arid and semi-arid areas. Odhiambo *et al.* (2019) argues that milk production declines during droughts; this has led to an increase in calf pneumonia and increasing cases of silent heat due to poor management.

**Effect of Drought on Amount of Milk Produced Per Cow in Bungoma County, Kenya**

Respondents were asked to state how the changes had on the amount of milk produced per cow. The results were recorded in Figure 6.

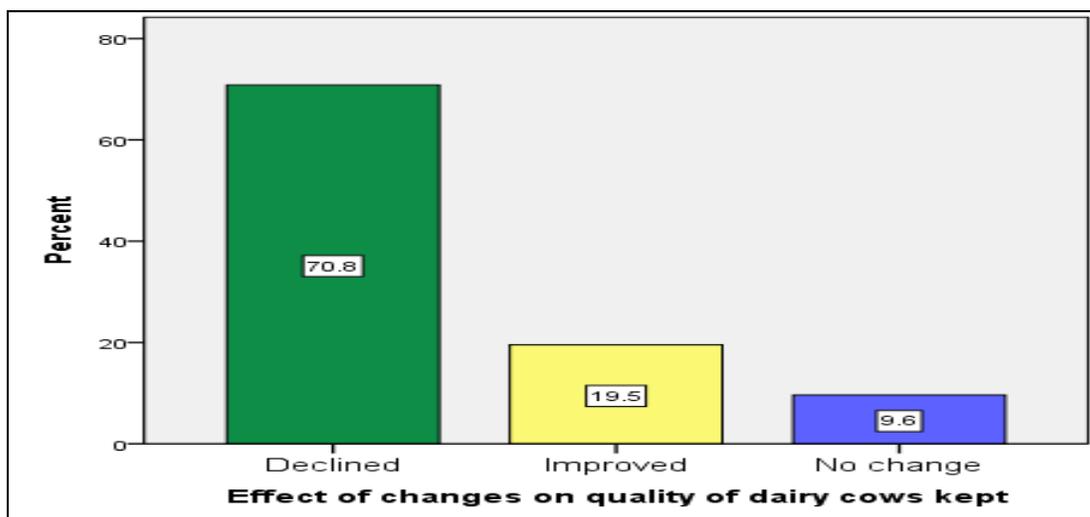


Figure 6: Effect of changes on quality of dairy cows kept

**Source: Researcher (2019)**

From the results, 70.8% respondents indicated that the quality had declined, 19.4% said it had improved while 9.8% indicated that the quality had not changed. A significant 70.8% observed a decline in the quality of cows kept. Corroborating this finding Samir (2017) argues that for the solution of adaptation problems it is important to know the qualitative and quantitative responses of the animal to various degrees of heat stress; Promoting indigenous breeds for rearing as these are more heat tolerant than cross bred and exotic breeds.

The small scale dairy cattle farmers were asked questions on breeding and calving whose descriptive statistics were summarized in Table 3.

**Table 3: Descriptive statistics on breeding and calving in Bungoma County, Kenya**

	N	Minimum	Maximum	Sum	Mean	Std. Error	
Number of cows and heifers that bed last season	342	0	6	542	1.58	0.0576	Chi square X <sup>2</sup> =319.031a df=6 p=0.000
Number of those that became pregnant	373	0	6	523	1.40	0.0501	
Number that successfully calved	369	0	6	466	1.26	0.0496	
Number that aborted	280	0	1	13	.05	0.0126	
Number that had still births	275	0	2	37	.13	0.0219	
Number that died soon after calving	276	0	6	25	.09	0.0278	
Valid N (list wise)	257						

The data shows that farmers had several challenges associated with breeding. Some failed to get pregnant after breeding, some aborted, had still births or calves died soon after delivery. The calculated Chi-square  $\chi^2 = 319.031$  was greater than the critical 434.507. In addition, the p-value (0.000) is less than the significant level (0.05). This finding agrees with Odhiambo *et al.*, (2019) and Maleko *et al.*, (2018) that the effects of climate change has compromised the breeding of the dairy cattle, thereby elongating the calving interval. Focus group discussions added their voice, that breeding has increasing become unpredictable characterised by miscarriages and calving difficulties.

**Pearson Correlation Analysis and Regression between rainfall pattern, temperature, dairy cattle and milk production for Bungoma County, period (2003-2018).**

Correlation analysis was conducted to show the relationship between rainfall (mm), temperature (oC), dairy cattle population and milk production (kgs.) in Mt. Elgon, Tongaren and Kimilili sub counties. Data for three types of cattle was collected from all the sites under consideration namely Kimilili, Tongaren and Mt. Elgon. These regions have different types of cattle that are kept for dairy purposes.

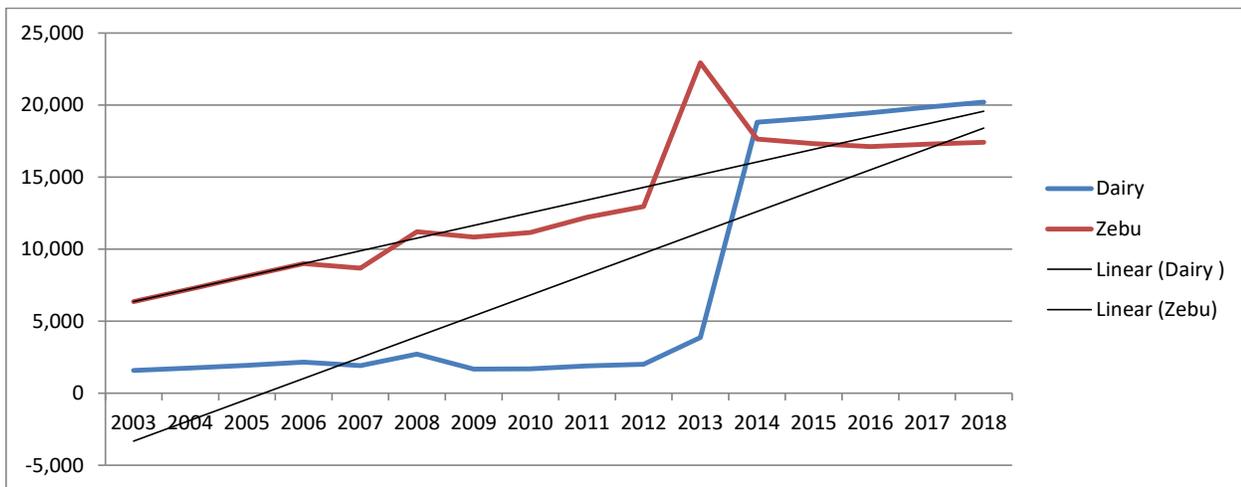
**4.8.1 Correlation Analysis for Kimilili**

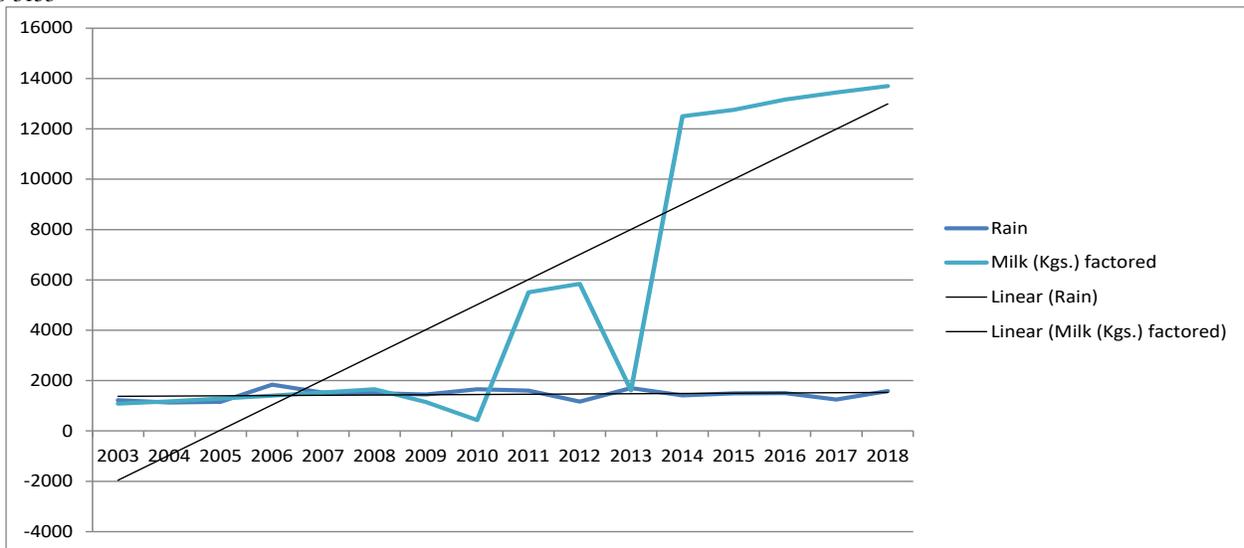
Correlation was done on data from Kimilili from the year 2003-2018 which had the most accurate and complete set of data for all the parameters under consideration. The results of the correlation are illustrated in Table 4.

**Table 4: Correlation Analysis for Zebu, Dairy and Rain from 2003-2018 in Kimilili**

Correlation (Rain vs Dairy cattle)	Correlation (Rain vs Zebu cattle)	Correlation (Rain vs Milk)	Correlation (Dairy cattle vs Milk)	Correlation (Zebu cattle vs Milk)
0.021679729	0.315947395	-0.037594073	0.960741186	0.663088805

The results indicated that there is positive correlation between the rainfall over the years and the population of cattle within the region. This indicates that as the annual rainfall has been increasing, so has the population of both the Zebu and dairy cattle with Zebu exhibiting a stronger correlation. The correlation trend of Zebu, Dairy and Rain from 2003-2018 are as shown in Figure 7.





The correlation between both cattle types and total milk production is strongly positive as hypothesized. As the cattle increased so did the milk production. There was however negative correlation between the rainfall and the milk production by the two cattle breeds. The correlation is quite low and as such may not tell us much about the relationship. The reason for the negative correlation could be that the milk production is increasing at a very high rate compared to the rainfall which is indicating an overall increasing trend but is characterised by high variability.

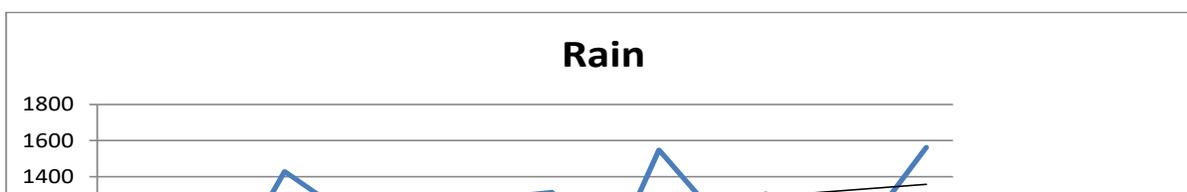
**Correlation Analysis for Tongaren**

Correlation was done on data from Tongaren from the year 2003-2018 which had the most accurate and complete set of data for all the parameters under consideration. The results of the correlation are illustrated in Table 5.

**Table 5: Correlation Analysis for Zebu, Dairy and Rain from 2003-2018 in Kimilili**

Correlation (Rain Vs Dairy Cattle)	Correlation (Rain Vs Zebu Cattle)	Correlation (Rain Vs Milk)	Correlation (Dairy Cattle Vs Milk)	Correlation (Zebu Cattle Vs Milk)
0.323962945	-0.4114622	0.312891063	0.831186205	-0.08966167

From analysis there was relatively strong positive correlation between the rainfall amounts across the years and the population of Dairy cattle indicating that as the rainfall increased and the dairy cattle population likewise increased as shown in Figure 8 on the correlation trend for rain, dairy and Milk from 2003-2018 for Tongaren.



**Figure 8: Trend of Rain, dairy and Milk from 2003-2018 for Tongaren**

There was negative correlation between rainfall amounts across the years and the population of Zebu cattle. Therefore as the rainfall increased the Zebu cattle population decreased. There was also strong positive correlation between rainfall and milk production for the region which is unlike the situation observed for Kimilili. This therefore indicates that as the rainfall increased so did the milk production for the cattle in Tongaren. Lastly, there was also a very strong correlation between the milk production and the dairy cattle

and a negative one between the milk production and Zebu cattle. This indicates that the dairy cattle were mostly responsible for the increase in milk production across the years for the region.

**Correlation Analysis for Tongaren**

Correlation was done on data from Tongaren from the year 2003-2018 which had the most accurate and complete set of data for all the parameters under consideration. The results of the correlation are illustrated in Table 6.

**Table 6: Correlation Analysis for Zebu, Dairy and Rain from 2003-2018 in Kimilili**

Correlation (Rain Vs Dairy Cattle)	Correlation (Rain Vs Zebu Cattle)	Correlation (Rain Vs Milk)	Correlation (Dairy Cattle Vs Milk)	Correlation (Zebu Cattle Vs Milk)
-0.067250071	-0.188737315	0.239447778	0.56723892	0.261039249

There was negative correlation between rainfall and both cattle populations across the years. The rainfall exhibited an average increase across the years from 2003 as shown by figure (xx) while still having variability. Figure (xy) shows a plot of both cattle populations across the years along with their trend lines. The average increase in Zebu cattle is quite small and is characterised by significant variability, this could explain why the correlation is very small (0.06725) and negative. The relationship between cattle population and milk production as highlighted by the correlation is positive for both cattle breeds, such that as the population increases so does the milk production. There’s also a positive correlation between rainfall and milk production (0.26) which indicates that as the rainfall has been increasing across the years, so has the milk production. The correlation trend for the Zebu, Dairy and Milk from 2003-2018 for Tongaren is illustrated in Figure 9.

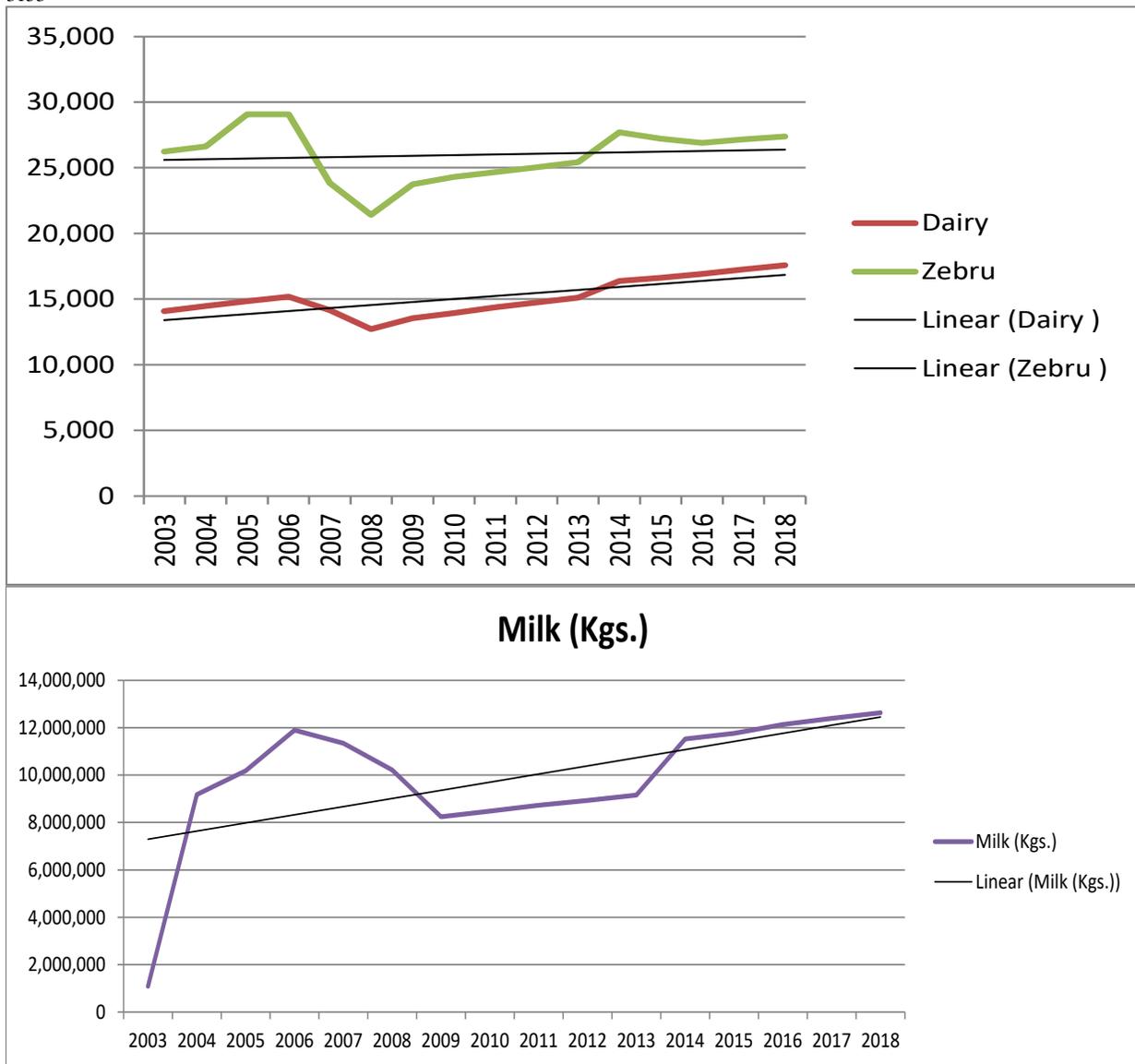


Figure 9: Trend of Zebu, Dairy and Milk from 2003-2018 for Tongaren

**Table 7: Pearson Correlation Analysis between milk Production, rainfall pattern, temperature and dairy cattle population in Bungoma County, Kenya**

	Milk production	SE	Rainfall	SE	Correlations Temperature	SE	Dairy cattle population
Milk production (kgs.)	1.000						
Rainfall(mm)	0.108	0.0034	1.000				
	0.005			0.0047			
Temperature (°C)	-0.289	0.0027	0.114		1.000		

	0.046		0.440			
Dairy cattle population	.679**	0.0035	0.127	0.0064	0.193	0.0037
	0.000		0.388		0.188	1.000

The results indicated that rainfall (mm) was positively and significantly ( $p < 0.01$ ) associated to milk production. However, temperature ( $^{\circ}\text{C}$ ) was negatively and significantly associated to milk production (kgs.). Lastly, the dairy cattle population was positively and significantly ( $p < 0.01$ ) associated to milk production (kgs.). This implied that the increase in Rainfall (mm) and Dairy cattle population had an increasing effect on Milk production (kgs.). However, an increase on temperature ( $^{\circ}\text{C}$ ) had a decreasing effect on Milk production (kgs.). The increase in milk level can be attributed to the increase of the dairy cattle population in Bungoma County as tabulated in 2.1 where there were 125,510 dairy cattle in 2014, 127,421 dairy cattle in 2015, 129,758 dairy cattle in 2016, 132,354 dairy cattle in 2017 and 134,736 dairy cattle in 2018. However, the production in comparison to the increased dairy cattle thus does not portray significant increase in milk production but increase in dairy cattle population. Rodriguez *et al.*, (2015) on the effects of relative humidity, maximum and minimum temperature, pregnancy and stage of lactation on milk composition and yield reported with a decrease of milk yield when the drought seasons prolonged.

The regression analysis was conducted to depict the statistical relationship between milk production with the input of type of cattle, rainfall and temperature.

**Table 8: Regression Analysis on Milk productivity and Type of Cattle, Rainfall and Temperature**

Milk	Coef. $\pm$ SE	t	P> t	[95% Conf.	Interval]
Dairy	700 $\pm$ 118	5.940	0.000	462	938
Zebu	-151 $\pm$ 174	-0.870	0.390	-503	200
Rain	6099 $\pm$ 3518	1.730	0.090	-1000	13198
Tmax	-81259 $\pm$ 1073	-0.080	0.940	-2247582	2085064
Tmin	-108751 $\pm$ 1128	-0.100	0.924	-2387046	2169545
_cons	-4600366 $\pm$ 1660	-0.280	0.783	-38200000	29000000
F(3, 44)	= 16.43				
Prob > F	= 0.000				
R-squared	= 0.5284				
Adj R-squared	= 0.4962				

The results indicated that the dairy cattle (Exotic breed) ( $\beta=700$ ,  $p=0.000 < 0.05$ ) had a positive and significant ( $p < 0.05$ ) relationship with milk production. The Zebu cattle (Local breed) ( $\beta=-151$ ,  $p=0.390 > 0.05$ ) had a negative and non-significant ( $p > 0.05$ ) relationship with milk production. The amount of rainfall ( $\beta= 6099$ ,  $p=0.090 > 0.05$ ) had a positive but insignificant ( $p > 0.05$ ) relationship with milk production. The level of temperature for Tmax and Tmin ( $\beta= -108751$ ,  $-4600366$ ,  $p=0.940$ ,  $0.924 > 0.05$ ) had a negative and insignificant relationship with milk production. These findings are in line with those of Mukherjee, *et al.*, (2013) who found that dairy cows need an optimum range of atmospheric conditions and not more than  $18.3^{\circ}\text{C}$  to be most productive. The scholars also established that future productivity growth in dairy farming can be hampered by a warmer environment in the region. The findings also in line with those of Zewdu *et al.* (2014), who noted that variability in climate influenced the production in milk, such that; as temperature increased, milk production declined notably.

Warmer and drier conditions increase the likelihood of heat stress in cattle. Heat stress adversely affects reproductive performance in dairy animals (Zewdu *et al.* 2014). The general increase in temperature leads to cattle heat stress that may affect the health of the animal and milk productivity. Summer *et al.* (2019) point out the negative effects of heat stress on the composition of milk (organic and inorganic components) and describe how those changes are strongly associated with the alteration of cheese making properties and the merchandise value of milk. The effect of climate change on health and growth, reduce body weight, reduce body condition score, reduce average daily body gain, reduce feed intake, and reduce feed conversion and allometric measurements (Zewdu *et al.* 2014). Bungoma County annual temperature range from - 0°C and 32°C due to different levels of altitude. Therefore, cases of heat stress may be witnessed in the county. Heat distress suffered by animals will reduce the rate of animal feed intake and result in poor growth performance (Rowlinson, 2018).

## 5. Conclusions

The finding indicates that there was decreasing acreage under fodder and pasture production. Farmers owned less than 5 dairy cows that produced a daily average of 5-8 litres and 2-5 litres per cow during the wet and the dry season respectively. During the dry season, farmers used preserved feed, crop residues or feeds purchased from neighbours. While the tick borne diseases, pneumonia and lumpy skin incidences had increased in the county, foot and mouth disease had decreased during the past ten years. Extreme weather changes especially dry spell was associated with increased incidences of tick borne and Foot and Mouth diseases, shortage of feed resources and reduced milk production in the three study sites

Changes in climatic patterns especially the decreasing dry spell, droughts, and unpredictable precipitation has contributed to increased livestock diseases incidences e.g East coast fever, foot and mouth diseases, shortage of feed resources hence, increased cost of food and feeds, and overall reduction of milk production in the Bungoma County. Therefore, there existed a significant relationship between the changing climatic patterns and smallholder dairy herd productivity in the county.

Climate change and variability effects are on great increase and quickly eroding the gains of dairy technologies adapted in the recent times in the county to boost smallholder dairy cattle production in the county. Both Policy formulation and investment adaptations by the county government to address to minimize losses and damages incurred by smallholder dairy cattle farmers, occasioned by increased frequency of extreme rainfall over the three sites.

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# Comprehending memory beliefs and knowledge of adolescents: Development and Psychometric Properties of a Metamemory Scale for Adolescents

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**Abstract-**Metamemory (i.e. knowledge and beliefs about memory) of adolescents is assumed to influence performance of cognitive tasks requiring memory hence possibly impacting their classroom performance. This necessitates the availability of appropriate tools for assessing metamemory among adolescent population. Due to the dearth of appropriate self-report measures assessing metamemory among adolescents, the current study aimed at developing such a measure. This assessment tool would assess the level of knowledge about various aspects of memory as well as beliefs regarding memory competence, from a classroom learning perspective. A three-factor, 25-items metamemory scale was developed. Prior to pilot testing of the tool, content validity was evaluated. Based on the content validity and expert feedback and suggestions, scale items were revised. The revised version was pilot tested on a sample of 242 school-going adolescents (169 girls and 73 boys, 10 to 18-year-olds). Based on the obtained data, psychometric properties of the measure were evaluated. Internal consistency estimates for the factors as well as for the full measure was indicative of the instrument's reliability. Confirmatory factor analysis revealed satisfactory fit to the data providing support for construct validity of the measure. Factor covariance reached statistical significance indicative of the scale's multidimensionality. Obtained results indicate that this scale can be a useful tool for assessing metamemory among adolescents, both in classroom setting as well as for research purpose.

## **Keywords:**

Adolescents, metamemory, psychometric properties, scale development.

control one's own learning and memory performance (e.g., Grainger, Williams and Lind, 2016; Flavell, 1971). These two perspectives have also been construed by many as defining two components of metamemory, commonly named declarative metamemory (DM) and procedural metamemory (PM), respectively, (e.g., Fritz, Howie and Kleitman, 2010; Dunlosky and Thiede, 2013).

Flavell's (1971) conceptualization of metamemory upheld both perspectives, i.e., knowledge about as well as monitoring and control of learning and memory processes as is evident from his definition of metamemory: "... (the) intelligent "... (the) intelligent structuring and storage of input, of intelligent search and retrieval operations, and of intelligent monitoring and knowledge of these storage and retrieval operations" (p. 277).

## *A. Components of metamemory*

Flavell and Wellman (1977) made a distinction between two components of metamemory, namely 'variables' and 'sensitivity' (referred to as declarative and procedural metamemory, respectively, in recent literature). The variables component comprises of knowledge about variables that are assumed to influence memory performance. Whereas, the sensitivity component constitutes of the application or use of the 'knowledge about variables' to monitor and control learning, memorization and retrieval of information. The variables component is further subdivided into three categories- Person variables, strategy variables and task variables. Knowledge and beliefs about one's own memory capacities and limitations constitutes person variables. Strategy variables refer to knowledge about memory strategies, mnemonics, their applicability, and relative pertinence and efficiency in situations demanding memory performance. Task variables refers to the knowledge about the various task characteristics that influence learning, storage and retrieval of information (e.g., Schneider, 1999; Tarricone, 2011). Another major point of distinction between the two broad metamemory components (i.e., declarative and procedural metamemory) comes from the assessment point of view. While assessment of DM is more of an 'offline' metacognitive assessment, where declaration of knowledge and beliefs about memory are not validated by memory task performance; that of PM is an 'online'

## I. INTRODUCTION

Metamemory has often been defined either from the perspective of knowledge about memory or from that of monitoring of memory and utilization of memory skills. With respect to the former perspective, metamemory refers to an individual's knowledge about various facets of human memory system (such as capacities, limitations, functioning, influence of memory task characteristics on performance, etc) in general as well as self-referential beliefs about memory (e.g., Pierce and Lange, 2000; Flavell and Wellman, 1977). Whereas, the second perspective defines metamemory as the ability to monitor and

metacognitive assessment where judgments about memory performance or memory tasks are often preceded or followed by performance on memory tasks ( e.g., Sarac and Karakelle, 2017).

### B. Existing metamemory assessment measures

In the four-decade long metamemory literature, DM has been assessed using a variety of assessment measures like interviews, tasks and scales. A majority of studies exploring the development of DM in children have done so using interviews, much of which was possible due to the seminal work done by Krueger, Leonard and Flavell (1975) in developing an interview instrument. Some studies used the measure in its original form (e.g., Cavanaugh & Borkowski, 1980); others used only portions of it (e.g., Lockl and Schneider, 2007); while another study reported a similar measure based on it (Belmont & Borkowski, 1988).

Several non-verbal measures of DM have been developed and used to study metamemory. Justice (1985, 1986) developed a technique for studying children's knowledge about the relative efficiency of different memory strategies, wherein they were to watch videos of various memory strategies and rank them in order of their degree of efficiency. DM –vignette task (Cornoldi & Orlando, 1988) and DM- story task (Cornoldi, Gobbo & Mazzoni, 1991) are two such measures that evaluate children's knowledge about various aspects of memory variables. DM-vignette task is used to assess children's knowledge about how memory is influenced by four factors- noise, number of to-be remembered-items, categorization of to-be-remembered items, and use of memory strategies, whereas DM- story task uses narrative passages to assess children's knowledge about forgetting and memory strategies ( Leece, Demicheli, Zocchi & Palladino, 2015). Studies have also used various sort-recall tasks for assessing rehearsal as well as sorting strategies for effective recall among children (e.g., Kron-Sperl, Schneider & Hasselhorn, 2008).

Studies exploring declarative metamemory among the adults and older adults have done so using questionnaires (e.g., Parikh, Troyer, Maione & Murphy, 2015). Most of the metamemory scales and questionnaires reported in existing literature have been developed pertaining to various aspects of DM, more specifically, with items exclusively applicable for adults and older adults from both clinical and non-clinical population. Metamemory in Adulthood Questionnaire (Dixon, Hultsch and Hertzog, 1988) assesses metamemory on the following seven domains- achievement (i.e., perceived importance of performing well on memory tasks), anxiety (i.e., perceived impact of anxiety on memory task performance), capacity (i.e., perceived memory capacities), change (i.e., perceived stability of memory over time), Locus (i.e., perceived control over memory), strategy (i.e. reported use of memory strategies and aids), task (i.e. knowledge of basic memory processes). Memory Functioning Questionnaire (Gilewski, Zelinski & Schaie, 1990) assesses subjective appraisal of one's own memory capabilities across various everyday situations based on four domains- General frequency of forgetting (i.e. perceived frequency of forgetting in specific situations), Seriousness of Forgetting ( i.e., perceived gravity of the consequences of forgetting in different situations), Retrospective Functioning (i.e. perceived change in current memory ability

with respect to previous ability) and Mnemonics Usage (i.e., perceived frequency of using specific memory strategies). Another more recent questionnaire is Multifactorial Memory Questionnaire (Troyer and Rich, 2002). This questionnaire assesses three dimensions of self-reported memory-Contentment (i.e., emotions and perceptions about one's current memory ability), Ability (i.e., perceived frequency of everyday memory failures) and Strategy (i.e., reported frequency of employing memory aids). Other questionnaires include Memory Failures of Everyday Questionnaire (Sunderland, Harris & Baddeley, 1984), Memory Controllability Inventory (Lachman, Bandura, Weaver & Elliott, 1995), Everyday Memory Questionnaire (Royle and Lincoln, 2008), Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald and Parkes, 1982) and the Subjective Memory Questionnaire (Bennett- Levy & Powell, 1980) to name a few. Literature on metamemory reveals that the number of studies on adults and older adults outnumbers that on adolescents by a large margin. In a review by Khatoon and Roy (2017), it was reported that a database search conducted through the ScienceDirect website using the terms 'metamemory' and 'adolescents' during the period '2000 to 2016' returned 134 studies, while in case of children and adults the numbers were 347 and 499 results respectively. A similar search on APA PsychNet returned eight studies for adolescents and nine for children, whereas 90 studies in case of adults.

Even though there are a considerable number of metamemory scales, none of them are suitable for adolescents. However, some can be made suitable with appropriate modification of items to suit their vocabulary and at the same time be of adequate relevance in capturing the various facets of their metamemory. Also, since most of these measures focus mainly on subjective beliefs that an individual holds about his or her memory capacities, limitations and strategies that one employs, they have been viewed as focusing only on the 'person' variable (e.g., Schnieder, 1999). Prior research examining DM of adolescents have mostly done so using metamemory tasks (see Schneider, 1999) and interviews (e.g., Krueger, Leonard, Flavell and Hagen, 1975) which focused on task specific metamemory knowledge (e.g., Justice, 1986), thus tapping only task specific DM components rather than providing a global or integrated assessment of DM.

### C. Aim of the study

The present study reports the development of a scale that aims to assess DM of adolescents. The impetus for developing this tool was two-fold: first, was to introduce an assessment tool to alleviate the paucity of metamemory questionnaire for adolescents; second, to serve the purpose of another study exploring the development of DM across the adolescent years in relation to other cognitive and non-cognitive variables. Such a tool would serve the purpose of providing a holistic assessment of DM of adolescents, thereby opening new avenues for answering research questions pertaining to metamemory and performance of adolescents on memory tasks. This in turn, could have important implications in introducing modification in classroom instructions to assist students of this age group in reflecting upon and making intelligent use of their DM while performing in class.

## II. METHOD

### A. Participants

The sample for this study consisted of 242 students (169 girls, 73 boys) within the age range of 10-18 years ( $M = 13.64$ ,  $SD = 1.98$ ), from three middle and high schools in the city of Kolkata, situated in Eastern India.

### B. Procedure

**Conceptualization and Development.** The present scale was based on the conceptualization of declarative metamemory which proposes that memory performance is influenced by three broad classes of variables, namely person variables, strategy variables and task variables. Initially, a three-factor, 30-items scale was constructed based on this conceptualization. Each of the factors had 10 items, the generation of which were conceptually driven and based on empirically established facts about human memory. The items were developed to capture metamemory of adolescents from the academic learning perspective.

**Person variable** The items for this subscale were framed to tap the beliefs and knowledge of participants regarding their memory capacities and limitations. For e.g., 'I find it hard to remember words that are difficult for me', 'I know exactly how much I will be able to remember after learning a lesson', etc.

**Strategy variables** This subscale comprised of items meant to assess participants' knowledge regarding the relative efficiency of various memory strategies in the learning situation. For e.g., 'Using acronyms (e.g. VIBGYOR for order of colors in a rainbow) can help us remember list of words'.

**Task variables** The items for this subscale were meant to assess the participants knowledge about the various learning related factors affecting encoding and retrieval of information. For e.g., 'In an exam, answering multiple choice questions is easier than answering subjective questions'.

### C. Content validity

Prior to pilot testing of the scale, the initial draft of the measure was subjected to content validity analysis. Following the criteria for the minimum number of content experts proposed by Lynn (1986), three experts were recruited for the content validation of the scale. All the experts had a PhD degree in psychology; more than five years of research experience, and four or more publications in the area of metacognition or metamemory.

The raters were instructed to rate the relevance of each of the items on a four-point scale ranging from not relevant to highly relevant. They were also asked to classify each item into one of the three predetermined domains/factors of the scale, i.e., person variables, strategy variables and task variables. Additional instructions to the experts included asking them to provide suggestions for improving the relevance of an item (for example, by re-wording an item, suggesting an alternate item as a replacement, etc.) and to suggest domain-specific additional items.

### D. Modifications in the scale

Following the content validity analysis, two items were dropped from the questionnaire while some items were reframed or replaced by other items as per the suggestions given by the experts. The modified scale consisted of 28 items (person variables=9 items; strategy variables= 11 items ; task variables=8 items).

### E. Response and scoring

Response to each of the item was to be made by selecting one out of five response anchors which were based either on frequency or on degree of agreement. For the former, the five response anchors were 'never', 'rarely', 'sometimes', 'often' and 'always', whereas for the latter, the response anchors were 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree', which were scored as 1 through 5 respectively. For both the response types, higher scores indicated high DM.

### F. Pilot testing

Prior to the commencement of data collection for pilot testing of the tool, permission was sought from the school authorities. Participants completed the 28-items scale. The items for each of the three domains were grouped separately as three sections in the scale (Section A, B and C) with separate set of instructions for each of the sections. Participants were clearly instructed to select only one alternative from the five response anchors to indicate their response to each item. They were also explicitly instructed to respond to all the items and not to skip any of the items. Scores were calculated by summing up the respective weightage given to each response anchor, separately for each of the domain as well as for the full scale.

Scores of participants who did not respond to a substantial number of scale items (5 or more), were excluded from the obtained data set considered for statistical analysis.

### G. Data analysis

Data thus obtained from the pilot administration of the tool, was subjected to confirmatory factor analysis to test the predetermined factor structure of the scale. Other statistical tests included examination of the internal consistency, descriptive statistics and domain inter-correlations. The analyses were done using MS-Excel, SPSS 16 and STATA 12.

## III. RESULTS

### A. Content validity

The content validity index (CVI) for the items was calculated as the percentage of experts who agreed on the items being representative of the respective factors of DM. For strategy variables domain, there was 100% agreement among the raters for eight items, 33% agreement for one item and no agreement for one item. In case of person variable domain, the percentage of agreement was 100%, 66% and 33% and no agreement for two items, one item, five items and two items, respectively. Lastly for the task variable domain, the agreement was 100%, 66% and 33% for two items, three items and five items, respectively. The items with 33% agreement were either reworded or modified in accordance with the suggestions by the experts. Two items with no agreement and no modification suggested by any of the

experts were omitted. One item with no agreement was retained after modifying it in accordance to expert suggestion as it was considered by the authors to be of significant importance in tapping the construct.

**B. Internal Consistency**

Cronbach's Alpha was computed to examine the internal consistency of the measure. The estimates for the three factors, i.e., person variables, strategy variables, task variables and full measure were 0.58, 0.81, 0.57 and 0.82 respectively. The estimates for task variables factor and full measure were obtained after removing three items from the task variables factor based on the predicted improvement in the internal consistency estimates on deletion of those items. It is to be noted that the three deleted items were all reverse items probably indicating that these items may have created confusion among the young respondents thus contaminating the scores. The final scale thus consisted a total of 25 items (see Appendix).

**C. Descriptive statistics**

Table 1 shows the means, standard deviations, range and percentiles of the scores obtained by the participants. The mean scores on each of the factors as well as the full scale were more on the higher end of the observed range. To test the normality of the score distributions, Shapiro Wilk's test was performed. Results showed that neither the factor scores nor the full scale scores showed normal distribution.

Table 1  
 Descriptive statistics for scores on Metamemory in Adolescence Scale.

Measure	Person Variables (9 items)	Strategy Variables (11 items)	Task Variables (5 items)	Full Scale (25 items)
M	34.11	44.25	19.72	106.38
SD	4.75	6.51	3.20	10.87
Possible range	9-45	11-55	5-25	25-125
Observed Range	19-45	17-55	5-25	62-119
SK	-0.40	-1.17	-0.99	-0.66
Ku	0.61	2.71	2.49	0.69
Percentiles				
5	26.0	32.0	14.0	75.0
10	29.0	36.0	16.0	85.0
25	31.0	41.0	18.0	92.0
50	34.0	45.0	20.0	98.0
75	37.0	49.0	22.0	106.0
90	40.0	51.0	24.0	112.0
95	42.0	54.0	25.0	116.0
Shapiro-Wilk statistic	0.98**	0.93**	0.94**	0.97**

Note: M=mean; SD=standard deviation; SK=skewness; Ku= kurtosis; n= 239; \*\* values are significant at 0.01 level.

**D. Factor structure**

Confirmatory factor analysis (CFA) was conducted using STATA 12 to test the predetermined three- factor model against a single factor model with respect to goodness of fit indices, namely Chi Square/ degrees of freedom ratio, root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI) and standardized root mean square residual (SRMR). The fit indices for each model are presented in Table 2. As is evident, the three-

factor model showed a better fit in comparison to the one factor model. The standardized factor loadings for the three-factor model ranged from 0.2 to 0.67 (see Figure 1). All loadings were statistically significant at 0.001 level with the exception of one for which the loading was significant at 0.05 level.

Model	$\chi^2$ (df)	$\chi^2$ /df	RMSEA	CFI	TLI	SRMR
Three-factor model	520.3* (275)	1.892	0.061	0.769	0.748	0.069
One-factor model	442.168* (272)	1.626	0.051	0.084	0.082	0.064

Table 2  
 Goodness-of-fit indices for confirmatory factor models of Metamemory in Adolescence Scale (n=239).  
 Note:  $\chi^2$  (df), chi-square (degrees of freedom);  $\chi^2$  /df, chi-square/degrees of freedom; RMSEA, root mean square error of approximation; CFI, comparative fit index; TLI, Tucker-Lewis index; SRMR, standardized root mean square residual); \*Significant at 0.001 level.

Table 3 shows the factor intercorrelations which were significant at 0.001 level with the exception of that between two factors, namely person variables and task variables. However, the covariances between the three factors were significant at 0.05 level which are presented in Table 4 .

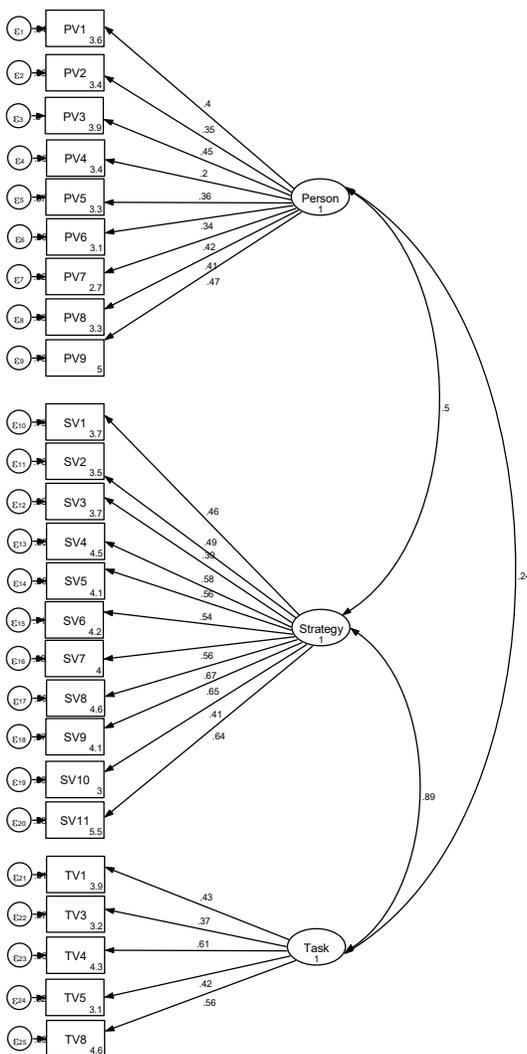


Figure 1. The three-factor model with standardized factor loadings, error variances and covariance between the three factors of the 25- item Metamemory in Adolescence scale. Note: PV, person variable item; SV, strategy variable item; TV, task variable item; with the numbers beside them denoting the item number.

Table 3  
Intercorrelation between the three factors of Metamemory in Adolescence scale.

Factors	Person variable	Strategy Variable	Task Variable
Person variable	1		
Strategy Variable	0.4*	1	
Task Variable	0.1	0.62*	1

\* Significant at 0.001 level

Table 4  
Covariance between the three factors of Metamemory in Adolescence scale

Factors	Person variable	Strategy Variable	Task Variable
Person variable	1		
Strategy Variable	0.5*	1	
Task Variable	0.24*	0.89*	1

\*Significant at 0.05 level

#### IV. DISCUSSION

The present study was conducted to develop a new self-report scale meant to assess declarative metamemory among adolescents and test its psychometric properties. A number of studies have reported scales on metamemory but to the best of our knowledge none of them address the metamemory of adolescents from academic learning perspective. The plethora of curricular and co-curricular activities that adolescents have to engage during school hours place great demands on their cognitive resources, memory being an inevitable one. The conceptualization that memory performance is influenced by three sets of factors, namely person variables, strategy variables and task variables, formed the basis of the present scale.

Initially, a 30- item scale was subjected to content validity analysis which revealed the degree to which the items developed for the tool were representative of DM as well as its three dimensions or factors. Modification of items were undertaken based on the content validity indices and expert suggestions. Also, the comprehensibility, ambiguity and clarity of the items were taken into consideration while making changes.

The internal consistency of the resultant 28-items scale was examined. Following the omission of three reverse items revealed the scale as being highly reliable. Thereafter, psychometric properties were examined with the scale finally comprising of 25-items ( see Appendix ).

Results of CFA revealed that a 25-item three factor model adequately fit the data. The superiority of a three factor solution over a single factor solution in terms of estimates of fit indices is indicative of the multidimensional nature of the scale. As suggested by previous studies, the construct of metamemory is multidimensional in nature (Troyer and Rich, 2002; Gilewski, Zelinski and Schaie, 1990). This could justify the use of the subscales separately for the assessment of the separate dimensions of declarative metamemory.

The inclination of the mean scores towards the higher end of the possible range suggests that declarative metamemory was high in the present sample. Schneider and Lockl (2002) demonstrated that by the time individuals reach adolescence, they develop impressive knowledge about memory strategies and factual knowledge about memory. So, the present finding is in line with previous research. Mean scores on the higher end in case of person variable factor might be suggesting that adolescence not only develop impressive factual knowledge

about memory but are also self aware of their memory capacity and limitations.

There was no a-priori hypothesis about the relationship between the scale domains. It was observed that the domains were intercorrelated with the exception of correlation between person variable and task variable. The observed relationship between the person variables domain and strategy variables domain suggests an association between self-awareness about memory competencies and general knowledge about relative effectiveness of memory strategies. Ideally, it is expected that individuals who can make appropriate metacognitive judgement about their memory make use of efficient memory strategies that suit their needs. This warrants them to have the knowledge about the various memory strategies even though they might not necessarily make use of those strategies. A significant relationship between strategy variables and task variables domains is an indicator of the possibility that the knowledge about various memory strategies develops in the context of knowledge about memory task characteristics and demands. Finally, an individual's general perception of his or her memory competence may develop as a result of various social factors such as judgements and remarks made by significant others and does not solely take shape as a result of exposure to memory demanding situations. This could be a possible reason for a non-significant and low correlation between person variables and task variables domain.

Overall, the 25-item scale showed promising psychometric properties which makes it a sound tool that can be used for assessing declarative metamemory among adolescents, both in classroom setting as well as for research purpose.

## V. LIMITATIONS AND FUTURE DIRECTIONS

Since the tool is at its infancy stage, there are a number of issues that still need to be addressed. A limitation of the study is that the convergent validity could not be established due to lack of similar metacognitive tools for adolescents. However, the validity of the scale could be established by examining the association of the subscales with measures of constructs such as memory self-efficacy, locus of control, academic achievement, etc. It might be reasonable to expect that an individual's knowledge and beliefs about his or her memory will have some reflection on the aforementioned constructs and vice versa.

Another limitation of the study was that we did not examine the item characteristics in terms of item difficulty and discrimination. Further research examining item characteristics will assist in refining the items which in turn can be expected to bring about improvement in model fit with respect to the existing factor structure.

Additional research can be undertaken to use the tool to explore the developmental trend of declarative metamemory across the substages of adolescence, viz., early middle and late adolescence. It is a well established fact that cognitive skills exhibit an accelerated growth during the adolescent phase of life. Finding out whether this applies to metacognitive knowledge as well, would further upgrade our understanding of the related mechanisms underlying the development of cognitive functions (memory, in this case).

## VI. CONCLUSION

The present study was an attempt to introduce a scale for assessing declarative metamemory of adolescents from a holistic standpoint. Extant literature witnesses a lack of such a self-report measure which gauges declarative metamemory for the adolescent age group, especially from an academic learning perspective. In this study, we attempted to address this issue by developing the Metamemory in Adolescence scale. The robustness of the measure was examined through (i) content validity analysis; (ii) internal consistency analysis; (iii) confirmatory factor analysis; and (iv) factor intercorrelations.

The findings thus obtained provide evidence for the scale being a reliable and valid measure of self-referential beliefs and factual knowledge about different aspects of memory. However, additional research is required for the further refinement and improvement of the scale in terms of item characteristics.

## APPENDIX

The items included in the final version of the scale are listed as follows. The values in parentheses represent the respective factor loadings for each item.

### Person variable

1. I find it hard to remember words that are difficult for me. (.40)
2. I feel I can improve my memory. (.35)
3. I feel confident of remembering what I learn in school. (.45)
4. I give up easily when I cannot remember an answer. (.20)
5. I know exactly how much I will be able to remember after learning a lesson. (.36)
6. I forget important points of a lesson I learnt. (.34)
7. I remember lessons better than my friends. (.42)
8. I think my memory will improve when I grow older. (.41)
9. I remember my lessons because I pay attention in class. (.47)

### Strategy variables

1. Rhyming a new word with a known word helps us remember it. (.46)
2. Using acronyms (e.g. VIBGYOR for order of colors in a rainbow) can help us remember list of words. (.49)
3. Writing down the steps of a process (e.g., steps in math problems) is a good way to remember the process. (.39)
4. Asking ourselves questions about the learnt lesson can help us remember the lesson. (.58)
5. Creating a picture in our mind of what has been read is a good way to remember the lesson. (.56)
6. Learning a chapter, again and again, can help us remember the lesson. (.54)
7. Relating new concepts with known concepts helps us remember them better. (.56)
8. Underlining/markings important points in the textbook help us to memorize them. (.67)
9. Asking a friend to quiz us on a lesson that we learnt can improve our memory for the lesson. (.65)
10. Going through the alphabets one by one can help remember a word that we have forgotten. (.41)

11. Understanding the meaning of words helps us remember them better. (.64)

#### Task variable

1. In an exam, answering multiple choice questions is easier than answering subjective questions. (.43)
2. A recently learnt lesson (say 1 or 2 hours ago) is easy to recall compared to the one learnt a week ago. (.37)
3. Diagrams in a chapter help us remember details better. (.61)
4. A story is easier to remember than an informative chapter (e.g. geography chapter). (.42)
5. Pictures in a chapter help us remember the information better. (.56)

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# Knowledge, Attitude and Barriers to Hormonal Contraceptive Use among Women with Sickle Cell Disease in the Kumasi Metropolis of Ghana

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## ABSTRACT

Despite the non-contraceptive benefits hormonal contraceptives offer to women with haemoglobin SS, the utilization of hormonal contraceptives is on the decrease. The study sought to assess the knowledge, attitudes and barriers to the use of hormonal contraceptives among women with SCD in the Kumasi metropolis. The study used questionnaires to collect primary data from 378 women with haemoglobin SS within their reproductive ages. The results of the study showed that knowledge was not significantly associated with the use of contraceptives among women with SCD. Attitude was found to be significantly associated with the use of contraceptives among women with SCD. Principal barriers to contraceptive use were: discussion of contraceptive method with partner, informing partner of use, partner's support for use and wanting to get pregnant. It is recommended that Ghana's Ministry of Health and its agencies, Planned Parenthood Association of Ghana, Marie Stopes International-Ghana should scale up awareness and education among respondents and their partners on both the contraceptive and non-contraceptive benefits of progestin-only contraceptives for women with SCD and how it can improve their quality of life. Partner cooperation and approval should be given priority in all family planning programmes.

**Index Terms:** Knowledge, Attitude, Barriers to Hormonal, Contraceptive Use, Sickle Cell Disease, Kumasi Metropolis.

## I. INTRODUCTION

Globally, 300,000 children are born every year with sickle cell disease (SCD) (Agyun & Odame, 2012; Model & Darlison, 2008; Weatherfall, 2011). It is estimated that 75-80% of children born with SCD are born in Africa (Agyun & Odame, 2012; Makani et al. 2011). Consequently, the birth prevalence of SCD is high in Africa. In Ghana about 2% of neonates are affected by SCD leading to 14,000 new cases annually (Wilson et al. 2012).

Empirically, the use of hormonal contraceptives by women with SCD remains controversial as some researchers have associated the occurrence of strokes and thromboembolism to the long term use of some hormonal contraceptives in women with SCD. Despite the negative publicity hormonal contraceptive use in SCD has received, good evidence exists that the injectables and progestin-only contraceptive methods are safe and effective for women with sickle cell disease. The IUD appears to be safe as are the common barrier methods, while combined oral contraceptive pill is contraindicated for use in women with SCD.

In Ghana, pregnant women with SCD who delivered at Korle-Bu Teaching Hospital in Accra accounted for ~7.2% of all maternal mortality cases in the hospital (Dare et al.1992: Odum et al. 2002). This figure is similar to what has been observed in other studies across Africa (Dare et al. 1992: Odum et al. 2002). This high maternal mortality in pregnancy suggests that in sub-Saharan Africa, the health of women with SCD is severely compromised during pregnancy. Each birth of a child by women with SCD poses significant risk for maternal mortality. It also important to note that Ghana, like other developing countries beset by high maternal and child mortality rates, has the most to gain from family planning's numerous health benefits such as reducing a woman's exposure to unintended pregnancies, reducing the number of abortions and abortion-related complications as well as illnesses related to complications of pregnancy and childbirth. Adherence to contraceptive method and discontinuation of contraception for method-related reasons is common, and accounts for a significant proportion of unintended pregnancies since many women switch to less effective methods or use no method at all.

## Problem Statement

Historically, women with sickle cell disease experience difficult pregnancies, characterized by high rates of maternal

mortality and morbidity and poor infant outcomes (Amid & Odame, 2014). Unresolved questions about hormonal contraceptives in women with sickle cell disease include whether using hormonal contraceptives may promote vaso-occlusive crisis. Women with sickle cell disease therefore need adequate family planning advice to prevent unwanted pregnancy. Due to limited data, it is difficult to account for the number of unwanted pregnancies among women with SCD in Ghana. The use of hormonal contraceptives alone by women with sickle cell disease can reduce accidental pregnancies by 73% and associated maternal deaths by 75% (Klufio, 2014).

Interestingly, Depomedroxyprogesterone acetate offers non contraceptive benefits to women with SCD. Women with SCD were less likely to experience vaso occlusive crisis while using the injectable birth control known as Depo (a progestin contraceptive) (Gomez et al. 2012). Gomez et al. (2012) further adds that progestin only contraceptives decreases the intensity and frequency of bone pain associated with vaso-occlusive crisis. Depomedroxyprogesterone acetate (DMPA) is an increasingly popular contraceptive in sub-Saharan Africa (Adetunji, 2006).

Social, economic, and cultural characteristics of patients with sickle cell disease are important in assessing their knowledge, attitudes and barriers that influence their ability to access reproductive health services including contraceptives uptake (Housten et al. 2015). Patients with sickle cell disease are often poorer than the national average and are more often covered by Medicaid (Ashgarian & Anie, 2003). The psychosocial and/or economic impact of SCD on families, religious beliefs, experiences resulting from the presence an affected child for SCD, and future chance of having a healthy child may influence reproductive options (Wonkam et al. 2014). The effective control of conception leads the society to an indisputable advance, as it facilitates the emancipation of women. Additionally, planned pregnancies increases the participation women in the labor market and matches the number of children to the economic conditions of women (Cruz Santos et al. 2014).

According to Rapley and Davidson (2010), hormonal contraceptive decisions among women with SCD are heavily influenced by several external factors. Factors such as health care access, psychosocial needs, and community understanding of the disease mostly affect contraceptive decision among women with SCD (Rapley & Davidson, 2010). Other factors that influence contraceptive decisions include perceptions of miscommunication between patient and their partners.

Hormonal contraceptive offers non-contraceptive benefits for women with sickle cell disease (SCD) and these include reduction in the episodes (frequency) and the severity vaso-occlusive crisis associated with the disease. Current literature on hormonal contraceptives mainly focuses on either experiences of the general population or combines the experiences of women with SCD and those of the general population. Current SCD family planning recommendations

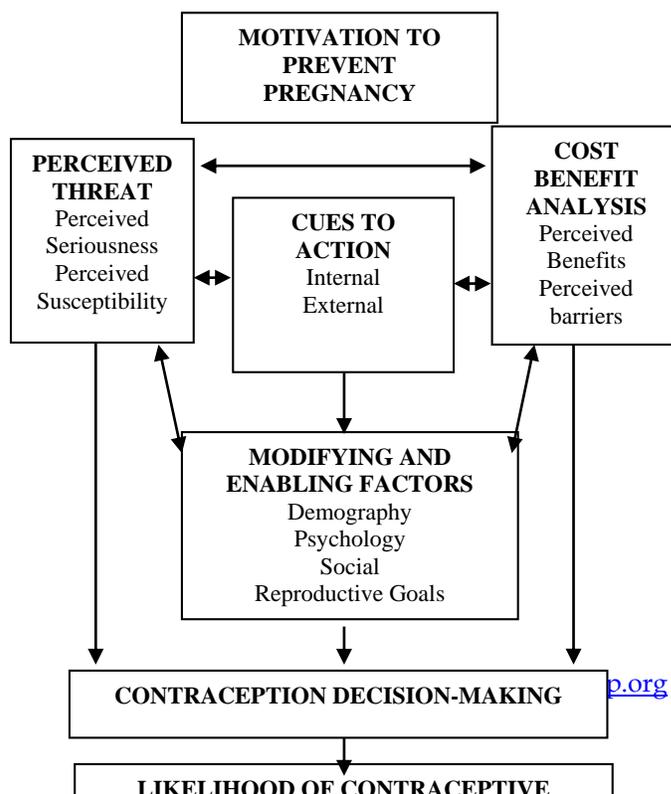
are most often based on lower quality evidence, expert consensus opinion, or adaptation of evidence from other patient populations (Savage et al. 2014). Therefore, every aspect of SCD care warrants additional evidence to guide appropriate reproductive health interventions. Thus, the main objective of the study was to investigate the association between knowledge, attitude, principal barriers and use of contraceptives among women with sickle cell disease.

**II. Theoretical Framework**

**The Health Belief Model (HBM)**

A modified model of Rosenstock’s (1974) Health Belief Model (HBM) (Figure 2.1) served as the framework to understand contraceptive behavior of women with sickle cell disease (SCD). The HBM is a cognitive, interpersonal framework that views humans as rational beings who use a multidimensional approach to decision-making regarding whether to perform a health behavior (Rosenstock, 1974). The model is appropriate for complex preventive and sick-role health behaviors such as contraceptive behaviour.

The HBM's adaptability and holistic nature facilitate applications in diverse contexts like family planning and with complex behaviors like hormonal contraceptive behavior (Katatsky, 1977; Nathanson, 1983). Family planning is a dynamic and complex set of services, programs and behaviors towards regulating the number and spacing of children within a family (Janz & Becker, 1984). Contraceptive behavior, one form of family planning which WHO (2011) refers to as activities involved in the process of identifying and using a contraceptive method to prevent pregnancy. These activities can include specific actions such as hormonal contraceptive initiation, continuation or discontinuation, misuse, nonuse, and more broadly compliance and adherence (Hall et al. 2010).



**Figure 2.1: Constructs of the Health Belief Model (Source : Rosenstock, 1974)**

Modifying or enabling factors in fig 2.1 are factors that interact with an individual's perceptions of pregnancy and decision-making to influence contraceptive use. This dimension includes a broad range of well researched demographic, social, structural, psychological and reproductive factors predictive of hormonal contraceptive behavior (Rosenberg & Waugh, 1998; Lin & Hingson, 1974).

The general argument focused on the role of motivation. That is the motivation to prevent an unwanted pregnancy would predict hormonal contraceptive compliance just as the motivation to prevent a disease would predict medication therapy compliance.

**Cues to Action**

Cues to action in fig. 2.1 above are internal and external stimuli that trigger a consciousness of the perceived pregnancy threat and facilitate consideration of using hormonal contraception to remedy the threat. This may include symptoms like missed menses after intercourse (internal stimuli) or contraceptive communication from the media, and worry from a sexual partner or counseling by a health care provider (external stimuli) (Egarter et al. (1997); Kaunitz, 1999).

**Perceived Threat**

Perceived threat (susceptibility and seriousness) may refer to an unwanted pregnancy and its sequelae (i.e. birth, abortion, parenthood) provides the incentive to use hormonal contraception. This construct considers personal feelings of the seriousness of becoming pregnant, based upon subjective assessment of medical and social consequences of pregnancy and childbearing.

**Socio-demographic variables as predictors of use of contraceptive methods**

In developing countries, use of modern contraceptives including use of hormonal contraceptive methods can be influenced by the socio-demographic characteristics of women. Indian studies have shown that woman's education emerges as the strongest predictor of use of contraceptive methods (Das et al. 2011). In one Yemen study, parity, age, marital status, religion, husband's education, husband's occupation, monthly family income, and woman's occupation were found to be associated with use of contraceptive methods (Almuallm, 2014).

The principal predisposing and enabling factors affecting use of hormonal contraceptive methods by women with sickle cell disease were socioeconomic status, level of knowledge, communication between spouses and education (Almuallm, 2014; Kessy & Rwabudongo, 2016). This leads to the conclusion that the main limiting factors to the use of contraceptive methods in the state are poverty, ignorance, and illiteracy.

Studies in Sudan, an Islamic country in the developing world, very few women reported that the use of contraceptive methods was against religion or cultural beliefs, knowledge of use was therefore far from being universal (Ibnouf et al. 2013). Religions vary widely in their views of the ethics of birth control. The Roman Catholic Church accepts only Natural Family Planning and only for serious reasons, while Protestants maintain a wide range of views from allowing none to very lenient (Nakiboneka & Maniple, 2008; Hirsch, 2008).

**III. METHODOLOGY**

**Study Design and Study Setting**

The study employed a cross sectional descriptive design aimed at assessing factors that influence hormonal contraceptive use by clients with sickle cell disease in the Kumasi Metropolis. Cross-sectional design was the appropriate choice of design because, the investigator was interested in assessing the characteristics of women with SCD and the influence of the level of knowledge, attitudes and barriers on the use of hormonal contraceptives among women with SCD attending health facilities.

**Study Population**

The study population was women with SCD aged between 15-49 years who were returning on an out-patient basis after expiration of previous contraceptive and for resupply of hormonal contraceptives, routine follow-up or those with problems associated with the use of a specific hormonal contraceptive method. The women were selected from five hospitals in the Kumasi Metropolis.

**Sample and Sampling Procedure**

According to the Ghana Health Service District Health Information system (2017), the total attendance of women with SCD aged 15-49 years for 3 months at the hospitals was 507. The sample size was determined using the Kish (1965) formula  $n(\text{minimum sample size}) = Z^2 pq/d^2$   
 $Z = \text{Area under the normal curve corresponding to 95\% confidence interval (CI)} = 1.96$ .  $P = \text{Expected prevalence of hormonal contraceptive use among women with SCD}$  was estimated using a case control study by Samuel-Reid et al (1984). Prevalence of hormonal prevalence for this study ( $p$ ) = 33% = 0.33.  $q = 1 - p = 1 - 0.33 = 0.67$ ;  $d = \text{level of statistical significance/maximum tolerable error} = 0.05$ . Assuming non-response rate is 10 per cent. Therefore, adjustment for non-response =  $339.75/0.9$ . Therefore, the estimated total sample size ( $n$ ) for the study was 378.

Two stage sampling technique was used to select the hospitals and the women with sickle cell disease. At stage one, the hospitals in the metropolis were divided among the five sub metros in the Metropolis. The number of respondents to be recruited from each facility was determined using proportionate sampling. A facility was randomly selected from each sub-metro using balloting. At stage two, all women who attended the clinics during the three months' period of the study and consented to participate in the study were enrolled. This was repeated until the required sample size was attained for each facility in each sub-metro.

### Data Collection

A semi-structured questionnaire was designed as the data collection instrument. The questionnaire was written in English and translated to Twi which was the local language spoken in Kumasi, by a language expert and transcribed back to English to check for consistency and correctness of the translation. Validity and reliability of the instrument was done through relevant literature search. The minimum Cronbach's coefficient alpha of 0.7 was used to measure the internal consistency and determined the reliability of the questionnaire used for the study. The questionnaire was administered in all the selected facilities by the principal investigator with the help of two supervisors and ten data field assistants who were trained intensively for four were prior to data collection.

### Variables

Dependent variables were knowledge, attitude and barriers of women with SCD regarding hormonal contraceptive use. Independent variables were educational qualification, age of women of reproductive age group, parity and religion.

The level of knowledge was assessed using a Likert scales for various items on the questionnaire compared with the proportion of use of hormonal contraceptive use, same was done for attitudes as well as barriers. The research results were then presented in the form of frequency tables showing the frequency of responses to the research questions. Logistic regression was used to determine the associations between each of the independent variables and the dependent variables. All statistical tests were considered statistically significant at  $p < 0.05$ .

A reliability test (Chronbach's alpha) was conducted on the "knowledge subscale" for the survey. Table 3.1 shows that, "knowledge subscale" had an alpha level of 0.865 which indicated that the subscale had a very high and adequate level of inter-item reliability.

**Table 3.1: Validity Test of Subscale**

Parameter (Subscale)	Cronbach's Alpha	No. of Items
Knowledge	0.865	16

Source: Field Survey, 2020

The attitudes of sexually active respondents towards hormonal contraceptives were computed into cumulative percentages and graded into three classification levels according to Rubaish, (2010) namely: Poor/Improvement required (<60%), Acceptable/good (60-80%), Excellent/High (81-100%). The nine barriers posed to respondents were analyzed using Principal Component Analysis (PCA) to identify the principal barriers to contraceptive use among the study participants. Data adequacy and suitability for PCA was validated using the Kaiser-Meyer-Oklun (KMO) test with data coefficient of 0.637 and the Bartlett's Test of sphericity at 99% confidence interval shown to be significant ( $p < 0.0001$ ). The investigator used Chi-square values to determine whether the differences between the theoretical and observed measures could be reasonably regarded as chance variation.

### Results and Discussion

The study population involved women with SCD aged between 15-49 years who were returning after expiration of previous contraceptives for routine follow up as well as those returning with problems associated with the use of a specific hormonal contraceptive method.

#### Relationship between Socio-Demographic Characteristics and the Attitude of Respondents towards Contraceptive Use

Table 4.3 shows the relationship between socio-demographic characteristics and the attitude of respondents towards contraceptive use. Age of the study participants was found to be significantly associated with attitude towards contraceptive use,  $\chi^2=24.892$ ,  $p=0.023$ . Among participants aged 15-19 years who were sexually active, a higher proportion (4.8%) had an excellent attitude towards contraceptive use. This pattern was similar among ages 35-39years, 40-45 years and 46-49 years. For those aged 20-24 years their highest proportion 19 (19.4%) had poor attitude towards contraceptives use. A similar outcome was observed among ages 30-34 years.

**Table 4.3: Relationship between socio-demographic characteristics and attitude of sickle cell disease women towards contraceptive use**

Parameter		Attitude towards contraceptive						d(f)	X2	p value
		Poor		Acceptable		Excellent				
		N	%	N	%	N	%			
Age (yrs)	15-19*	4	4.1%	1	2.0%	4	4.8%	12	24.892	0.023
	20-24*	19	19.4%	3	6.0%	5	14.3%			
	25-29	23	23.5%	24	48.0%	11	30.7%			
	30-34 years	47	48.0%	20	40.0%	14	42.9%			
	35-39 years	4	4.1%	2	4.0%	4	5.3%			
	40-45 years	1	1.0%	0	0.0%	2	1.6%			
	46-49 years	0	0.0%	0	0.0%	1	1.0%			
Qualification	No formal education	45	45.9%	21	42.0%	22	53.7%	8	14.665	0.067
	SSSCE	13	13.3%	7	14.0%	9	22.0%			
	Diploma/HND	2	2.0%	6	12.0%	0	0.0%			
	1st Degree	1	1.0%	0	0.0%	0	0.0%			
	Masters Degree	37	37.8%	16	32.0%	10	24.4%			
Marital Status	Single	33	33.7%	12	24.0%	10	24.4%	4	5.572	0.092
	Married	65	66.3%	38	76.0%	30	73.2%			
	Separated	0	0.0%	0	0.0%	1	2.4%			
Parity	Nulliparous	34	28.0%	14	28.0%	4	9.8%	8	22.978	0.003
	Primiparous	16	16.3%	9	18.0%	6	14.6%			
	Para 2	23	23.5%	13	26.0%	8	19.5%			
	Para 3	9	9.2%	10	20.0%	16	39.0%			
	Para 4 and Above	16	16.3%	4	8.0%	7	17.1%			
Occupation	Unemployed	25	25.5%	9	18.0%	2	4.9%	6	24.877	0.0001
	self Employed	44	44.9%	13	26.0%	19	46.3%			
	Student	11	11.2%	3	6.0%	8	19.5%			
	Employed	18	18.4%	25	50.0%	12	29.3%			
Religion	Christian	51	52.0%	40	80.0%	12	29.3%	4	32.316	0.0001
	Islamic	47	48.0%	9	18.0%	25	61.0%			
	Traditional	0	0.0%	1	2.0%	4	9.8%			

χ- Square analysis: Data= frequencies (N) & Percentages (%), d (f) = degree of freedom, χ- Square analysis: Data= frequencies (N) & Percentages (%), d (f) = degree of freedom, significance (2-sided) was achieved at p<0.05.



The educational qualification of the study participants was not found to be significantly related to their attitude towards contraceptive use,  $\chi^2=14.665$ ,  $p=0.067$ . Also, marital status was not significantly associated with attitude towards contraceptive use,  $\chi^2=5.572$ ,  $p=0.092$ .

Parity was found to be significantly associated with the attitude of respondents towards the contraceptive use,  $\chi^2=22.978$ ,  $p=0.003$ . Nulliparous women generally had a poor attitude towards contraceptive use, primiparous and para 2 women had a moderate attitude towards contraceptive use while para 3 and para 4 had an excellent attitude towards contraceptive use.

Occupation was found to be significantly associated with the attitude of respondents towards the contraceptive use  $\chi^2=24.877$ ,  $p<0.0001$ . Unemployed participants generally had poor attitude towards contraceptive use. For self-employed participants, students and the employed, highest proportions had excellent attitude towards contraceptive use.

Religion was significantly associated with attitude towards contraceptive use,  $\chi^2=32.316$ ,  $p<0.0001$ . Proportionally, a majority of Christians had acceptable attitude towards contraception, while a majority of Islamic religion and traditional religion practitioners had excellent attitude towards contraceptive use.

From this study, there was a significant association between the knowledge on progestin-only contraceptives and respondent's educational qualification, marital status and parity. Women with higher educational qualifications may have been introduced to various forms of contraceptives including progestin-only contraceptives. Education has been shown to be greatly associated with knowledge in many correlation studies (Patton et al. 2015). The results from this study support previous studies that showed that increased education was associated with knowledge in contraception (Ochako et al. 2015).

Marital status was also significantly associated with knowledge on hormonal contraceptives. In typical African societies, contraceptive use is only permissible for married couples. Due to the judgemental attitudes of the society, single women who openly talked about contraceptives may be tagged with promiscuity (Johnson et al. 2013). It was therefore not surprising that, women who were married were better placed in providing correct responses to the questions on progestin-only contraceptives. In addition, married women engage more in sexual activities more than the unmarried partners do.

Additionally, results from this research showed that parity was also significantly associated with knowledge on progestin-only contraceptives. The results obtained indicated that the higher the parity of the woman, the better the knowledge on contraceptives including progestin-only contraceptives. This could be attributed to the increase in antenatal clinic sessions that pregnant women usually attend. Current research in Ghana shows that there has been an increase in the access,

availability and usage of antenatal visits (Baffour-Awuah et al. 2015).

### **Association between Knowledge, Attitude, Principal Barriers and Use of Contraceptives**

Table 4.4 (in Appendix) describes the association between knowledge, attitude, principal barriers and use of contraceptives. It was observed that, knowledge was not significantly associated with the use of contraceptives among respondents,  $\chi^2=0.136$ ,  $p=0.672$ . However, the risk that one with poor knowledge on progestin-only contraceptives would not use contraceptives was 1.04 times higher than among those with good knowledge.

Attitude was found to be significantly associated with the use of contraceptives among respondents,  $\chi^2=205.726$ ,  $p<0.001$ . Among the four identified as principal barriers to contraceptive use namely: discussion of contraceptive method with partner, informed partner of use, partner's support for use, wanting to get pregnant, the latter two were shown to be associated with contraceptive use ( $\chi^2=9.203$ ,  $p=0.006$  and  $\chi^2=13.354$ ,  $p=0.001$ ).

The results from this study thus support previous studies that showed that increased education was associated with knowledge in contraception (Ochako et al. 2015). Furthermore, there was a significant association between the knowledge on progestin-only contraceptives and respondent's educational qualification, marital status and parity. Women with higher educational qualification may have been introduced to various forms of contraceptives including progestin-only contraceptives. Education has been shown to be greatly associated with knowledge in many correlation studies (Patton et al., 2015).

It was observed that, knowledge was not significantly associated with the use of contraceptives among respondents,  $\chi^2=0.136$ ,  $p=0.672$ . However, the risk that those with poor knowledge of contraceptives would not use them was 1.04 times higher than in those with good knowledge. Attitude was found to be significantly associated with the use of contraceptives among respondents,  $\chi^2=205.726$ ,  $p<0.001$

Out of the nine barriers identified, four components which had eigen value  $>1$ , and could contribute more half of the total variance were extracted as the principal barriers to contraceptive use. Partners support for contraceptive use and women wanting to get pregnant were the only two factors among the principal barriers that hindered respondents from using hormonal contraceptives.

## **IV. SUMMARY AND RECOMMENDATIONS**

Based on the results, respondents had poor knowledge on progestin-only contraceptives, poor attitudes towards hormonal contraceptives and two principal barriers: partners support for contraceptive use and women wanting to get

pregnant hindered respondents from using hormonal contraceptives.

It is recommended that Ghana's Ministry of Health and its agencies, the Planned Parenthood Association of Ghana, Marie Stopes International-Ghana should scale up awareness and education among respondents and their partners on both the contraceptive and non-contraceptive benefits of progestin-only contraceptives for women with SCD and how it can improve their quality of life. Communication through mass media (radio, television, or print) may help to improve the knowledge of respondents, and thereby increase the use of progestin-only contraceptives and dispel the myth and misconceptions about their use.

Partner support for use was still a barrier to hormonal contraceptive utilization despite the volumes of education. Women seeking partners consent prior to use implied women rights for self-determination were being infringed upon by their partners. It is therefore recommended that family planning educational programmes targets women empowerment activities as well as strategies to whip up partner support for contraceptive use. Partner support could be enhanced through the concept of male involvement at child welfare clinics, antenatal clinics, men's golf clubs, seminars and workshop for women with SCD and their partners, and also health professionals visiting communities to educate partners within the community. Health care providers using these educational avenues must carefully broach the concept of contraceptive use in sickle cell disease to partners of these respondents. Group therapy sessions involving partners of respondents should be incorporated into the educational sessions at these centres to educate partners that allowing women with SCD to use progestin-only contraceptives prevents the risk of poorly timed pregnancies that jeopardize their health, prevents unwanted pregnancies with its associated ramifications such as criminal abortions, child abandonment and students dropping out of school.

Patients with sickle cell disease are often poorer than the national average. It appeared respondents were therefore unable to afford the cost of long-term efficacious contraceptive methods. To reduce the unmet contraceptive needs of women with SCD, it is recommended that the Ministry of Health adds contraception to services covered by the National Health Insurance Scheme (NHIS) so that women with SCD who are subscribers of the NHIS in the Kumasi Metropolis could access service without having to pay out of pocket.

### Suggestions for Future Research

Firstly, since the study focused on assessing the knowledge, attitude and barriers to hormonal contraceptive use among women with sickle cell disease in the Kumasi metropolis of Ghana, it is suggested that future studies should cover all the districts and municipalities in Ashanti Region, of which Kumasi is the capital in order to strengthen generalization of the findings.

Furthermore, it is suggested that future studies must examine the knowledge, attitude and barriers to hormonal contraceptive use among partners of women with sickle cell disease, since the study found that partners disapproved the use of hormonal contraceptives for their female partners. Additionally, questionnaires were the only instrument used to gather data; it is therefore recommended that future studies include in-depth interviews and focus group discussions to obtain the diverse views of respondents.

Lastly, it is recommended that future studies focus on level of knowledge and awareness of health workers on the safety of use and non-contraceptive benefits of hormonal contraceptives in women with SCD. Education on hormonal use is a vertical process i.e. from the health workers to the clients. The lack of awareness and safety of use of progestin-only contraceptives in women with SCD may be an indication that gaps exist in education and awareness among health workers as well.

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APPENDIX

**Table 4.6: Association between knowledge, attitude, principal barriers and use of contraceptives**

Parameter		Use of Contraceptives				$\chi^2$	p value (2-sided)	RR (95% CI)
		Yes		No				
		N	%	N	%			
Knowledge	Poor	61	25.1%	182	74.9%	0.136	0.672	1.04(0.83-1.31)
	Good/Acceptable	9	28.1%	23	71.9%			
Attitude	Poor	1	0.7%	141	99.3%	205.726	<b>&lt;0.001</b>	Nil
	Good/Acceptable	15	19.0%	64	81.0%			
	Excellent	54	100%	0	0.0%			
Discussion of contraceptive method with partner	Yes	42	25.3%	124	74.7	1.675	0.238	Nil
	No	31	24.8%	94	75.2%			
	No partner as yet	0	0.0%	5	100%			
Informed partner of use	Yes	36	22.4%	125	77.6%	1.618	0.222	1.09 (0.95-1.25)
	No	37	28.9%	91	71.1%			
Partner's support for use	Yes	33	27.5%	87	72.5%	9.203	<b>0.006</b>	Nil
	No	10	23.3%	33	76.7%			
	I don't know	0	0.00%	26	100%			
Wanting to get pregnant.	Yes	10	10.5%	85	89.5%	13.354	<b>0.001</b>	Nil
	No	49	29.7%	116	70.3%			
	No partner as yet	11	30.6%	25	69.4%			

$\chi$ - Square analysis: Data= frequencies (N) & Percentages (%), significance (2-sided) was achieved at  $p < 0.05$ , RR (95% CI) for non-use of hormonal contraceptives.

# Awareness and Perceptions of Biological and Chemical Safety in Laboratories by Polytechnic Students; Implications for Professionalism

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**Abstract-** This study examines the awareness and perceptions of biological and chemical safety in laboratories among Polytechnic students at the Delta State Polytechnics at Ozoro and Otefe-Oghara, Nigeria. The research design employed was cross-sectional survey. The study population comprises science laboratory students the Polytechnics in Delta state. A random sample size of 240 students from the Department of science laboratory Technology was selected. A questionnaire was designed to obtain responses from participants on their level of awareness and Perceptions of Biological and chemical safety in school science laboratories. Descriptive statistics was employed in data analysis. Pearson Correlation tested the research hypothesis. The findings reject the null hypothesis. There was positive correlation in the perception of relevance of compliance to basic Laboratory rules for safety by male and female science laboratory students. Turning off power, water and gas sources, after laboratory experiments is one of the cardinal safety measures in a science laboratory. Over seventy nine percent of the students (79.17%) admit that they usually forget to turn these sources off after completion or termination of laboratory experiments. The study recommends that trainers such as laboratory technologists and lecturers ensure that students obey safety procedures and practices while conducting laboratory experiments in school laboratories. This is imperative as graduates from the science laboratory technology departments are expected to be competent as professionals in handling of laboratory works. The government should also ensure proper monitoring of Laboratories within the State and ensure periodic provision of professional safety education to laboratory staff.

**Index Terms-** Awareness; chemical safety, school laboratory; hazards; compliance; professionals

## I. INTRODUCTION

A typical laboratory functions as suitable environment for research and teaching of science (Collins and O'Brien, 2008). In typical biology or Chemistry laboratories, there are stocks of materials that can be classified as potentially flammable and explosive in nature. Others may be irritants to the human skin and radioactive in nature. In essence, most science laboratories have chemicals and materials that can be health hazards to the

users and require care and knowledge of these materials on their utilization and storage.

The science laboratory is also designated as facility suited for teaching Science in academic institutions. It facilitates the achievements of scientific education for students in diverse scientific disciplines. There are however challenges inherent in the use and management of laboratories. These challenges may be linked to infrastructure decay or faults as well as human activities and behaviour when using the laboratory.

Generally, there are measures that can be adopted to ensure enhanced or improved Safety in school laboratories. It is imperative that the users have relevant knowledge of Laboratory risk Management and basic laboratory safety rules and regulations. This will prevent or reduce the risks of accidents and minimize damages to facilities and harm to users.

*Statement of the problem:* Science laboratory staff must be trained to acknowledge and apply safety practices when working in the laboratory. All types of devices, equipment and experimental procedures must only be used after due consideration to safety implications associated with them (Jo et al., 2002). Laboratory experiments should have defined procedures, precautions and instructions regulating them. Non-compliance to scientific procedures can lead to accidents. Often, this had been linked to users performing experiments in haste, without proper training on the use of equipment or adequate knowledge of the properties of the biological or chemical materials involved in the experiment.

Some empirical studies had highlighted the increasing levels of laboratory accidents occurring as a result of negligence in compliance to laboratory safety ethics and rules (Julius and Thomas, 2014; Ahlin & Weiss, 2007).

Other reasons deduced for laboratory related accidents and injuries, damages and losses include non-usage of personal protective equipment (PPE) in the laboratory, inadequate experience by laboratory staff or students, wrong use of chemicals, and wrong handling of emergency cases resulting from laboratory accidents (American Chemical Society, 2012; Schroder et al., 2016). Ensuring availability and effective utilization of First aid in the laboratory by laboratory managers is crucial to a safety in the Laboratory.

Some of the identified factors responsible for laboratory accidents include indifference to set down rules, lack of experience in experimental procedures, disregard for

manufacturers’ instructions equipment or chemical. Others factors include incidences of mistakes or errors in carrying out bench works or operating a machine. Understanding the labeling and codes associated with categorization of materials (biological and chemical) is needed to avoid consequences of wrong use of substances. Correct identification of established symbols and labels of substances found in the laboratory especially chemical labels is thus very crucial for forestalling laboratory accidents (Karapantsios et al., 2008).

*Aim of study:* The research seek to assess the knowledge, practices and attitudes of science laboratory students of the School of Applied Sciences at the two state owned Polytechnics located at Ozoro and Otefe –Oghara towns in Delta state. It also seek to examine students’ ability to identify potential biological and chemical hazards in the laboratory

*Research questions:* The research seek to answer the following research questions

1). what are the Science Laboratory Students’ Attitudes to and compliance with basic rules and safety procedures in the laboratory?

2). what are the reasons or factors responsible for Science Laboratory Students’ non-use of Personal Protective Equipment (PPE) in the Laboratory?

*Research Hypothesis:* The following null hypothesis is formulated for the research

Ho: There is no significant difference in the mean perception of relevance of compliance to basic Laboratory rules for safety by male and female science laboratory students

*Significance of the study:* The outcome of this study will be useful to policy makers and Regulatory body Polytechnics in Nigeria as they design and implement curriculum for the training of science laboratory technicians and technologist in Nigeria. The findings could be relevant to the Delta State government. They can also adopt and implement suitable safety measures from the research output for use in all the Science laboratories in institutions of higher learning in the State.

## II. MATERIALS AND METHODS

The study period lasted from August to October 2020. The study Population includes all science laboratory students in the two Delta State Polytechnics located in Ozoro and Otefe towns. The participants due to the curriculum content and training requirements for the award of National Diploma in Science Lobotomy Technology do have exposure to potential biological and chemical materials during their class work and laboratory practical activities. A sample size of 240 students was obtained by random sampling technique. All the participants received assurances of keeping their responses in the study confidential. The return rate of the completed questionnaire was a ninety six percent. A total of 240 out of 250 questionnaires were successfully retrieved from participants.

Stratified random sampling technique was employed in selecting 165 male and 75 female science laboratory students from the two Polytechnics in the study. schools, giving the sample size 240 students Instruments of Data collection

*Instrument for data collection:* for this research was a rating scale and a structured questionnaire administered to science laboratory students from the two Polytechnics in the study. The questionnaire was divided into two parts; part A and B. Part A consists of general information of the respondents such as gender, school, One of the rating scale items were structure as ‘YES’ and ‘NO’ while the other questionnaire items were structured in 4-point rating scale of Strongly Agreed (SA) = 4, Agreed (A) = 3, Disagreed (D) = 2 and Strongly Disagreed (SD) = 1 respectively to elicit information on perception of relevance of compliance to basic Laboratory rules for safety by male and female science laboratory students in the State owned Polytechnics. Statistical means of 2.5 and above are regarded as responses indicating ‘relevant’, while responses receiving mean score less than 2.5 are regarded as responses indicating ‘not relevant’

## III. RESULTS AND DISCUSSION

**Table 1: Science Laboratory Students’ Attitudes to and compliance with safety procedures in the laboratory**

Attitude/ compliance in the Lab	Yes		No	
	Frequency	%	Frequency	%
Always handling samples with hand gloves	100	41.67	140	58.33
Washing of hands before and after any laboratory process	75	31.25	165	68.75
covering of cuts , abrasions and injuries with waterproof plaster before engaging in Laboratory experiments	198	82.50	42	17.50
Use of laboratory coats in the laboratory	110	45.83	130	54.17
Eating, drinking, in the laboratory	170	70.83	70	29.17
Always using facemasks and goggles in the laboratory as required in experiment	72	30.00	168	70.00
Turning off power sources after laboratory experiments	50	20.83	190	79.17
Turning off water sources after use in laboratory experiments	50	20.83	190	79.17
Turning off gas sources after use in laboratory experiments	50	20.83	190	79.17
Always Reading equipment instructional manual before using them	95	39.58	145	60.42
Always checking the expiry date of chemicals and reagents before using them	58	24.17	182	75.83

Always ensuring the exit door during emergency is free from encumbrances during laboratory work	94	39.17	146	60.83
Always checking for prescribed precautions for each experiment in the laboratory	120	50.00	120	50.00
Ensuring hygiene/ alcoholic disinfectants after handling laboratory animals	80	33.33	160	66.67
Ensuring hygiene/use of alcoholic disinfectants after handling dishes with microbial contents in the laboratory	80	33.33	160	66.67
Ensuring a fully equipped first aid box in available during laboratory experiments	110	45.83	130	54.17
Ensuring a functional fire extinguisher is available in the lab during experiments	48	220.00	192	880.00

The attitudinal disposition of the Polytechnic students towards safety precautions and compliance with basic rules in the laboratory is relatively poor and a cause for safety concerns. The results show that 70.83% of them formed the habit of eating or drinking in the laboratory. The implication of this finding is that they lack knowledge of the health hazards posed by eating or drinking inside the laboratory. Food and drinks can have risk of chemical exposure in the lab leading to possible food poisoning (Hardy, 1999). Turning off power, water and gas sources, after laboratory experiments is one of the cardinal safety measures in a science laboratory. Over seventy nine percent of the students (79.17%) admit that they usually forget to turn these sources off after completion or termination of laboratory experiments. This is a potential risky attitude that can lead to fire incidents as well as electrical accidents such as electrocution or damage to equipment. However, findings indicate that 82.50% of the students would always remember to cover of cuts, abrasions and injuries with waterproof plaster before engaging in Laboratory experiments. This health related attitude is positive and needs to be encouraged among all the students and laboratory staff. Covering of cuts in the lab is recommended as this prevents possible infections of the wounds by pathogens or cut getting in contact with irritant chemicals (Percival et al., 2012; Izegebu et al., 2006; Odusanya, 2003).

Over seventy five percent (75.83%) of the students do not bother to read the equipment instructional manual before using them and 60.83% do not consider checking the expiry date of chemicals and reagents before using them. This attitude can be potentially risky as manufacturer’s manual is crucial to proper handling of equipment in the laboratory. This would prevent accidents and faulty results etc.

**Table 2: Participants responses to Reasons for non-Use of Personal Protective Equipment (PPE) in the Lab**

Factors /Reasons for non-use of PPE	Frequency	Percentage
Was not made compulsory by Lecturer./Technologist in charge of the Lab	168	70.00
PPE is expensive	195	81.25
Hinders free movement and activities in lab	110	45.83
Make the user Uncomfortable	45	18.75
Not made available by school	200	83.33

Analysis of the factors or reasons put forward by the students for non-use of PPE in the laboratory show that most of them (70%) do so because the use of PPE was not made mandatory by the staff in the laboratory all the time. This highlights the need for enforcement of basic laboratory rules in the school science laboratories. This will ensure the students ultimately imbibe in the need to be safety conscious as professionals and scientists.

Economic reasons were also put forward by the students as 81.25% of them consider PPE as expensive. The students also expected the Polytechnic authorities and the State government to provide PPE for students in the labs. About 83.33% of the students say they have not being using PPE regularly because the school did not make them available in the school laboratories. The use of personal protective equipment as revealed by this study is unsatisfactory. These finding are similar to those of Okebukola, et al (2020) that identified poor chemical safety in Nigerian secondary schools. It emphasized the need for training of the teachers and the need to ensure enforcement of laboratory safety regulations.

**Table 3: Participants response on relevance of compliance to basic Laboratory rules for safety by male and female science laboratory students**

S/N	Questionnaire item	Respondents	4 S A	3 A	2 D	1 S D	total	mean $\bar{X}$
1	Laboratory rules and regulations are necessary and relevant for safety in the laboratory	Male students	13	2	4	-	16	3.80
		Female students	62	8	5	-	75	3.74

The mean value of 3.80 and 3.74 indicates that the science laboratory students consider Laboratory rules and regulations as necessary and relevant for safety in the laboratory environment. The study regards Statistical means of 2.5 and above are as responses indicating ‘relevant’, while responses receiving mean

score less than 2.5 are regarded as responses indicating ‘not relevant’ The implications of this findings underpins the need for enforcement and training of the students on compliance with safety rules. The students know that the rules are relevant. However, they need enforcement mechanisms to ensure they do the right thing.

The null hypotheses formulated for the research were tested using Pearson Correlation analysis at 0.05 level of significance Table 4: Pearson Correlation analysis results on relevance of compliance to basic Laboratory rules for safety by male and female science laboratory students

Gender	N	Mean	SD	DF	r	r-critical	Remarks
Male	16	3.82	0.4	23	0.68	0.19	Significant
	5		4	8	8	5	
Females	75	3.74	0.5				
			7				

The calculated r-value of 0.688 is greater than the r-critical value of 0.195 at degree of freedom of 238 and 0.05 level of significance. This implies that the null hypothesis ( $H_0$ ) is rejected, and alternative hypothesis ( $H_1$ ) accepted. The findings show that there is a significant and strong positive relationship between Male and female science laboratory students’ perception on relevance of compliance to basic Laboratory rules for safety in the Laboratory environment.

#### IV. CONCLUSION

This study examined science laboratory students’ awareness and perceptions of Biological and Chemical Safety in science Laboratories. The findings indicate that students’ general perception and awareness for compliance to laboratory rules and regulations needs to be improved upon. It is imperative as it underpins the implications for their practice as technicians and/or technologist when they graduate and the need to uphold professionalism in the laboratory environments.

#### V. RECOMMENDATIONS

The present study recommends:

1) The Federal government of Nigeria should conduct a broad review of the National Board for Technical Education (NBTE) curriculum for Science laboratory technology training and certifications in Polytechnics in Nigeria. This is to ensure the curriculum provides for improved students’ awareness and compliance with laboratory safety measures while still at school.

The government should create multiple avenues for awareness and education on laboratory safety, ethics and best global practices. The social media, targeted advertisements and news channels can be harnessed to accomplish this goal.

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*APPENDIX*

**PART A**

**DEMOGRAPHIC DATA**

Please mark [  ] in the boxes to answer any of the corresponding questions below.

Gender: Male [  ] Female [  ]  
School [  ] [  ]

**PART B**

Please mark [  ] in the boxes to answer any of the corresponding questions below

Attitude/ compliance in the Lab		
	Yes	No
Always handling samples with hand gloves		
Washing of hands before and after any laboratory process		
covering of cuts , abrasions and injuries with waterproof plaster before engaging in Laboratory experiments		
Use of laboratory coats in the laboratory		
Eating, drinking, in the laboratory		
Always using facemasks and goggles in the laboratory as required in experiment		
Turning off power sources after laboratory experiments		
Turning off water sources after use in laboratory experiments		
Turning off gas sources after use in laboratory experiments		
Always Reading equipment instructional manual before using them		
Always checking the expiry date of chemicals and reagents before using them		
Always ensuring the exit door during emergency is free from encumbrances during laboratory work		
Always checking for prescribed precautions for each experiment in the laboratory		
Ensuring hygiene/ alcoholic disinfectants after handling laboratory animals		
Ensuring hygiene/use of alcoholic disinfectants after handling dishes with microbial contents in the laboratory		
Ensuring a fully equipped first aid box in available during laboratory experiments		
Ensuring a functional fire extinguisher is available in the lab during experiments		

Please mark [  ] in the boxes to answer any of the corresponding questions below

Factors /Reasons for non-use of PPE	Yes	No
Was not made compulsory by Lecturer./Technologist in charge of the Lab		
PPE is expensive		

Hinders free movement and activities in lab		
Make the user Uncomfortable		
Not made available by school		

Please mark [  ] in the boxes as appropriate

S/N	Questionnaire item	4 SA	3 A	2 D	1 SD
	Laboratory rules and regulations are necessary and relevant for safety in the laboratory				-
					-

SA= STRONGLY AGREE

A= AGREE

D= DISAGREE

SD= STRONGLY DISAGREE

# Overcoming the Difficulties Confronted by Grade 10 Students in Using Present Perfect Tense: A Study on T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka

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## ABSTRACT

Several English as a Second Language or English as a Foreign Language learners around the globe confront difficulties in using present perfect tense according to appropriate context. This study was conducted with the aim of overcoming the difficulties encountered by grade 10 students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka in using present perfect tense. In this study, 30 students in grade 10 were systematically selected for data collection, and quantitative method was used for data collection. A test and a questionnaire were used as research instruments. The test was set focusing on identifying the difficulties faced by the students in using present perfect tense. The questionnaire was designed to gather participants' opinions regarding grammar, tense and present perfect tense. The findings of the test show that 16 participants obtained 1 – 5 marks, 9 participants obtained 6 – 10 marks and 5 participants obtained 11 – 15 marks out of 15 in the test. The findings of the questionnaire show that 18 participants were disinterested in learning English, 21 participants liked to learn grammar than other components like reading, writing, speaking etc., 26 participants encountered difficulties in using tense according to appropriate situation and 27 participant faced challenges in forming and using present perfect tense. And, several factors such as insufficient knowledge of basic grammatical rule, lack of practice, insufficient knowledge of the use of tense and lack of writing and speaking activities regarding the use of Present perfect tense in classroom lead to face difficulties in forming and using present perfect tense. The ability of forming and using present perfect tense according to suitable situation can be improved when more emphasis is given to teach the correct use of tense and Present perfect tense practically, and give a number of reading, writing and speaking practices in classroom.

**Index Terms:** Appropriate, Confront, Present perfect tense, Teaching grammar, Tense

## 1. INTRODUCTION

English language has been the significant language around the globe since it is an international language. It is widely spoken as the first language, a second language or a foreign language. In several countries around the world, English language is recognized as the national or official language in every country, which seems the language of law, administration, business, education, media etc. According to Crystal (2006), 1.5 billion people speak English around the world. In this sense, English is learnt and spoken as a second language in Sri Lanka and the current status of English language is link language.

Abeywickrama (2008) says that English language is considered as a highly prestigious language which provides access to all kinds of privileges. As a result, more prominence is given to learning English in Sri Lanka. English is taught from grade 3 to 13 at government schools in Sri Lanka. According to General Certificate of Education (G.C.E) Ordinary Level (O/L) curriculum, English language is a compulsory subject. In a language, there are many sub-components in which grammar seems a significant component to improve the accuracy in both written and oral communication and to overcome the errors made by the speakers. In particular, learning grammar is significant for second/foreign language speakers. With regard to grammar of English language, tense is a vital part in verbal communication which takes part to develop grammatical accuracy (Cakir, 2011).

Nevertheless, the English as a Second Language (ESL) and English as a Foreign Language (EFL) learners confront difficulties in using appropriate tense in their writing and speaking according to the context. It is one of the challenges for a large number of ESL and EFL learners. As far as Sri Lanka is concerned, English Language is taught as a second language in educational contexts. English Language seems one of the compulsory subjects and English tense is introduced in the textbook from grade 6, which starts from simple present tense according to the ESL curriculum of Sri Lankan schools. Likewise, present perfect tense has been included in grade 10 textbook. Regarding present perfect tense, when a past action was related to the present, we use the "present perfect tense". Appropriately using present perfect tense in writing and speaking has been a challenge for most of the learners in Sri Lanka. In this sense, many grade 10 students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka encounter challenges in forming and using present perfect tense appropriately. Although some students are good at constructing correct sentences in present perfect tense, they are unable to use it in their writing according to its usage. Therefore, with the aim of overcoming the challenges and of improving the ability of using present perfect tense according to suitable context, this research was carried out.

### 1.1 Problem Statement

Tense is a significant element of English grammar to develop the accuracy of verbal communication. Therefore, according to the ESL school curriculum in Sri Lanka, English Tense is included as a major part in the school textbook from grade 6 to 13. However, learning Tense seems challengeable for most of the students, particularly in the use of tense according to appropriate situation. It was observed in classroom teaching that a large number of grade 10 students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka confronted difficulties in forming and using present perfect tense appropriately. Further, they were not aware of the signal words used in present perfect tense and got confused with simple past tense, past perfect tense and present perfect tense.

### 1.2 Objectives of the Study

- To identify the difficulties confronted by the grade 10 students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka in forming and using present perfect tense
- To explore the reasons that contribute to the difficulties in using present perfect tense
- To furnish appropriate remedies and recommendations to overcome the difficulties in forming and using present perfect tense

### 1.3 Hypotheses of the Study

- A large number of students in grade 10 encounter difficulties in using present perfect tense according to its proper usage in verbal communication.
- Lack of writing and oral practice is the major cause for learners' difficulties in using present perfect tense
- The ability of forming and using present perfect tense can be improved when number of reading, writing and speaking practices are given in classroom.

### 1.4 Significance of the Study

This study is significant for the grade 10 students of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka to overcome their difficulties in forming and using present perfect tense as well as to improve the ability of using present perfect tense in their writing. Further, this study is significant for the ESL teachers of T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka to implement the necessary remedies and recommendations to facilitate their teaching process. In particular, this study is beneficial for the ESL curriculum designers to bring a practical change in teaching grammar. Also this study is significant for all other ESL/EFL learners, teachers, material designers, test developers, and text book writers around the globe.

### 1.5 Limitations of the Study

In English language, tense seems a vast area which consists of three tenses and four aspects in each tense, and grade 10 students find difficulties in using each aspect of tense. Identifying a specific problem is challengeable when a vast area is considered for investigation in a research. Therefore, present perfect tense had been focused to identify the difficulties in forming and using present perfect tense. There are over 70 students in grade 10 at T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka. However, to limit this study, 30 students were selected as sample population for data collection. There are several primary research instruments for data collection in which two instruments such as test and questionnaire were chosen as the data collection instruments of this study.

### 1.6 Methodology

This study was carried out with the aim of overcoming the difficulties confronted by grade 10 students in using Present perfect tense appropriately. The setting of this research was T/Mu/Al Hilal Central College, Mutur, Trincomalee, Sri Lanka and the total population

of this study was 75 students in grade 10. Amongst the total population, 30 students were selected as sample population for data collection. With regard to sampling technique, systematic sampling technique was used to draw the sample of the study from the total population. Further, in this study, two instruments namely: test and questionnaire were used to collect the primary data. The data collection methods of this study was quantitative. The test was designed based on reliability and practicability which was used to identify the difficulties and mistakes of the students in forming and using present perfect tense. The test consisted of 15 questions which was distributed among the participants with proper instruction. The questionnaire on the other hand was used to gather opinions among the participants regarding the interest in learning English, learning difficulties and attitude of the participants in learning grammar and tense. It consisted of both close-ended and open-ended questions. After the data collection process was over, the collected data were analyzed in systematic and descriptive manner by using statistics.

## 2. RESEARCH ELOBARATION

### 2.1 Concept of Tense and Present perfect tense in English

Tense is a significant component in English grammar which helps the learners to construct grammatically correct sentence according to time. Numerous ESL and EFL learners confront difficulties in using the tense appropriately. As a result, several research studies were carried out regarding the tense for investigation. As reviewing the previous studies, Lyons (1977) explains that the word of “tense” is derived ultimately from the Latin word “tempus” which means “time”. Similarly, according to Thomson and Martinet (1986), tense can be said to be the mixture of present and past. It always implies a strong connection with the present and it is chiefly used in conversation, letters, newspapers and television and radio report. With regard to the difficulties in using tense, Quirk et al (1975) argue that most students get confused in determining tenses, because before they use verb form they have to understand the relationship between the form of the verb and their concept of time.

In particular, present perfect tense is one of the important aspects in English tense in which a large number of learners encounter challenges and difficulties in using it in both written and oral communication. There are a number of previous studies which were conducted locally and internationally. According to Eastwood (1999), present perfect tense tells us about the past and the present “The aircraft has landed” which means that aircraft is on the ground now (p. 14). Moreover, with regard to present perfect tense, in a similar study, Azar (1989) explains about Present perfect tense that the present perfect expresses the idea that something happened (or never happened) before now at an unspecified time in the past. The exact time it happened is not important.

### 2.2 Other Relevant Studies

According the review of previous studies, Cowan (2008) points out the problems in learning tense and using it in writing and speaking. He states that use of verb forms is one of the two or three most difficult areas for English language learners to master. Similarly, in another study carried out by Maisari (2011), the findings show that the students confronted difficulties in understanding present perfect tense. As found above, in the current study also, difficulties and problems were observed in using present perfect tense among most of the students. Therefore, use of tense and use of present perfect tense have been a common problem among most of the learners around the globe.

Further, in another similar study, according to Rizka (2017), there are many factors that cause students’ problems in using present perfect tense: they are: a lot of tenses in English, interference First Language (L1), differences between English structure and Indonesian structure, lack of vocabulary mastery, lack of textbook to support learning process, lack of interesting in teaching learning process, lack of motivation, family background and classroom environment. Similarly, the participants of this current study were observed in classroom teaching that several factors such as insufficient basic knowledge of English grammar, lack of practice, disinterest in learning English and get confusing with different aspects of tense. For instance, use of simple past tense instead of using present perfect tense and use of past perfect tense instead of using present perfect tense which contribute to confront the difficulties in using present perfect tense in writing. Further, Buba (2015) states that some grammatical deformities occur in learners’ use of present perfect tense. These mistakes are committed by the non-application of the appropriate rule of present perfect tense. For instance, the “ed” or “en” participle has not been added to the verbal node. Likewise, one of the major difficulty encountered among most of the students was grammatically constructing sentence in present perfect tense. They commit mistakes in using past participle form of irregular verbs. According to the review of previous studies and the problem of the current study, it is obvious that the form and use of present perfect tense has been a crucial problem which has to be investigated to furnish remedies to overcome the problems in present perfect tense.

## 3. FINDINGS

This part presents the analysis of data which were collected through the test and questionnaire, and the results of the findings of the data analysis. Accordingly, when the findings and results of the test is concerned, the test consisted of 15 questions and 15 marks were allocated for the test. According to the analysis of the test, the findings show that 16 of the participants obtained marks between the

range of 1 – 5, 9 of the participants obtained a range of 6 – 10 while 5 of them scored in between 11 – 15 marks. The following graph shows participants’ test score by percentage.

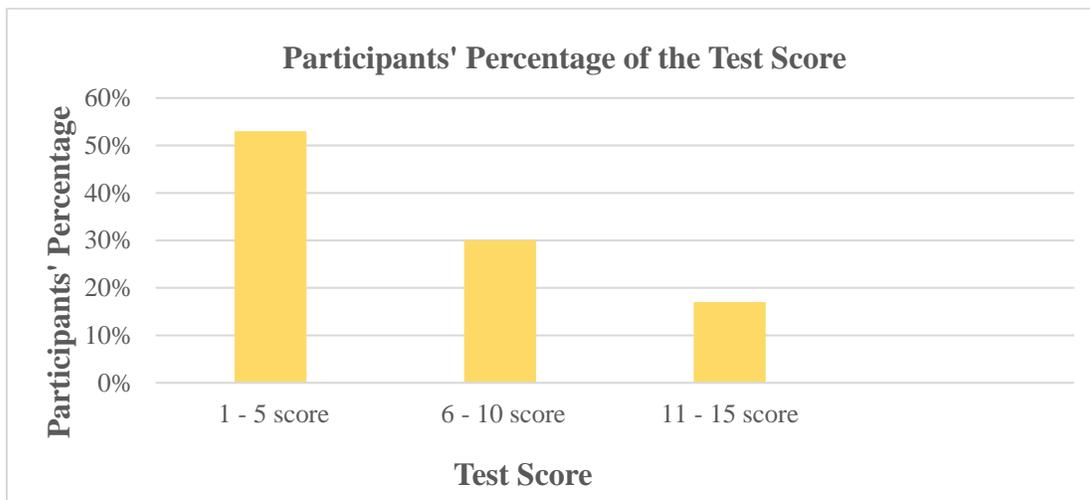


Figure 1

As far as the participants’ performance in the test is concerned, difficulties and mistakes were found in certain significant areas in verb and tense among most of the participants. Regarding basic Subject(S) Verb(V) agreement in sentence, participants made mistakes, for instance: the participants had used “\*<sup>1</sup>She have washed” for “She has washed” and the participants had used “\*The students has organized” for “The students have organized”. With regard to forms of verb, the participants did not have proper knowledge of irregular verb and their past participle form, for instance, most of the participants had used “\*eated” for “eaten”, “wrote” for “written” “\*weared” for “worn” and “saw” for “seen”. Moreover, with regard to the use of signal words in present perfect tense, most of the participants failed to use appropriate signal words like now, already, yet and just according to the context. Likewise, they got confused with the use of present perfect tense and simple past tense, and present perfect tense and past perfect tense.

Further, the questionnaire consisted of both close-ended and open-ended questions which was used to gather opinions among the participants regarding the difficulties faced by the students in using present perfect tense appropriately. According to the findings of the data analysis, 18 of the participants (60%) were not interested in learning English, whereas 12 of the participants (40%) were interested in learning English. Likewise, the participants were asked in the next question that whether they like grammar than other components in English. To which, 21 of the participants (70%) expressed that they like to learn grammar than other components like reading, writing, speaking, etc. whereas 9 of the participants (30%) expressed that they do not like grammar. As far as the use of tense is concerned, the findings show that 26 of the participants (86.5%) encountered difficulties in using tense according to appropriate situation. Just 4 of the participants (13.5%) on the other hand, were able to use each tense according to appropriate situation. Likewise, 27 of the participants (90%) faced difficulties and challenges in forming and using present perfect tense. When the participants who face difficulties in using tense and present perfect tense were asked, they expressed distinct factors and reasons. Therefore, the following table shows the reasons for participants’ disinterest in learning English, interest in learning grammar and difficulties in using appropriate tense, and present perfect tense according to the situation.

	Questionnaire questions	Factors and reasons expressed by the participants for yes/no response
01	Are you interested in learning English?	Reasons for expressing disinterest in learning English <ul style="list-style-type: none"> <li>• Poor English learning environment</li> <li>• Lack of basic knowledge in English</li> <li>• Lack of motivation</li> <li>• Negative attitude towards learning English</li> </ul>
02	Do you like to learn grammar?	Reasons for preferring grammar to learn than other components <ul style="list-style-type: none"> <li>• Easy for learning grammar</li> <li>• Deductive method of teaching grammar</li> <li>• No productivity (unlike writing and speaking)</li> </ul>
03	Do you confront difficulties in using tense	Reasons behind the difficulties in using appropriate tense

<sup>1</sup> \* symbolizes ungrammatical sentence, clause, phrases, or words

	according to appropriate situation?	according to the situation <ul style="list-style-type: none"> <li>• Insufficient knowledge of basic grammar rule</li> <li>• Lack of practice</li> <li>• Lack of writing and speaking activities in classroom</li> <li>• Insufficient knowledge of the use of tense</li> </ul>
04	Are you able to use present perfect tense correctly in writing?	Reasons for facing difficulties in using Present perfect tense <ul style="list-style-type: none"> <li>• Lack of basic knowledge of grammar rule</li> <li>• Insufficient knowledge of the form and use of Present perfect tense</li> <li>• Lack of writing and speaking activities regarding the use of Present perfect tense in classroom</li> </ul>

**Table 1**

**4. CONCLUSION**

This study can be concluded that the researcher observed in classroom teaching that several students in grade 10 at the T/Mu/Al Hilal Central College, Muttur, Trincomalee, Sri Lanka face difficulties and make errors in forming and using tense and present perfect tense in their writing. With the aim of overcoming the challenges and difficulties, this study was conducted. Accordingly, the primary data were collected among 30 grade 10 students by using a test and a questionnaire. According to the findings of the analysis of the test, the results show that 16 participants had obtained 1 – 5 marks, 9 participants had obtained 6 – 10 marks and 5 participants had obtained 11 – 15 marks. Moreover, the findings of the questionnaire show that according to the response to the close-ended questions, 18 participants were not interested in learning English, 21 participants liked to learn grammar rather than learning other components like reading, writing, speaking, etc., 26 participants encountered difficulties in using tense according to appropriate situation and 27 participant faced challenges in forming and using present perfect tense. Further, according to participants’ response to open-ended questions, there are several factors and reasons which contributed to the difficulties in forming and using tense and present perfect tense. They are: insufficient knowledge of basic grammatical rule, lack of practice, insufficient knowledge of the form and use of present perfect tense and lack of writing and speaking activities regarding the use of present perfect tense in classroom.

The difficulties and challenges can be overcome and the ability of forming and using present perfect tense according to suitable situation can be improved when the following are implemented in the classroom. They are as follow:

- More emphasis is given to teach the correct use of tense and present perfect tense practically using inductive method.
- A number of grammar practices should be implemented using interesting language games and activities.
- More reading practice should be given.
- More focus should be given to writing and speaking practice in classroom.

**APPENDICES**

**Appendix A: Test**

1. We \_\_\_\_\_ wash the dishes. They're all clean now (HELP)
2. The Queen \_\_\_\_\_ her two-week tour through Australia yesterday. (START)
3. Prices \_\_\_\_\_ up last year, but they \_\_\_\_\_ by 8% already this year. (NOT GO, INCREASE)
4. The plane from New York \_\_\_\_\_. The passengers are getting out. (JUST LAND)
5. Maria \_\_\_\_\_ her suitcase last night. (PACK)
6. She \_\_\_\_\_ in London for three years. However, when her mom \_\_\_\_\_, she \_\_\_\_\_ to Leeds ((LIVE, DIE, MOVE)
7. My aunt flew to Paris last year. She \_\_\_\_\_ (never / go) on a plane before that.
8. - My students \_\_\_\_\_ (raise) some money after they \_\_\_\_\_ (SEE) a documentary on TV about Africa.
9. We didn't need to queue because my wife \_\_\_\_\_ (already / buy) the tickets.
10. How many books \_\_\_\_\_ in the last few years? (HE WRITE)
11. I \_\_\_\_\_ the car. Now it looks great! (WASH)

12. I don't need any new driving lessons. I \_\_\_\_\_ the test. (ALREADY PASS)
13. John \_\_\_\_\_ the homework (YET, NOT, DO)
14. \_\_\_\_\_ he \_\_\_\_\_ the project in time? (COMPLETE)
15. The student \_\_\_\_\_ an English Day Competition (ORGANIZE)

## Appendix B: Questionnaire

This questionnaire has been designed to collect the relevant information about the interest in learning English, participants' attitude towards learning English grammar and tense and challenges in learning English and tense, particularly Present Perfect Tense. Therefore, kindly complete this questionnaire and provide your support to achieve the aim of this study.

1. Are you interested in learning English?

If not, why are you not interested in learning English?

2. Do you like to learn grammar?

If so, why do you like grammar than other components in English?

3. Do you confront difficulties in using tense according to appropriate situation?

If so, what are the reasons behind the difficulties in using tense?

4. Are you able to use the Present Perfect Tense correctly in writing?

If not, why do you face problems in using the Present Perfect Tense?

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# The Users Trust Mining Based On Sentiment Similarity Analysis Using Various E-Commerce Reviews

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**Abstract-** Electronic commerce is the phenomenon of buying and selling of goods and services on the Internet system. Apart from buying and selling, so many people are using Internet as a source of information look at the latest products on offer or to compare prices before to buy. The E-commerce systems are usually estimated as the prominent resources that give user's experience, feelings, and interest to purchase items by using Consumers' views. This type of data involves consumers' views on products that can show interest, sentiments, and expressions. The different research ideas have shown that people are more likely to trust each other with the same attitude toward similar things.

In this paper, we consider both seeking and accepting sentiments and suggestions in E-commerce systems represents a form of trust between consumers during shopping. Based on this point, an E-commerce system reviews mining oriented sentiment similarity analysis approach is put forward to explore users' similarity and their trust. Basically we can divide the trust into two categories, namely direct trust, and propagation of trust, which gives a trust relationship between two individuals. The direct trust degree is obtained from sentiment similarity, and we present an entity-sentiment word pair mining method for similarity feature extraction. The propagation of trust is calculated according to the transitivity feature. The shortest path to describe the tightness of trust and put forward an improved shortest path algorithm to figure out the propagation trust relationship between users using the proposed trust model. A large-scale E-commerce reviews dataset is collected to examine the accuracy of the algorithms and feasibility of the models. The experimental results indicate that the sentiment similarity analysis can be an efficient method to find trust between users in E-commerce systems.

## I. INTRODUCTION

E-Business is sometimes used as another term for the same process. More often, though, it is used to define a broader process of how the Internet is changing the way companies do business, of the way they relate to their customers and suppliers, and of the way they think about such functions as marketing and logistics. For the purpose of this study e-commerce is taken to mean doing business electronically. By the increasing diffusion of ICTs, more specifically the Internet, the global business community is rapidly moving towards Business-to Business (B2B) e-Commerce.

The buyers gain a clear advantage when the Internet gives them access to the global market, by which they can compare

prices across regions, find out whether prices vary by order fragmentation and get awareness about substitute products. Due to transparency of the market, customer can compare the services of various e-commerce sites easily. For instant, in case of e-commerce the competitors are one click away from customer. If clients are not happy with the products, prices or services offered by a particular ecommerce site, they are able to change much more easily than in the physical. From the Sellers' point of view, they don't need to have physical existence of shop.

## BENEFITS OF E-COMMERCE

The main benefit from the customers' point of view is significant increase and saves of time and eases access from anywhere in the globe. Customer can place a purchase order at any time. The main benefits of ecommerce for customers are as follows:

- Reduced transaction costs for participating exchange in a market.
- Increased comfort - transactions can be made 24 hours a day, without requiring the physical interaction with the business organization. Time saving- Customer can buy or sell any product at any time with the help of internet.
- Quick and continuous access to information. Customer will have easier to access information check on different websites at the click of a button.
- Convenience-All the purchases and sales can be performed from the comfort sitting home or working place or from the place a customer wants to.
- Switch to others companies-Customer can easily change the company at any time if the service of a company is not satisfactory.
  - Customer can buy a product which is not available in the local or national market, which gives customer a wider range of access to product than before.
  - A customer can put review comments about a product and can see what others are buying or see the review comments of other customers before making a final buy.
  - Reduces purchase and procurement costs.
  - Raises customer loyalty and retention.
  - Reduces transportation costs.
  - Develops customer and supplier relationships.
  - Improves speed of the process of selling.
  - Improves internal and external communication. And
  - Develops the company image and brand.

Reviews from consumers are very important information in E-commerce systems. Many online shops have developed reviews system for users to post their reviews. With the rapid development of social networking media, more and more people are willing to share their feelings, opinions and suggestions on their bought items with their friends or even strangers in social network applications or E-commerce systems.

## SENTIMENT ANALYSIS

Sentiment analysis is meant to determine the polarity of a certain text, which can be positive, negative or neutral. Related academia and industries have been extensively investigating sentiment analysis methods over the last decade. While most of the early work in sentiment analysis is aimed at analysing the polarity of customer reviews.

The object of sentiment analysis has typically been a product or a service whose review has been made public on the Internet. This might explain why sentiment analysis and opinion mining are often used as synonyms, although, we think it is more accurate to view sentiments as emotionally loaded opinions. The interest on other's opinion is probably almost as old as verbal communication itself. Historically, leaders have been intrigued with the opinions of their subordinates to either prepare for opposition or to increase their popularity.

## II. LITERATURE REVIEW

### 2.1 TRUST COMPUTATION

The concept of trust has been studied by scholars all over the world in diverse contexts and from various disciplines, including Economics, Management, Computer Science and Sociology. In the field of economic research, trust is explained from the theory of rational choice, and defined as a rational action to make a choice of whether to give a trust after careful thought and cost calculation. That is, individuals are inclined to make rational and maximizing benefit choices, which is usually called computational trust in existing research work [1]. In trust computation, there are two core kinds of trust as direct trust and indirect trust. Trust can be established according observations on whether the previous interactions among the subjects, and can be called direct trust. Direct trust is used for reflecting the trustworthiness between direct connected users. Typically, many direct historical interactions data, such as behaviours, reviews, or other various evidences, are used to compute the direct trust degree among users.

Dimah explore the potential of social information derived from micro-bloggings as a source of user relevant recommendations. They proposed an approach ISTS that can exploit two factors from online social network: the sentiment orientation in friends posts about certain items and the trust relations between friends [2]. Li and Dai proposed a promising methodology to handle the trust mechanism for P2P network. They let parties rate each other after the completion of transaction, and use the aggregated ratings of a given party to derive a trust score. While indirect trust is used widely in long path connected users through intermediate users. This kind of trust is treated as transferability that may arise from one familiar context to another new context, or from one trusted entity to another unknown entity.

Bo, Yang. and Qiang present an information propagation mechanism in semantic web to semantic trust score computation. Entire trust is measured by a combined trust score from both subjective and objective sides of information. The objective side of trust is semantic trust of information, and the subjective side is trust relationship between peers. And trust relationship is based on the historical interactions between peers,[3]. Faruk and Arnab proposed a trust management model which will take factors like direct, indirect and global trust of the service to find out the final trust value of the service. They take the trust path distance into consideration while calculating the indirect trust [4]. Li *et al.* [5] propose two trust models to content delivery network: a local trust model and a cross-domain trust model. Hong *et al.* [6] presents a new method called Max-aggregation, which calculates peer's reputation through the view of multidimensional and multi-attribute, and gets the indirect reputation using trust propagation and aggregation in the web of trust.

### A. SENTIMENT SIMILARITY ANALYSIS

The methods take the similarity analysis as an important and basic content, which consider the sentiment and emotion as the evaluation factors for trust. Additionally, sentiment and affective similarity analysis have been studied extensively in natural language understanding, data mining and statistical analysis. The existing methods of sentiment analysis-based similarity exploration can be divided into three levels, which are document level, sentence level, and entity and feature level. All three levels are based on opinion lexicon, which is a collection of specific keywords or sentiment lexicons (extracted from gathered reviews) with parts-of-speech tags and treaded as the basis for analysing the reliability of reviews. At document level, the task is to classify a whole opinion document according to whether it expresses a positive or negative sentiment.

At sentence level, the task considers the sentences and determines whether each sentence expresses a positive, negative, or neutral opinion. Neutral usually means that no opinion is given. The analysis, both at the document level and at the sentence level, cannot exactly discover those specific objects whether people like or dislike. At entity and feature level, the approach concerns directly about the opinion itself instead of looking at language construct (documents, paragraphs, sentences, clauses, or phrases). It is based on the idea that an opinion consists of a sentiment (positive or negative). Hsu [7] adopted a sentiment word database to extract sentiment related data from microblog posts and used these data to investigate the effect of different types of sentiment-related words on product recommendations. The main goal of the existing sentiment analysis methods is to cluster the sentiments of users, commonly dividing people's sentiments to things into several types. Even at the entity and feature levels, its main purpose is to divide the user's sentiments into likes or dislikes. However, the above methods concern directly in overall trend which is insufficient when we calculate the trust based on sentiment similarity. It is necessary to analyse the specific attitudes on specific objects in reviews.

### B. ON CORRELATIONS BETWEEN TRUST AND SIMILARITY

Over the past few years, many works have focused on the relationship analysis between trust and similarity. The similarity

analysis based on sentiment has become an important research approach to establish trust relationship. Many studies have shown that there is highly correlation between trust and similarity. They demonstrated that individuals with similarities also have a high degree of trust in certain areas. These similarities include interest, content, behaviour, etc. Cai-Nicolas Ziegler and J. Golbeck investigated correlations between trust and interest similarity. They established a formal framework for investigating interactions between trust and similarity. They used a mathematical model to compute similarity and presented computation algorithms for profile and profile similarity. They used two experiments to analyse possible positive correlations between similarity and interpersonal trust. At meanwhile, through the analysis of the data from the Film Trust Web site, the results show that when the similarity of users changes within a certain range, the trust between users changes accordingly. This change indicates that there is very strong relationship between trust and similarity [8]. Li proposed a node interest similarity-based trust model, which took both node interest bias and reputations in each interest domain into consideration, and used interest domain reputation vector to maintain the behaviours of node in specific interest domain. They used interest similarity between nodes to weight domain local trust recommendation. These innovative studies proved that there is a correlation between trust and similarity, and they had presented the corresponding calculation method.

### III. PROBLEM STATEMENT

However, most of these above methods focus on exploring the overall trend of some sentiment or emotional tendencies to classify users by text sentiments. They do not take into account the similarity of sentiment between individuals and trust relationship between users. And at meanwhile, sentiments can spread in social networks, and this propagation feature also has an important impact on user relationships. So, if we want to get accurate text similarity and user trusts, we should start from real sentiment vocabulary. Bloom believe that in the reviews text, the sentiments words are always targeted at specific evaluation objects.

- In our existing work focused on trust construction and maintenance between customers and companies over time and after repeated experiences.
- While limited effort is spent on trust between consumers and potential consumers in E-commerce systems. In the field of E-commerce reviews, people are more concerned about the credibility of reviews and the trust of user who post the reviews.
- These reviews are important to the business holders as they can take business decisions according to the analysis results of users' opinions about their products.
- Some of the major problems with processing unstructured text are dealing with spelling mistakes, incorrect punctuation, and irrelevant words, use of non-dictionary words or slang terms, and undefined abbreviations.

### IV. OBJECTIVES

The main objectives are

- To show customer reviews based on sentiment similarity analysis in E-commerce systems can be an efficient method to find trust between users.
- To enhance business strategies for the better outcomes in E-commerce.

### SENTIMENT SIMILARITY BASED USER TRUST RELATIONSHIP CALCULATION FRAMEWORK

The users are usually the consumers who have involved in E-commerce activities. They may have purchased some items or services and posted reviews on these objects, as shown in fig1. Typically, a user can post multiple reviews on multiple items. Therefore, these reviews for specific items can be expressed in several texts. These reviews can usually be obtained by collecting network information. To find the trust, including direct and propagation, based on sentiment similarity of reviews by users in E-commerce systems, we propose a generally four-step computing framework. Firstly, the entity-sentiment word pairs are extracted from reviews. The step is a key process to further deal with the sentiment similarity analysis and direct trust computing.

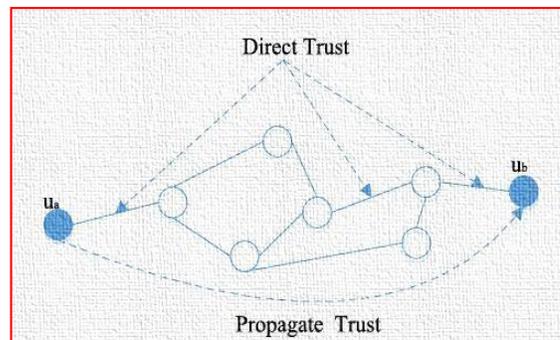


FIG (1). Propagation trust link based on direct trust.

The extraction of entity-sentiment word pairs in part 1 is mainly to analyse the vocabulary of the text, extract the entity words and sentiment words which describing the object. We use NL Processor linguistic parser for entity word and high frequency word combined with public lexicon for sentiment word. A mutual information formula is used to calculate the relationship between each entity word and the sentiment word. And then we can find those words pairs with close relationship.

Secondly, we perform sentiment similarity calculations for two user-related reviews based on entity-sentiment word pairs. Calculation of sentiment similarity in part 2 is to compute the similarity degree of different reviews texts. This step is to use the obtained entity-sentiment word pairs for comparative analysis. Thirdly, we use a new formula to calculate direct trust between two users with a common review object. Calculation of direct trust in part 3 is to compute direct trust that have reviews on same item or object. The calculation method mainly includes two aspects, one is sentiment similarity, and the other is the user's rating of the object. Finally, calculation of propagation trust in part 4, assume users as nodes, and the links, which are based on their direct trust, as edges to create a trust network.

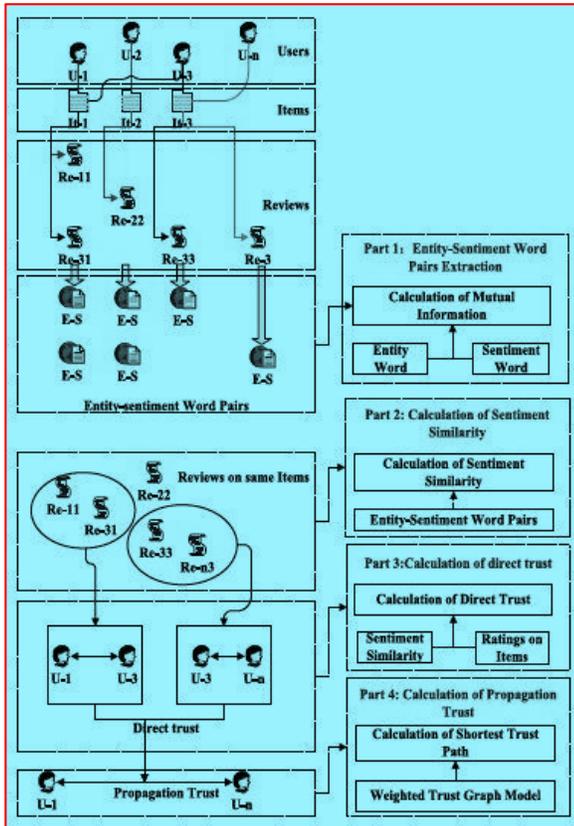


FIG (2). Trust calculation framework

Then we use an improved shortest path algorithm to calculate the propagation trust links between each pair of user nodes.

**B. SENTIMENT SIMILARITY AND DIRECT TRUST COMPUTING**

The sentiment similarity is to compute the similar degree of two reviews texts. For two users  $ui$  and  $uj$ , the reviews texts they post on an object  $o$  are  $t_{ui}$  and  $t_{uj}$  respectively. The similarity degree between these two texts can be calculated by formula (6) based on Pearson Correlation

$$Sim(t_{ui}, t_{uj}) = \frac{\sum_{k=0}^{\min|V|} (r_{ik} - \bar{r}_i)(r_{jk} - \bar{r}_j)}{\sqrt{\sum_{k=0}^{\min|V|} (r_{ik} - \bar{r}_i)^2 \cdot \sum_{k=0}^{\min|V|} (r_{jk} - \bar{r}_j)^2}}$$

where  $\min |V_j|$  is the minimum number of entity-sentiment pairs in reviews text of user  $ui$  and  $uj$ . For any two users who have reviewed on same object, their sentiments may be positive, negative, or neutral. Whenever the emotion or sentiments of their reviews on the same object are consistent or approximate, the opinions or sentiments of the two users are treated as generally similar in E-commerce environment. Thus, sentiment similarity between users  $ui$  and  $uj$  can be acquired based on the context of their all reviews on same object, and can be calculated according to the following formula (7).

$$D_{ui,uj} = \frac{1}{|O_{ui} \cap O_{uj}|} \times \left( \sum_{i \in O_{ui} \cap O_{uj}} \rho(i) \frac{\sum_{k=0}^{|T|} \sigma(S_{ui}, S_{uj}) \cdot Sim(t_{ui}, t_{uj})}{\sum_{i \in O_{ui} \cap O_{uj}} Sim(t_{ui}, t_{uj})} + (1 - \rho(i)) \cdot D_0 \right)$$

where  $O_{ui} \setminus O_{uj}$  is a set of objects that the two users have commented simultaneously.

In E-commerce, user ratings are ubiquitous information. We consider using user rating factors and combining sentiment similarity to calculate users trust.  $(s_{ui}; s_{uj})$  is an influence function and it can be calculated using a covariance function as following formula 8.

$$\sigma(s_{ui}, s_{uj}) = \frac{\sum_{i=1}^n (s_{ui} - \bar{s}_{ui,uj})(s_{uj} - \bar{s}_{ui,uj})}{n - 1}, \quad n \neq 1$$

where  $s$  is the rating for an object.  $s_{ui}$  and  $s_{uj}$  indicate that the rating on an object of users  $ui$  and  $uj$  respectively, and  $\bar{s}_{ui,uj}$  is the mean of the ratings of the two users on same object.  $\rho(i)$  is a control function of the number of reviews by the two users. It reflects the user's activity level and stability to the objects. The higher the control function, the greater the degree of intersection between the two users, the higher the activity level, and then the greater the influence of similarity on trust. Conversely, the smaller the control function, the smaller the degree of intersection between the two users, the lower the activity, and the less the effect of similarity on trust. The control function has the following properties:

- (1).  $0 \leq \rho(i) \leq 1$
- (2).  $\rho(i)$  is monotonically increasing function, that is when  $i_1 < i_2$ , there is  $\rho(i_1) \leq \rho(i_2)$ ;
- (3). When  $i \rightarrow \infty$ , there is  $\rho(i) \rightarrow 1$

The calculation formula of  $\rho(i)$  can be expressed as following formula 9.

$$\rho(i) = \frac{\arctan(i + \alpha)}{\pi} + 0.5$$

where  $i$  is the number of objects with common reviews of two users. Parameter  $\alpha \geq 1$  is an adjustment factors of  $i$ .

**A. PROPAGATION TRUST COMPUTING**

According to definition (3), propagation trust of two users can be acquired from direct trust between intermediate users. We proposes a weighted trust graph model  $G = (U; L; D)$  for all users who review items in E-commerce systems. In the trust graph model,  $U$  is the collection of users, denoted as nodes in the graph;

$L$  is the set of links that connect nodes;  $D$  is the weight of direct trust between the user nodes that are directly connected by  $L$ . Let  $lij$  be the path distance between two user nodes ( $i$  and  $j$ ),  $Dij$  is the direct trust degree between the two user nodes and set  $lij D \ln Dij$ . According to the definition (3), there are  $0 < Dij \leq 1, \ln Dij \leq 0$ , and the path distances between all nodes is a set of nonnegative numbers. When the shortest path of two users  $i$  and  $j$  is calculated, the propagation trust between the users can be obtained by  $Dij D \ln lij$ .

Take part of a weighted trust graph model (as shown in Figure 3) as an example, if  $D_{i;k} = 0.6, D_{k;j} = 0.8$ , then path distances  $lij = 0.48$ ,  $lkj = 0.8$ , and

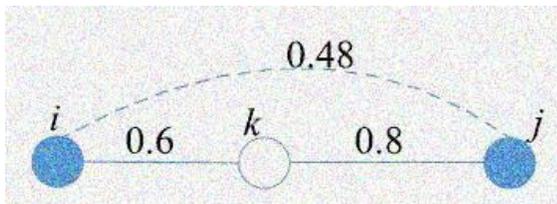


FIG (3). Part of a weighted trust graph model.

### Experiment Evaluation for Sentiment Similarity Based User Trust Relationship

#### V. DATASET COLLECTION

The experimental dataset is collected from Amazon.com. It contains 143.7 million reviews on 24 categories of products with 9.4 million items from May 1996 to July 2014. The dataset includes basic information about reviewers, such as user name, user ID, and object information of the review, e.g. the product name or the product ID, the specific text of the review and the user's rating status, etc. Specifically, the dataset contains two files:

- (1) Review data file, which consists of ratings, text and helpfulness votes.
- (2) Product metadata file that contains item description, product category information, price, brand, and image features and also-viewed / also-bought. The whole dataset is more than 350GB, and we just collect reviews on five categories (books, electronic, sports and outdoors, video games and baby) of products as test data for our experiments.

S.No	Category	Reviews	Items
1	Books	21.5M	2.17M
2	Electronics	8.21M	564K
3	Sports and Outdoors	1.5M	856K
4	Video Games	4.5M	87K
5	Baby	968K	85.3K

Table 1. Selected dataset of reviews from amazon

#### VI. MEASURES

According to the data description in Tab. 1 and 2, we use three elds: related, overall and helpfulness, which is in the original experiment dataset, to judge whether the trust exists between users. If two users have the same related products (also bought, also viewed, bought together, buy after viewing), the same overall value (rating of the product) and the same helpful value (helpfulness rating of the review), we assume there is trust relationship between them. To our best knowledge, there are no published papers adopt the same or similar approach to explore users' trust from E-commerce system reviews based on sentiment similarity analysis. Therefore, we just follow the existing research and introduce four evaluation indicators, *Precision*, *Recall*, *F value* and *Accuracy* to evaluate the effectiveness of our approach.

If the trust of any two nodes obtained by the sentiment mining algorithm is greater than a pre-set non-zero threshold value and trust relationship exists actually at the same time, then we deem the result of calculation is correct, and otherwise it is incorrect. If the results acquired by the proposed algorithm do not show trust links (including direct and propagation) relationship between two users, but the trust between them is true actually, this situation is called trust relationship missing. *Precision* and *recall* are defined as following formula 10:

$$precision = \frac{CorrectLinksNumber}{CorrectLinksNumber + IncorrectLinksNumber}$$

$$recall = \frac{CorrectLinksNumber}{CorrectLinksNumber + MissedLinksNumber}$$

According to the relationship between *precision* and *recall*, *F value* is used to represent the common impact of the two indicators on the results and it is defined as formula :

$$F - value = \frac{2precision \times recall}{precision + recall}$$

#### VII. EXPERIMENTAL RESULTS AND ANALYSIS

We divide the review dataset into two parts, which is randomly divided into two non-overlapping parts, namely, training dataset and test dataset. We use 80% of the dataset for training and extracting entity-sentiment word pairs, computing sentiment similarity and trust. We use the left 20% of the dataset for experiment of accuracy and effectiveness of direct and propagation trust.

Product Id	Product Name	Price	Rating	Friend Name
2	speaker	4000	0	padmasri
2	speaker	4000	2	padmasri
5	java	600	0	padmasri

FIG (4). Recommended products

Both direct trust relationship and the propagation trust are analysed experimentally to get trust between users.

### VIII. CONCLUSION AND FUTURE WORK

The main idea of this paper is to address the problem of mining users trust in E-commerce system. By defining two kinds of trust relationship, namely, direct trust and propagation trust, we transfer the point of exploring trust between users into calculation of sentiment similarity of their reviews with the help of entity-sentiment word pairs mining, sentiment similarity of reviews can be calculated and direct trust relationships can be obtained through sentiment similarity analysis, which contains of sentiments and ratings aspect. These two aspects can be used jointly to analyse the sentiment direct trust relationship. We establish a weighed trust graph model for propagation trust computing. Propagation trust is the use of the propagation characteristics of trust. It is an indirect trust between two users without direct trust and is obtained through intermediate users who have direct trust between these two users.

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# A Survey of Nigeria's Conspiracy Response Theories on the COVID-19 Pandemic with its Effect on National Development

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**Abstract-** The approach of the Nigerian government concerning the COVID-19 pandemic has drawn public criticism by the citizens, especially in the media. The outbreak of the COVID-19 epidemic has brought a diverse, responsive approach among different nations. Since the disease outbreak, measures have been taken to curb the spread of the virus by government and private organizations in Nigeria. This study explores the different concerns that Nigerians have raised against the government in responding to the pandemic. Through different media platforms, a significant number of Nigerians accused the government of a fraudulent approach to the plague, arguing that its consequences are enormous, especially on national development. This study is qualitative, using an anecdotal method to explore the viewpoint of Nigerians on the different measures that the government has adopted to win the global war against the COVID-19 virus. As the pandemic continues to impact the global society, Nigeria is not exempted. The question, therefore, is, how has the Nigerian government responded to the outbreak? What impact has those approaches made in the lives of the ordinary citizen? How confident are the Nigerian populace on the government that they duly elected to safeguard them in times of threats and anxiety? Would the aftermath of the outbreak strengthen or further crumble the fragile infrastructural development of Nigeria? These glaring concerns ignite the passion for this synopsis.

**Index Terms-** Nigeria, Survey, Conspiracy Theories, COVID-19, Response, National Development

## I. INTRODUCTION

The Nigerian government has always been accused of taking advantage of the people it is supposed to protect (Olabode, 2018, p. 116). Many of the citizens do not trust the political elite, which has grossly affected the response of individuals and communities concerning the spread of the COVID-19 pandemic. Nigeria has the highest population in Africa, with one of the fastest-growing economies in the continent (Vinson, 2017, p. 5). Before the COVID-19 outbreak, the Nigerian system of governance has received widespread criticism by Nigerians, primarily through media use. Through the media, citizens are empowered and feel engaged with the government on silent issues. Again, the media, especially social media, has often been the first to break the news of corruption, misgovernance, and social ills in

the society before the mainstream media because people feel free to question and criticize the government's actions and politics without the need for an intermediary (Akpjivi, 2018, p. 133).

Consequently, some Nigerian political elite has demonstrated dissatisfaction and displeasure in the media because of its success in uncovering corruption (Junior, 2013, p. 131). As a result, the power of the media has been challenged as policies and bills have been made in an attempt to criminalize the use of the media as a means of criticizing the government (*Nigerians React To President Buhari's Speech On Covid-19 - YouTube*, n.d.). However, Nigerians had a national call to reject these bills and policies propagated by the Nigerian senate (Chiefe, 2020).

Meanwhile, the Nigerian society is comprised of diverse social clusters. These different groups consist of the home, school, various religious, ethnic, political, and otherwise, groups, government, and media, all making up society (Okorie et al., 2016, p. 204). All of these groups help shape the moral and patriotic behaviors of members of the community; they also help contribute to the sound value system and the nation's growth and development (Okorie et al., 2016, p. 204).

Abreast, the media has been the watchdog of bad governance in Nigeria. It has also been the means that Nigerians get at the government and hold political office holders accountable (Omotoso & Kehinde, 2016, p. 80). Accordingly, the social media agenda-setting mode is a means that good and bad governance is acknowledged. Through the media, the public has less dependent on government and journalists who sometimes are closely aligned for information (Olabode, 2018, p. 127). Thus, through the media, citizens cast a spotlight on government malfeasance and serve as a force for accountability and challenge the legitimacy of those in power (Fitch, 2013, p. 415). Hence, this study explores the influx of information through the media, which challenges the government response to the COVID-19 pandemic. Thus, many Nigerians have so much dependence on the media as its source of information, and it is such mediums that influence the decisions of the average citizenry. For many, the diverse media platforms are set up to address the challenges of governance and bridge the existing gaps between the government and the governed (H, 2017, p. 56).

Meanwhile, the concerns raised in different media platforms about the government response to the COVID-19 pandemic have drawn criticism by the citizens, affecting Nigeria's moral, social, and economic stability. Similarly, the outcome of the critique could leave devastating results and the disruption of national peace

and unity of Nigeria; hence, this study is essential. It explores the concerns of the ordinary Nigerian who may not have the opportunity to be heard through other formal means.

## II. THE COVID-19 PANDEMIC AND THE NIGERIAN SOCIETY

The outbreak of COVID-19 and its declaration as a global pandemic by the World Health Organization (WHO) has raised concerns, fear, and angst. Indeed, people's social lives have been shattered due to the enforcement of social distancing and lockdown as preventive measures, more so that economic hardship had grown (*WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020*, 2020). What the world experience, as reported by media channels, is disheartening. There is the danger of economic stalking, threat of violence, and increased lawlessness. These concerns are the result of anxiety and uncertainty of what tomorrow might be. While social life is disrupted, hospitals and health workers seemed overwhelmed with the influx of possible viruses (Lennox, 2020).

In Nigeria, people appeared to be dying not because of the infection but because the attention of medical personnel turned to COVID-19 with little attention given to other ailments. Also, the Nigerian government's medical infrastructure is porous, as lamented by Nigeria's secretary to the federation (Elumoye & Okocha, 2020). Similarly, it is suspected that every medical issue is COVID-19 related as medical personnel seemed to turn patients with other illnesses, declaring them victims of the pandemic. Recently, the secretary to the Government of the Federation (SGF), Boss Mustapha, expressed concern about reports received on medical institutions refusing to accept patients with other diseases over the fear of COVID-19 (Owolabi, 2020). The SGF submitted that the refusal to treat patients with different ailments had resulted in several unfortunate fatalities, which has led to more deaths amidst the war against the pandemic (Owolabi, 2020).

The impact of the pandemic is affecting the healthcare of non-COVID-19 cases, more so that medical personnel expressed fear of the contagion, which has resulted in turning patients away from hospitals (Adeboyejo, 2020). There is a rising concern about hunger and economic hardship. As alluded, it is not the COVID-19 virus that will kill people, but starvation and fear because many Nigerians survived on the small and medium industries (Idris, 2020).

COVID-19 is a virus discovered in China, which has spread rapidly to nations around the world. The disease has claimed lives and continues to do without a permanent solution. The spread of the virus has challenged the global society to reawaken the quest for medicine (Gate, 2020). Today, the response to the infectious disease (COVID-19) accepts intellectual, religious, and political interests among nations, people, and societies (Warah, 2020).

Consequently, the aftermath of the pandemic could record the emergence of new powers and interests and could open new economic borders and allegiance (Mahbubani, 2020). While the global community is all in the fight against the virus, Africa is not left behind. The pandemic has challenged the infrastructures and governments of many African nations. COVID-19 has unraveled the weakness of countries and brought some African nations into the limelight in the effort to impact society (Denton, 2020). For instance, while the world was struggling for medical supplies and how to manage the virus, Madagascar, a small island in the

African continent, developed a traditional medicine that drew the attention of the global society. Accordingly, the bold step and support that the government has given to medical research have pride-lifted Madagascar. Such medical discovery has attracted the commendation of WHO, which has also brought Africa to the limelight of the war against the pandemic (AfricaNews, 2020). However, in Nigeria, this development has raised concern about what role a strong economic and human resource nation like Nigeria is playing in the global scene on the war on COVID-19 (Alfa Shaban, 2020).

Meanwhile, different African governments, including Nigeria, turned to Madagascar for an alternative traditional cure for the virus. (Ekonde, 2020). These realities have challenged the Nigerian populace to cry out on the ineffectual role with great potentiality in the lead against the pandemic. This paper explores the response of Nigerians and their dissatisfaction with government responses against the fight on the COVID-19 virus. The study is conducted based on four questions: First, what is the people's view on the government approach to COVID-19? Second, how do people perceive government response to the pandemic? Third, what possible impact of government response to COVID-19 is to the development of Nigeria. Finally, the study examines people's suggestions on what the government ought to do at the COVID-19 outbreak?

## III. GOVERNMENT RESPONSE TO THE COVID-19 PANDEMIC

A sampled response of different media platforms showed that most Nigerian populace described the Nigerian government approach to the COVID-19 as inadequate. For instance, Campbell and McCaslin submit that since the pandemic outbreak, Nigeria had recorded a low impact, which could be due to the low level of testing (Cambell & McCaslin, 2020). The government had adopted the global measures of social distancing, lockdown, stay at home, and the avoidance of social and large gatherings; nevertheless, the enforcement of these measures were described as epileptic. The impact of the virus was twofold; on the one hand, the elites were primarily affected due to their abroad travel. On the other hand, the lockdown profoundly impacted the poor, partly due to Nigeria's low economic standard. Foremost, a day without work means a day without food (Avenue, 2020). Many who depended on the daily income for their livelihood found it challenging to obey government instructions. Other measures that the government put in place to fight the pandemic included initiating isolation centers in different states of the federation, support, and donations by individuals, non-governmental organizations, and the private sectors (Unah, 2020).

There was also the sharing of palliatives to most needy Nigerians, revising medical incentives for health workers, and many more to fight coronavirus. For instance, the Kaduna State government reviewed the salary income of COVID-19 health workers whom the governor described as the most vulnerable of

the pandemic.<sup>1</sup> There were also economic measures that the Nigerian government adopted to cushion the pain the virus inflicted on the populace (*INSIGHT*, 2020). Some of the actions that the government undertook included the reduction of fuel prices (“Why Nigeria reduce fuel price from N145,” 2020). There was also the adoption of new procedures by the central bank to tackle the economic impact of the pandemic, which consisted of the establishment of fund support to the country’s economy, which targeted household and micro and small enterprises, and reduction of the interest rate (*Nigeria - KPMG Global*, 2020).

#### IV. THEORIES OF NIGERIA’S CONSPIRACY RESPONSE TO THE COVID-19 PANDEMIC

While the spread of COVID-19 continues to impact society from different perspectives, the outcome of this exploration alludes that many Nigerians downplay the effort of the government. Notably, a significant number of media respondents argue that almost every measure that the government had taken seemed to be a conspiracy, propaganda, and the politics of the elite. Some contend that though the government had announced the reduction of fuel, many filling stations, apart from government-approved filling stations like the Nigerian National Petroleum Company (NNPC), are unwilling to reverse to the new price. Foremost, there seems to be no government enforcement on the new pump price (Ozugbakun, 2020). Alarmingly, after few months of fuel reduction, the government increased fuel prices; thus, it soared the hardship of the ordinary citizen. Also, the exchange rate has gone high, and the Naira had depreciated, causing more economic pain. Government financial measures seem to benefit only a few as the Naira experienced the worse devaluation in fifteen years (TVCNews, 2020).

Other areas that raised concern among Nigerians included the adopted steps taken to identify victims and generate the COVID-19 index number. The dispatching of *Almajiris* all over the states of the federation was described as a conspiracy to promote a political agenda (Channels Television, 2020). Also, the effort by the national assembly to pass the compulsory vaccine bill, and the models of sharing palliatives, all allude to these conspiracies. Few of the areas that this research explores include:

#### V. THE CONSPIRACY OF VICTIMS INDEX GATHERING

There was a lot of accusation on media of government measures in ascertaining victims and the daily index number. In an interview with the owner of Africa Independent Television (AIT), Raymond Dokpesi, about his COVID-19 experience, Dokpesi appreciated all those involved in the fight against the pandemic yet expressed concern and doubt about the virus in Nigeria. Dokpesi alleged that: He still needed to be educated about the difference between COVID-19, a virus, and mosquito parasite, asserting that every

medication he was given was malaria medication. People with other symptoms are turned into COVID -19 patients to add to the index number. This has instead ignited fear, which seems to kill more than the virus itself. Dokpesi questioned, “when has malaria become synonymous with COVID-19” (BEN Television, 2020). Similarly, another survey alleged that medical institutions are looking for every means to increase the index number of COVID-19 victims. It is claimed that:

The Nigeria Center for Disease Control (NCDC) has instructed some medical personnel to declare any serious medical issue in their hospital as a COVID-19 case, which goes with a promise of incentives. Nurses or doctors who report a client as COVID-19 get a weekly stipend. Any medical personnel who could inject and kill an older person and sign a fake death certificate on that patient collect a substantial amount for every adult death as a reward (*You Have Covid-19 If You Visit the Hospital in Nigeria*, 2020.).

Accordingly, an interview in Cross River State asserted that people were pressured to declare themselves COVID-19 patients to be given some money. People showed text messages alleging that they were to make the pronouncement and be given a considerable amount of money (ChannelsTV, 2020a). A lady from Delta State submitted that she was paid fifteen thousand Naira to lie that she had COVID-19 (Emmanuel Dudu, 2020). Consequently, Nigerians expressed concern and doubt, and many chose not to go to the hospitals for any medical treatment of any kind because of the ongoing COVID-19 fraud in Nigeria. These conspiracy theories suggested that some individuals or institutions were doing business with the pandemic and pursuing personal benefits. It was pathetic that while COVID-19 disease was real and killing people, some within Nigeria’s political elites and stakeholders were taking advantage of the pandemic to exploit the situation for a business venture.

Furthermore, the Governor of Kogi State, Yahaya Bello, cried out of an analogous conspiracy, contending that conspiracy plans were to import cases of coronavirus into Kogi State through illicit means. The governor also asserted that there was an unholy conspiracy to declare COVID-19 in all states of the federation, which suggested the attempt to import the disease or report fictitious cases. All these the governor described as “pressure from interesting quarters” (Abdulaziz, 2020). The presidential task force was also accused of instilling fear in people and lacked synergy by all those concerned (Ikumi, 2020). Responsively, rather than take the COVID-19 pandemic seriously, Nigerians used humor and comedies out of the pandemic.<sup>2</sup>

#### VI. THE CONSPIRACY OF LOCKDOWN

Another area that drew criticism on government response to the COVID-19 pandemic was the measures of lockdowns. Different nations reacted differently to the pandemic as ghost cities were shown on television with empty and stalked

<sup>1</sup> “Kaduna Government to Pay Daily Allowance to COVID-19Nigeria — The Guardian Nigeria News – Nigeria and World News,” accessed May 12, 2020, <https://guardian.ng/news/kaduna-government-to-pay-daily-allowance-to-covid-19-frontline-health-workers/>.

<sup>2</sup> *What Nigerians Are Doing With The COVID-19 Lockdown* (ChannelsTv, 2020), accessed May 26, 2020, <https://www.youtube.com/watch?v=nzXa0FdRulg>; (Ukomadu, 2020)

economies. In Nigeria, the issue appeared to be different. People seemed to have responded with mixed reactions. The economy was shattered, as there were no measures to stabilize the prices of commodities. Some argued that people were asked to stay at home while there were no adequate provisions for and other necessities for their survival.<sup>3</sup>

In an interview with the Governor of Cross River State, Professor Ben Ayade, the governor acclaimed that despite using his experience as a scientist and all strict measures taken and him, together with top government officials leading at the front line, yet, there was pressure to declare COVID-19 cases in Cross River (ChannelsTV, 2020-b). Ayade, in his examination of the Nigerian response to the pandemic, avowed:

The government was not customizing the action plan that reflected the situation and originality of Nigeria. As a nation, Nigeria could not just put money in the hands of companies for the production of test materials just because they wanted to test. Testing was only possible when it was suspicious that it called for such. Also, the test measures lacked credibility and reliability, and the COVID-19 was not related to diagnostic techniques since it was unknown “novel.” Thus, to conduct one COVID-19 test on a person and declare the result positive required some basic science rules and not just performing a rapid test and saying a person was a COVID-19 patient. So far, every test conducted was presumptuous. Also, in the western world, there seemed to be a business filing against all of these. As a medical professional, to do such a thing was abuse to his educational attainability and as a scientist. Consequently, the fight against COVID-19 had gone economic-political, and without a doubt, Nigerians and Africans were exploited due to Africa’s lube holes (ChannelsTV, 2020-b). Admittedly, the Nigerian response to the COVID-19 outbreak seemed to follow what could be described as “the west syndrome.” By implication, the government had no adequate measures to handle its problem but followed what others were doing. Following the west does not adequately address the need and impact of the virus on Africans and Nigerians.

Furthermore, Nigerians accused their political elites of not responding to the pandemic at the right time. For instance, many lamented that while other nations were closing their borders and civic leaders were addressing their citizens and reassuring their safety, Nigerian borders were opened, and the presidency did not make any national broadcast that could help calm their anxiety until different stakeholders pressured the presidency (TV 360 Nigeria, 2020). Despite the outcry, the administration accused the widespread concerns of some Nigerians as cheap politics and drama of a selected few.<sup>4</sup> These concerns questioned the credibility, government style, and the love that instituted authorities have for the citizens.

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<sup>3</sup> COVID-19: Mixed Reactions Trail Lockdown Extension in Lagos / TV360 Nigeria (TV360, 2020), accessed May 26, 2020, <https://www.youtube.com/watch?v=mKNTiW-i77Q>; (COVID-19 Lockdown Bites Lagos’ Unemployed Youth, 2020)

## VII. THE CONSPIRACY OF ECONOMIC RESPONSE AND SHARING OF PALLIATIVES

The outbreak of the COVID-19 pandemic ignited a national response by individuals and different organizations and stakeholders. Banks, individuals, and wealthy Nigerians contributed a considerable amount of money to fight the epidemic (CNN, 2020). Responsively, many Nigerians expressed dismay and fear that these monies may not be used purposefully due to previous corruption experiences in the government sectors.<sup>5</sup> Also, others describe the move by individual and non-governmental organizations as hypocritical. For instance, banks were at the forefront of contributing to the coffers of the federal government; however, it was to the detriment of their staff. Like in Access Bank, it was lamented that after donating millions of Naira, the bank staff was faced with salary cuts to curb job loss (Olurounbi, 2020). Also, the expression of worries by Nigerians and the donations made opened a new face of fire outbreaks in different government buildings. Some Nigerians ascribed these fire incidences as a conspiracy to hide the corrupt practices of some interested people in government and avoid accounting for the funds raised to fight the pandemic (Siteadmin, 2020).

Furthermore, the measures that were taken by the presidency to curtail the spread of the pandemic adopted the means for people to stay at home. This directive included keeping away from large gatherings and halting societies’ economies, which ignited anguish and anxiety in people. Citizens were groaning under the weight of the lockdown due to frustration, boredom, and hunger. Also, the lockdown extensions were described as worse than coronavirus (BBC News, 2020). Consequently, the president announced the distribution of palliatives to areas like Lagos, Ogun, and Abuja. The sharing of government palliative and the measures adopted for delivering these palliatives was debunked and described as a scam by many Nigerians (Vanguard News, 2020).

In an interview conducted by *9News Nigeria*, Buba Galadima, one of the leading critic of the Buhari-led government, asserted that the federal government’s claim of continuing with the school feeding program while schools were closed was fraudulent, which only make Nigerians look like fools. Galadima also said, “Tell me which children in your area that they give food to or show me one person who has received the N20,000 palliative. It is so surprising that Nigerians, especially the media, kept quiet in the face of all these” (Mbam, 2020).

Accordingly, a member of Nigeria’s senate, Ndume, called for the disbandment of the federal aid committee who was in charge of the Humanitarian services. The committee was accused of fraud and that it lacked credibility. The senate member expressed disappointment on Nigeria’s president Buhari for not disbanding the committee despite the outcry of many Nigerians (Haruna, 2020). However, in response, the government asked the

<sup>4</sup> ChannelsTV, “Presidency Explains Buhari’s Approach To Coronavirus - YouTube,” accessed May 26, 2020, <https://www.youtube.com/watch?v=aFhRI-uB9ls>.

<sup>5</sup> Salawu Abiodun and Owolabi Samson Toyosi Olugbenga, eds., *Exploring Journalism Practice and Perception in Developing Countries* (Hershey, PA: IGI Global, 2017), 14; (Izevbekhai, 2015)

concerned senate member to provide evidence of fraud against the palliative committee (editor, 2020).

In Lagos, for instance, like other parts of Nigeria that were on total lockdown, many citizens described the government as insincere. These concerned Nigerians claimed that the process of sharing the palliative was politicized as the more significant portion of the palliative package was reserved for party members, which led to lawless activities and the outbreak of violence (Okon, 2020). Appropriately, the accusation of fraudulent response on palliatives drew the attention of Independent Corrupt Practices and other Related Offences Commission (ICPC), an arm of government that deals with corruption-related matters. The commission called on all Nigerians to report breaches or any corrupt practices concerning the palliatives (Oyero, 2020). Thus, the media has remained a powerful means that the federal government was confronted to respond to the concerns of Nigerians rightly.

#### VIII. THE IMPACT OF GOVERNMENT CONSPIRACY RESPONSE TO COVID-19 PANDEMIC ON NATIONAL DEVELOPMENT

Before the global outbreak of COVID-19, Nigeria has battled with a fragile economy, insecurity, kidnapping, Boko Haram, and religious tensions. There are also political instability, underdevelopment, ethno-religious divisions, and demographic tensions between the predominantly educated Christian south and the mostly uneducated Muslim north.<sup>6</sup> These diverse challenges have continued to threaten the peace, unity, and stability of the nation. The wake of the pandemic unearthed Nigeria's poor governance and laid bare the political brouhaha of the elite class. For instance, Nigeria's weak capacity of the health care infrastructure seemed to exacerbate the pandemic and its impact on national economies (Ekeruche, 2020).

Also, the epidemic has unraveled the negative impact of the Almajiri system of education in northern Nigeria. Accordingly, different states have struggled to maintain a basic standard of healthcare expectations; however, in northern Nigeria, an attempt was made to relocate thousands of Almajirai to other states of the federation without the consent of some governors, especially in the Middle Belt and the South. Consequently, several governors rejected these Almajirai and returned them, considering them as economic and social burdens, which has raised concern among northern leaders (Channels Television, 2020). In Kaduna, for instance, the government contended that twenty-one out of the sixty-one Almajirai received from Kano were tested positive for COVID-19, which is a threat to the already fragile health infrastructure (Anyago, 2020).

Meanwhile, in other parts of the country – South-South, South-East, and Middle Belt, the transfer of the Almajirai to their regions were unwelcomed. It was considered with high suspicion and described a conspiracy to invade their territories with an Islamization plan, more so that it was an attempt to take the fight of Boko Haram insurgency to their regions. Indeed, the joint

statement of leaders of the Southern and Middle Belt Forum (SMBLF) described the silence of the federal government and security organizations as worrisome and ominous (Johnson et al., 2020). Indeed, the deliberate dispatched of Almajirai to the Southern part of Nigeria amid curfew, inter-travel ban, and without due consultation with governors of these regions confirmed the suspicions of some Nigerians. It also raised tensions between the north and the south, thereby threatening the nation's peace, unity, and stability (Bodeemen, 2020).

The global outbreak of COVID-19 has the potential to wreak havoc in the fragility of Nigeria and trigger widespread unrest. It could also create economic and political tensions between regions. However, at the center of the conspiracy response to the COVID-19 pandemic was the gross impact upon the ordinary citizen on the street of Nigeria. Unscrupulous leaders seemed to exploit the epidemic for their political and economic objectives to exacerbate crises among rival religions, rival communities, and geopolitical regions. Therefore, it was vital that the government re-strategize its approach to issues that affect the people and propose developmental measures that could help build the confidence of the citizens.

#### IX. THE TASK BEFORE THE NIGERIAN GOVERNMENT

The coronavirus is a world-changing reality, and the aftermath could alter how the global society approached issues as things may never remain the same. The disease outbreak caught much of the world off guard that has surreal the ordinary life of societies (Colbert, 2020, p. 10). Indeed, the COVID-19 is described as the new age pandemic, whose speed and severity rivaled the 1918 influenza epidemic (Balasubramanian, 2020). It has stalked nations' economics, and like in Africa, and Nigeria in particular, the outbreak has posed challenge to the fragility of government infrastructural development, that had drawn national concerns (CENTRE, 2020).

Nigerians ought to rise and learn from the effects of the pandemic; this seems to be demonstrated by Ayade. Governor Ayade appeared to handle the COVID-19 epidemic in Cross Rivers differently from his other counterparts. His approach could provide Nigeria with a roadmap to deal with the country's issues differently. His COVID-19 response has been applauded both by the NCDC and the federal government (NseAbasi, 2020). The governor avers that Nigeria and Africa need to come out from a "follow the west syndrome" and think beyond the "stomach syndrome." By implication, the continent should be bold to address her unique issues, as did Madagascar, who did not wait for any approval from anyone.<sup>7</sup>

Similarly, Nigeria needs to set up a proper vaccine production plant, which could be the first of its kind (Published, 2020). Nigeria is a nation full of potential, brilliant, energetic, and hardworking people. The government can produce almost everything, and what the country with the wealth of professionalism requires is empowerment (T & Nkechiny, 2019,

<sup>6</sup> Monica Emmanuel, *Federalism in Nigeria: Between Divisions in Conflict and Stability in Diversity* (Indonesia: Globethics.net, 2016); (David et al., 2015, p. 100)

<sup>7</sup> Published, "Ayade's Anti-COVID-19 War Strategy Stirs Controversy," *Punch Newspapers*, 2020., accessed May 26, 2020, <https://punchng.com/ayades-anti-covid-19-war-strategy-stirs-controversy/>.

p. 26). Arguably, Nigerians can lock their borders to viruses and other external threats and lock down the solutions.

Unfortunately, many Nigerians have expressed concern about the unwillingness of the government to invest in human capacity building. Also, Nigerian universities are disappointed and feel betrayed by the government for undermining their capabilities (Acemoglu & Robinson, 2012). For example, despite the national cry by some stakeholders and the association of Nigerian medical doctors not to bring foreign medical personnel, the government went on to bring Chinese doctors, which received mixed reactions.<sup>8</sup> It was later discovered that the so-called Chinese doctors were not all doctors, and their whereabouts seemed unknown (Ajayi, 2020). What Nigeria needs is human development that aims to increase knowledge, skills, and capacities in all sectors and all people. Nigerians need to be given adequate support and access to resources to enhance capacity building.

## X. CONCLUSION

The making and the destruction of every society depend on the models that instituted authorities adopt in responding to issues that threaten the people it claimed to govern. It is delineating that some measures taken by the Nigerian government to curb the spread of COVID-19 were in collocation to the viewpoint of some Nigerians. Many ordinary Nigerians took to the media to express their dismay, including some political elites. Therefore, the government must explore measures to redress its citizenry's concerns swiftly. This calls for a collaborative and dialogical approach immersed in the national agenda, which seeks to promote the unity, peace, and stability of Nigeria's democracy.

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# Nuclear Enhancement

## MODELLED BASED ON NEWTON'S LAWS

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**Abstract-** Nuclear enhancement is the continuous annihilation of mass until a level is reached where mass cannot interfere with the opposing weight of the universal system. Continuous nuclear enhancement is driven by the process of beta decay, beta minus decay is responsible for the expansion and beta plus decay is responsible for stability of the nucleus. Mass is an element of dark matter driven by a force that makes it to continuously gravitate towards itself. As dark matter gravitates towards itself, it moves in circular motion of three waves continuously colliding with itself and increasing its speed. Only the third fastest wave of dark matter, deep in its core result in the formation of the nucleus. This nucleus at the subatomic level, must survive the unforgiving environment of dark matter as driven by the force of gravity. Therefore, the nucleus resolves in enhancement so that it can survive the environment pushing it from side to side as well as up and down. Thus, the struggle for survival begins, with the nucleus having only the potential to be free. It carries the potential to use the same laws used by dark matter, as it is a product of dark matter. Thus, nuclear enhancement progresses through the levels of the solar system, the galactic system and finally the universal system where it balances and liberate from the might of dark matter.

**Index Terms-** Nuclear enhancement, Nuclear mapping, Nuclei enhancement table, dark matter, gravity.

two systems in existence as the solar system balances the 3<sup>rd</sup> wave of dark matter, the galactic system balances the 2<sup>nd</sup> wave of dark matter and the universal system balances the 1<sup>st</sup> wave of dark matter. For this model to completely succeed, there are two laws universally compliant with the process of nuclear enhancement. The law of potential creates the potential for nuclear enhancement, it happens at the subatomic level when beta decay takes place. The law of support provides temporary balance in the enhancement of the nucleus until conditions are favourable to fulfil Newton's 3<sup>rd</sup> law. This model also accounts for the expansion of the universe. As the waves of dark matter are conquered, the enhancing environment gains more space to expand. Mathematical accounting supporting these deductions based on the above-mentioned model here follows. The original raw data is available at Havard dataverse and relevant supporting material is also attached.

### 1. DARK MATTER LEVEL

The balanced universal system is not just floating in free space all by itself, it is balanced by a well-designed system of dark matter. Dark matter is divided into three waves moving in different gravitational speed. It is the third wave, moving at the highest speed that result in the formation of the nucleus, commonly referred to as the big bang.

## I. INTRODUCTION

There are only two systems in existence that when balanced life will thrive as it was naturally meant to, and that is dark matter and the universal system. Everything known until recently is based within the universal system and dark matter is something of great interest to us because it balances our universe and it can help with the understanding of where life started. In this model, dark matter is found to have three waves that respect Newton's laws of motion. The 1<sup>st</sup> wave fulfills the 1<sup>st</sup> law, the 2<sup>nd</sup> wave fulfills the 2<sup>nd</sup> law and the 3<sup>rd</sup> wave fulfills the 3<sup>rd</sup> law. The 1<sup>st</sup> wave is herein referred to as *Oclais*, the 2<sup>nd</sup> wave is referred to as *Diclais* and the 3<sup>rd</sup> wave is referred to as *Moclais*. Dark matter experiences a force that causes it to gravitate towards itself and this is a known trait of the force of gravity. As the 1<sup>st</sup> wave collides with itself, it gains direction and its speed increases, this continues to happen up to the 3<sup>rd</sup> wave. When the 3<sup>rd</sup> wave gravitates towards itself and collides, a transition happens, and the subatomic level of particles is formed. Only here are particle able to experience the process of beta decay, a critical trigger to the enhancement of the nucleus. The enhancement of the nucleus begins from the subatomic level to the solar level, the galactic level and finally the universal level. the subatomic level is like a bridge between the

## II. THE WAVES OF DARK MATTER

Matter is the stuff that makes up the universe, it takes up space and has mass. So, to understand matter, Newton's laws are critical because they continuously to comply with universal activities successfully. Therefore, matter can be simplified for this model as mass experiencing a certain degree of force:

$$\text{Matter} = \frac{\text{mass}}{\text{force}}$$

$$\text{Then } M = \frac{m}{ma}$$

At this level of dark matter, the force experienced by matter is the force of gravity. It is the consequence experienced by spheres as explained in the theory of relativity.

$$\text{Therefore: } M = \frac{m}{mg}$$

$$\text{Thus } M = \frac{1}{g}$$

The first wave of dark matter complies with Newton's 1<sup>st</sup> law. It is an object at rest, meaning it will remain at rest or in constant motion until acted on by an external force.

$$M = \frac{1}{g}$$

$$\text{Therefore: } M = \frac{1}{1} = 1$$

This means the force of gravity acting on dark matter at this level equates to the mass of dark matter.

Fig1. 1<sup>st</sup> wave of dark matter - *Oclais*



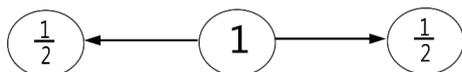
The second wave of dark matter complies with Newton's 2<sup>nd</sup> law. This is because an external force has now acted on dark matter and this force is now greater than the mass of dark matter. This external force is as a result of the freely drifting first wave of dark matter when it collides with itself.

$$M = \frac{1}{g}$$

$$\text{Therefore: } M = \frac{1}{2}$$

So, when matter collides, its speed doubles and immediately starts to move in opposite directions at a speed of the applied force.

Fig2. 2<sup>nd</sup> wave of dark matter - *Diclais*



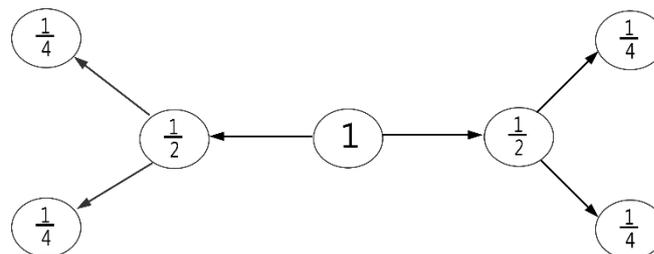
The third wave of dark matter complies with Newton's 3<sup>rd</sup> law. Now the applied force has reached a balanced state.

$$M = \frac{1}{g}$$

$$M = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

This is the balanced wave of dark matter; however, it continues in motion that further collisions remain possible.

Fig3. 3<sup>rd</sup> wave of dark matter - *Moclais*



This is how the waves of dark matter are arranged, this is what the nucleus is working on balancing. Hence its continuous enhancement to cosmic levels. This is the one part of life that is balancing the known universal system.

$$M = \frac{m}{mg} \text{ and } M = \frac{1}{g} = \frac{1}{4}$$

$$\text{Therefore } M = 4 \left( \frac{1}{4} \right) = 1$$

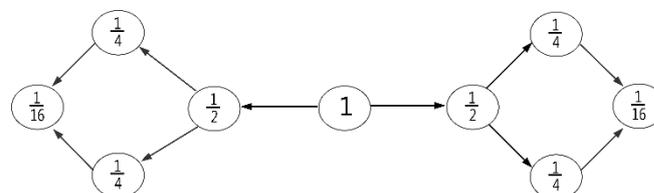
## 2. SUBATOMIC LEVEL

This level contains particles considered to form the foundation of life. However, the neutron, proton and electron are found to be the three critical particles in the enhancement of the nucleus. All other particles forming beyond the three are particles reacting with dark matter fragments during the balancing of dark matter and the universal system. That is how different elements and compounds are formed resulting to the environment as known today.

## III. FORMATION OF THE NUCLEUS (n=0)

The universal law of gravitation does not hold at this level. When matter moves at a gravity of 4, it is inevitably going to collide again. However, it does not divide anymore but transcend completely into a nucleus. The formation of the nucleus brings forth light, sound and charge. Things that are very critical to the enhancement of the nucleus.

Fig4. Nuclei formation



This is the beginning of something different from everything that happened with dark matter. For the first time the product of mass is achieved and that is weight. The weight of the particle is accounted for by the nucleus of the particle. 'The strong force holds together quarks, the fundamental particles that makes up the protons and neutron of the atomic nucleus, and further holds together protons and neutrons to form atomic nuclei. As such it is responsible for the underlying stability of matter' - newssciantist.com.

$$P = m_1 \times m_2$$

$$\text{Then } P = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$

The stability of the particle weight is affected by the strong force keeping subatomic particles intact. So, the total weight of the Nucleus is affected by the movement of dark matter at a gravity of 4, which is matter ( $M = \frac{1}{4}$ ), thus the nucleus experiences the gravity of dark matter. However, the electromagnetic force as carried by photons begins to directly confront dark matter and its force of gravity. 'The fundamental force associated with electric and magnetic fields. The electromagnetic force is carried by the photons and is responsible for atomic structure, chemical reactions, the attractive and repulsive forces associated with electrical charge and magnetism, and all other magnetic phenomena' – dictionary.com.

$$N = \frac{1}{4}P,$$

$$N = \frac{1}{4} \times \frac{1}{16} = \frac{1}{64}$$

The radius,  $r = \sqrt{N}$

$$r = \sqrt{\frac{1}{64}} = \frac{1}{8}$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$P_{\leftrightarrow} = 4r$  (4 is the inverse gravitational force working against  $M = \frac{1}{4}$ . So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times \frac{1}{8}$$

$$\text{Then } P_{\leftrightarrow} = \frac{1}{2}$$

Specific to the balancing particle, beta minus decay occurs. The neutron decays into a proton, an electron and an antineutrino. The electron is the level where the weak interaction occurs, creating a completely balanced environment for the nucleus to enhance. 'Weak interaction, also called weak force or weak nuclear force, a fundamental force of nature that underlies some forms of radioactivity governs the decay of unstable subatomic particles such as mesons and initiates the nuclear fusion reaction that fuels the sun' – C Sutton.

So,  $r = \sqrt{N}$  is associated with the strong force,

$N = \frac{1}{4}P$  is associated with the electromagnetic force

And  $P_{\leftrightarrow} = 4r$  is associated with the weak force.

### 3. SOLAR SYSTEM LEVEL

The solar system is formed by the continuous enhancement of the nucleus. From the subatomic particles, now spheres, such as the planet and the sun are accounted for through nuclei enhancement.

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#### IV. ATOM (n=1) – NEWTON'S 1<sup>ST</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

$$\text{And } N = \frac{1}{4}P,$$

$$\text{Then } N = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$

$$\text{The radius } r = \sqrt{\frac{1}{16}} = \frac{1}{4}$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$P_{\leftrightarrow} = 4r$  (4 is the gravitational force working against  $M = \frac{1}{4}$ . So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times \frac{1}{4}$$

$$\text{Then } P_{\leftrightarrow} = 1$$

#### V. ELEMENT (n=2) – NEWTON'S 2<sup>ND</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = 1 \times 1 = 1$$

$$\text{And } N = \frac{1}{4} \times P,$$

$$\text{Then } N = \frac{1}{4} \times 1 = \frac{1}{4}$$

$$\text{The radius } r = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$P_{\leftrightarrow} = 4r$  (4 is the gravitational force working against  $M = \frac{1}{4}$ . So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times \frac{1}{2}$$

$$\text{Then } P_{\leftrightarrow} = 2$$

There are two elements in opposite positions and the total particles at work is  $P = 4$ .

#### VI. ELEMENT (n=3) – THE LAW OF SUPPORT

$$P = m_1 \times m_2$$

$$\text{Then } P = 4 \times 4 = 16$$

$$\text{And } N = \frac{1}{4} \times P,$$

$$\text{Then } N = \frac{1}{4} \times 16 = 4$$

$$\text{The radius } r = \sqrt{4} = 2$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the

gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$P_{\leftrightarrow} = 4r$  (4 is the gravitational force working against  $M = \frac{1}{4}$ .)

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 2$$

$$\text{Then } P_{\leftrightarrow} = 8$$

Support is gained from the subatomic level:

$$P_{\leftrightarrow} = 2 \times \frac{1}{2} = 1$$

$$P_{\leftrightarrow total} = 8 + 1 = 9$$

VII. COMPOUND (n=4) – NEWTON’S 3<sup>RD</sup> LAW

$$P = m_1 \times m_2$$

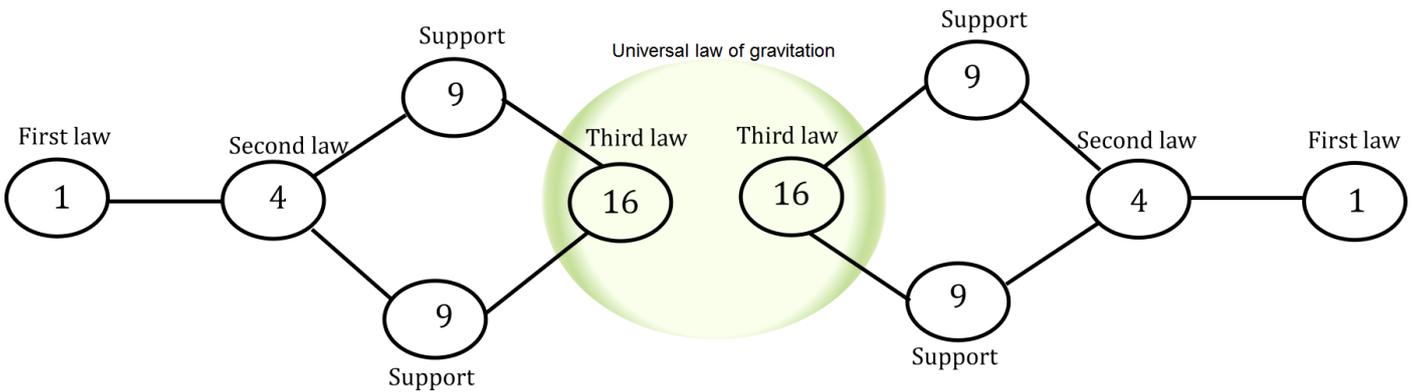
$$\text{Then } P = 4 \times 4 = 16$$

Here,  $N = P$  because nuclear enhancement has now been able to balance with  $M = \frac{1}{4}$  to a ratio of 1:1 speed.

$$\text{Therefore, } N = 1 \times P,$$

$$\text{Then } N = 16 = 16$$

Fig5. Balanced Solar system



For these conditions to fulfil and the universal law of gravitation to hold, the movement of dark matter must be balanced by the enhanced system. This clarifies the reason why the universal law of gravitation does not hold in the subatomic level. However, this level does not permanently balance dark matter and its independency exposes it and further work is triggered to achieve the next level of balance.

4. GALACTIC SYSTEM LEVEL

Particles at this level have not been named and therefore, the fission of a *Compound* and a *Compound* yields a *Compound*<sup>2</sup>. In this model; this is therefore named *Cemploce*, meaning complete center. The galactic system is between the solar system and the universe, it is therefore in the center of the creative universe.

The radius of this particle,  $r = \sqrt{16} = 4$

The weight of radius  $r$  is to deal with mass  $m = \frac{1}{4}$  and

therefore weight of particle ( $P_{\leftrightarrow}$ ) is the inverse of  $m \times r$  ( $P_{\leftrightarrow} = 4r$ )

$$P_{\leftrightarrow} = 4r$$

$$\text{Then } P_{\leftrightarrow} = 4 \times 4 = 16$$

Newton’s 3<sup>rd</sup> law is effectively fulfilled at this level.

VIII. THE UNIVERSAL LAW OF GRAVITATION (n=5)

A balanced solar system is formed by two solar systems opposite each other and a solar system is formed by two opposite suns. The universal law of gravitation fulfills when two identical systems balance. In this case, the systems were already forming through the process of nuclear enhancement and it effectively conquers the 3<sup>rd</sup> wave of dark matter. However, this balanced system does not completely balance dark matter, so Newton’s first law is immediately activated when the system starts to experience the second wave of dark matter and nuclei enhancement continues. It is only then that the enhancement of the galactic system begins.

IX. NEWTON’S 1<sup>ST</sup> LAW (n=6)

$$P = m_1 \times m_2$$

$$\text{Then } P = 16 \times 16 = 256$$

$$\text{And } N = \frac{1}{4}P,$$

$$\text{Then } N = \frac{1}{4} \times 256 = 64$$

$$\text{The radius } r = \sqrt{64} = 8$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$P_{\leftrightarrow} = 4r$  (4 is the gravitational force working against  $M = \frac{1}{4}$ .)

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 8$$

$$\text{Then } P_{\leftrightarrow} = 32$$

X. NEWTON'S 2<sup>ND</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = 32 \times 32 = 1024$$

$$\text{And } N = \frac{1}{4} \times P,$$

$$\text{Then } N = \frac{1}{4} \times 1024 = 256$$

$$\text{The radius } r = \sqrt{256} = 16$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$$P_{\leftrightarrow} = 4r \text{ (4 is the gravitational force working against } M = \frac{1}{4}.$$

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 16$$

$$\text{Then } P_{\leftrightarrow} = 64$$

XI. THE LAW OF SUPPORT

$$P = m_1 \times m_2$$

$$\text{Then } P = 64 \times 64 = 4096$$

$$\text{And } N = \frac{1}{4} \times P,$$

$$\text{Then } N = \frac{1}{4} \times 4096 = 1024$$

$$\text{The radius } r = \sqrt{1024} = 32$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

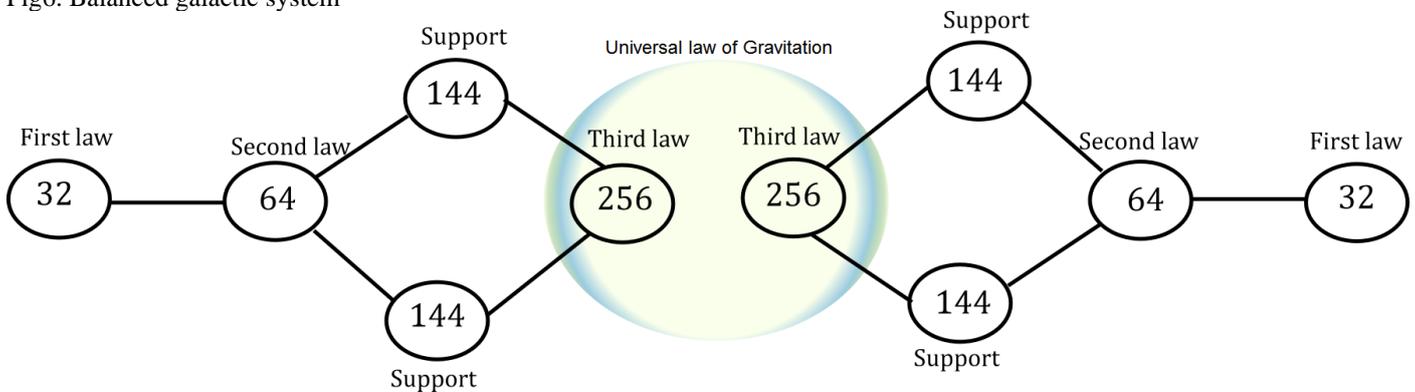
$$P_{\leftrightarrow} = 4r \text{ (4 is the gravitational force working against } M = \frac{1}{4}.$$

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 32$$

$$\text{Then } P_{\leftrightarrow} = 128$$

Fig6. Balanced galactic system



The galactic system occurs in a single level enhancing and balancing the second wave of dark matter. The solar system reached the level of the universal law of gravitation when it conquered the third wave of dark matter. Now its clear why the universal law of gravitation does not hold in the subatomic

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Support is gained from the subatomic level:

$$P_{\leftrightarrow} = 32 \times \frac{1}{2} = 16$$

$$P_{\leftrightarrow total} = 128 + 16 = 144$$

XII. NEWTON'S 3<sup>RD</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = 64 \times 64 = 4096$$

Here,  $N = P$  because nuclear enhancement has now been able to balance with  $M = \frac{1}{4}$  to a ratio of 1:1 speed.

Therefore,  $N = 1 \times P,$

$$\text{Then } N = 4096 = 4096$$

$$\text{The radius of this particle, } r = \sqrt{4096} = 64$$

The weight of radius  $r$  is to deal with mass  $m = \frac{1}{4}$  and

therefore weight of particle ( $P_{\leftrightarrow}$ ) is the inverse of  $m \times r$

$$(P_{\leftrightarrow} = 4r)$$

$$P_{\leftrightarrow} = 4r$$

$$\text{Then } P_{\leftrightarrow} = 64 \times 4 = 256$$

Newton's 3<sup>rd</sup> law is effectively fulfilled at this level.

XIII. THE UNIVERSAL LAW OF GRAVITATION

A balanced galactic system is formed by two galaxies opposite each other, fulfilling the universal law of gravitation. Once a galaxy has fulfilled Newton's third law, it starts to drift freely in space until it goes through itself and break itself, expanding its environment as it faces itself. The results yield a balanced galactic system that fulfils the universal law of gravitation. The universal law of gravitation holds until the balanced system comes face to face with the first wave of dark matter and further enhancement is triggered.

level, it is because that level has not conquered dark matter in any way.

5. UNIVERSAL SYSTEM LEVEL

The particle at this level is now a *Compound*<sup>4</sup> and it is named *Hamploce*, meaning half complete. A complete universal

system is made up of two universes and a *Hamploce* only denotes a single a universe. So, a balanced universal system is named a *Temploce*, meaning complete. It is the point of complete enhancement and complete balance, where now the only two things in existence are in perfect harmony.

XIV. NEWTON'S 1<sup>ST</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = 256 \times 256 = 65536$$

$$\text{And } N = \frac{1}{4}P,$$

$$\text{Then } N = \frac{1}{4} \times 65536 = 16384$$

$$\text{The radius } r = \sqrt{16384} = 128$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$$P_{\leftrightarrow} = 4r \text{ (4 is the gravitational force working against } M = \frac{1}{4}.$$

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 128$$

$$\text{Then } P_{\leftrightarrow} = 512$$

XV. NEWTON'S 2<sup>ND</sup> LAW

$$P = m_1 \times m_2$$

$$\text{Then } P = 512 \times 512 = 262144$$

$$\text{And } N = \frac{1}{4}P,$$

$$\text{Then } N = \frac{1}{4} \times 262144 = 65536$$

$$\text{The radius } r = \sqrt{65536} = 256$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$$P_{\leftrightarrow} = 4r \text{ (4 is the gravitational force working against } M = \frac{1}{4}.$$

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 256$$

$$\text{Then } P_{\leftrightarrow} = 1024$$

XVI. THE LAW OF SUPPORT (n=8)

$$P = m_1 \times m_2$$

$$\text{Then } P = 1024 \times 1024 = 1048576$$

$$\text{And } N = \frac{1}{4} \times P,$$

$$\text{Then } N = \frac{1}{4} \times 1048576 = 262144$$

$$\text{The radius } r = \sqrt{262144} = 512$$

For this particle of weight  $N$  to balance, the forces (strong force and electromagnetic force) in it, must move against the gravity of  $M = \frac{1}{4}$ . So, the balanced particle ( $P_{\leftrightarrow}$ ) with the nucleus ( $N$ ), have the radius of ( $N$ ), which is ( $r$ ) working to ensure balance.

$$P_{\leftrightarrow} = 4r \text{ (4 is the gravitational force working against } M = \frac{1}{4}.$$

So ( $P_{\leftrightarrow}$ ) is the particle balancing the nucleus.

$$P_{\leftrightarrow} = 4 \times 512$$

$$\text{Then } P_{\leftrightarrow} = 2048$$

Support is gained from the subatomic level:

$$P_{\leftrightarrow} = 512 \times \frac{1}{2} = 256$$

$$P_{\leftrightarrow total} = 2048 + 256 = 2304$$

XVII. NEWTON'S 3<sup>RD</sup> LAW (=9)

$$P = m_1 \times m_2$$

$$\text{Then } P = 1024 \times 1024 = 1048576$$

Here,  $N = P$  because nuclear enhancement has now been able to balance with  $M = \frac{1}{4}$  to a ratio of 1:1 speed.

Therefore,  $N = 1 \times P$ ,

$$\text{Then } N = 1048576 = 1048576$$

$$\text{The radius of this particle, } r = \sqrt{1048576} = 1024$$

The weight of radius  $r$  is to deal with mass  $m = \frac{1}{4}$  and therefore weight of particle ( $P_{\leftrightarrow}$ ) is the inverse of  $m \times r$  ( $P_{\leftrightarrow} = 4r$ )

$$P_{\leftrightarrow} = 4r$$

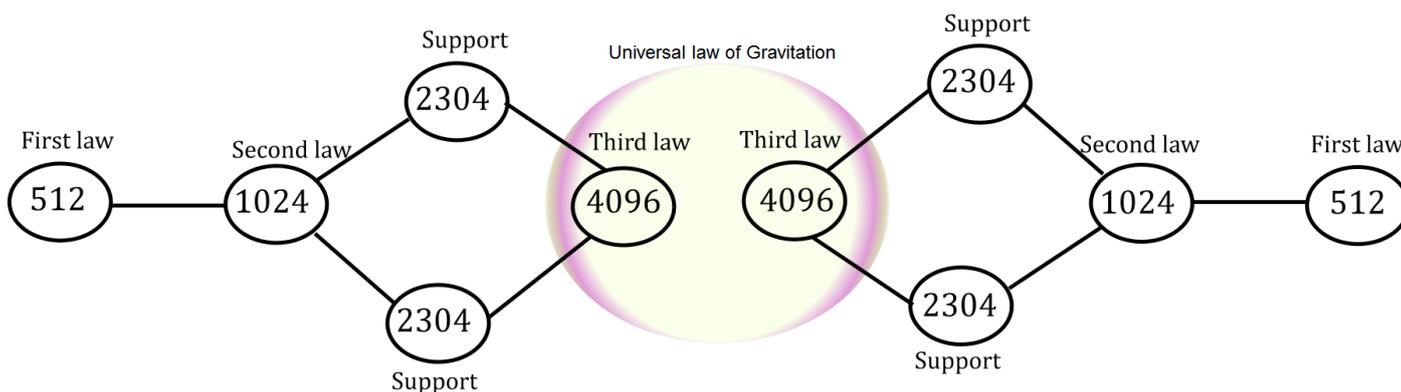
$$\text{Then } P_{\leftrightarrow} = 1024 \times 4 = 4096$$

Newton's 3<sup>rd</sup> law is effectively fulfilled at this level.

XVIII. THE UNIVERSAL LAW OF GRAVITATION

This is the bases of a finite universe balancing the elusive dark matter. It is the bases of order in the universal system as this forms part of the critical basic conditions of keeping the environment as is, because in this way life continues thrive.

Fig7. Balanced Cosmic system



The figure above shows that the cosmic system balanced itself in the same manner that the galactic system did. This is a little different from the way the solar system balanced. However, it's the same principle, when the force applied by dark matter to a system threatens to destroy the system, the system will always resolve in multiplying to gain a fighting chance. In the case of the solar system, its counterpart was already in existence and working on enhancement. So, when the threat came, the formation of a balanced solar system was the only way through.

The entire process of nuclear enhancement balances at:

$$P_{\rightarrow} = 4r$$

Dark matter balances at:

$$M = 4 \times \frac{1}{4} = 1$$

Thus, the balanced existence:

$$P_{\rightarrow} = 4r + 1$$

This is then the balanced universal system and the balanced dark matter.

### 6. NUCLEAR MAPPING

The mapping of the nucleus happens in three stages, where stage A represents the solar system, stage B represents the galactic system and stage C represents the universal system. This process is mainly focused in beta decay and traces the transitioning of nuclear particles in the process of nuclear enhancement.

#### XIX. STAGE A

$(p^+ - 1) = A$ , the proton gains a charge working on the neutron in the nucleus  $N$  and the process of beta minus decay happens.  $(e^- + 1) = A$ , the electron provides positive feedback balancing the nucleus through a process of beta plus decay. Protons and electrons are key particles in the enhancement of the nucleus and therefore the mapping and balancing of the nucleus is represented as follows, showing the nucleus discharging a particle and then the nucleus gaining a particle:

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$$(N - 1) + (N + 1)$$

$$A = 2N$$

For stage A to balance, the same work happens opposite this one.

$$(p^+ - 1) = B,$$

$$(e^- + 1) = B,$$

$$(N - 1) + (N + 1)$$

$$B = 2N$$

Therefore:  $A + B = 4N$

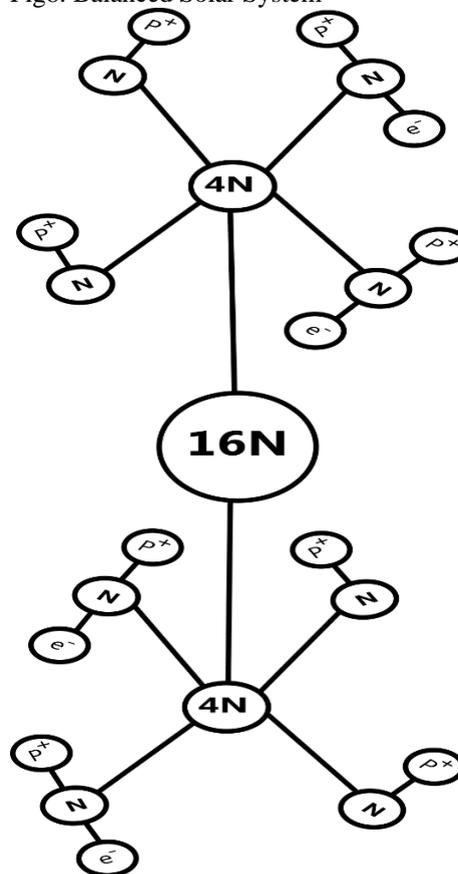
and  $N = 1$ , is the potential received.

Thus  $A + B = 4$

The center of stage A is  $N = (A + B)(A + B)$ ,

$$N = 4 \times 4 = 16$$

Fig8. Balanced Solar System



The figure above represents the chemical structure of the solar system. The particles resolve in facing each other in order to create more space and this approach gives the system advantage over the crushing gravity force of dark matter.

XX. STAGE B

$(2p^+ - 1) = A$ , two protons and two electrons work on enhancing the nucleus  $N$ .  $(2e^- + 1) = A$ .

$$A = (2N - 1) + (2N + 1)$$

$$A = 4N$$

stage B to balance, the same work happens opposite this one.

$(2p^+ - 1) = B$ , two protons and electrons work on enhancing the nucleus  $N$ .  $(2e^- + 1) = B$ .

$$B = (2N - 1) + (2N + 1)$$

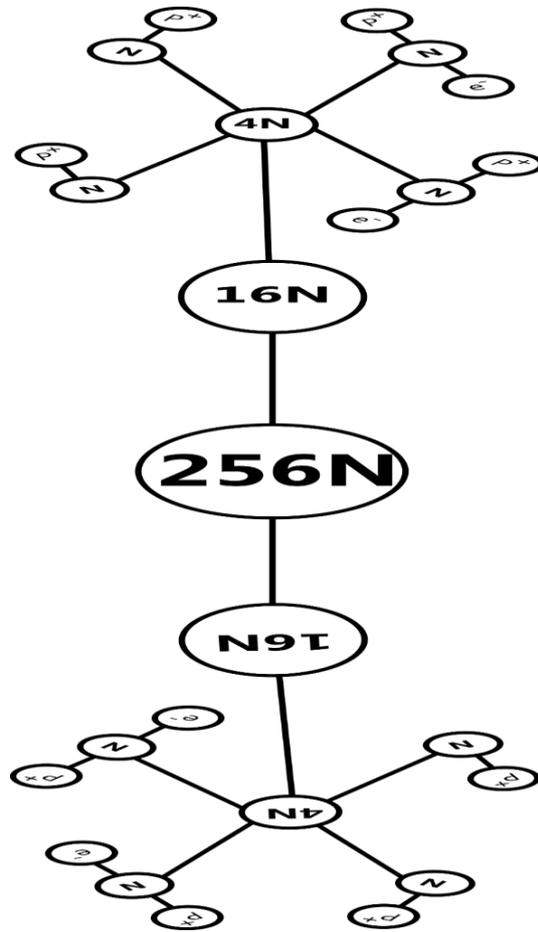
$$B = 4N$$

Therefore:  $A + B = 8N$

and  $N = 2$ , is the potential received.

Thus  $A + B = 16$

The center of stage B is  $N = (A + B)(A + B)$ ,  
 therefore  $N = 16 \times 16 = 256$



XXI. STAGE C

$(4p^+ - 1) = A$ , four new protons and electrons work on enhancing the nucleus.  $(4e^- + 1) = A$ ,

$$A = (4N - 1) + (4N + 1)$$

$$A = 8N$$

stage B to balance, the same activity happens opposite this one and on the same time.

$(4p^+ - 1) = A$ , four new protons and electrons work on enhancing the nucleus.  $(4e^- + 1) = A$ ,

$$A = (4N - 1) + (4N + 1)$$

$$A = 8N$$

$$\therefore A = (4N - 1) + (4N + 1)$$

$$A = 8N$$

Therefore:  $A + B = 16N$

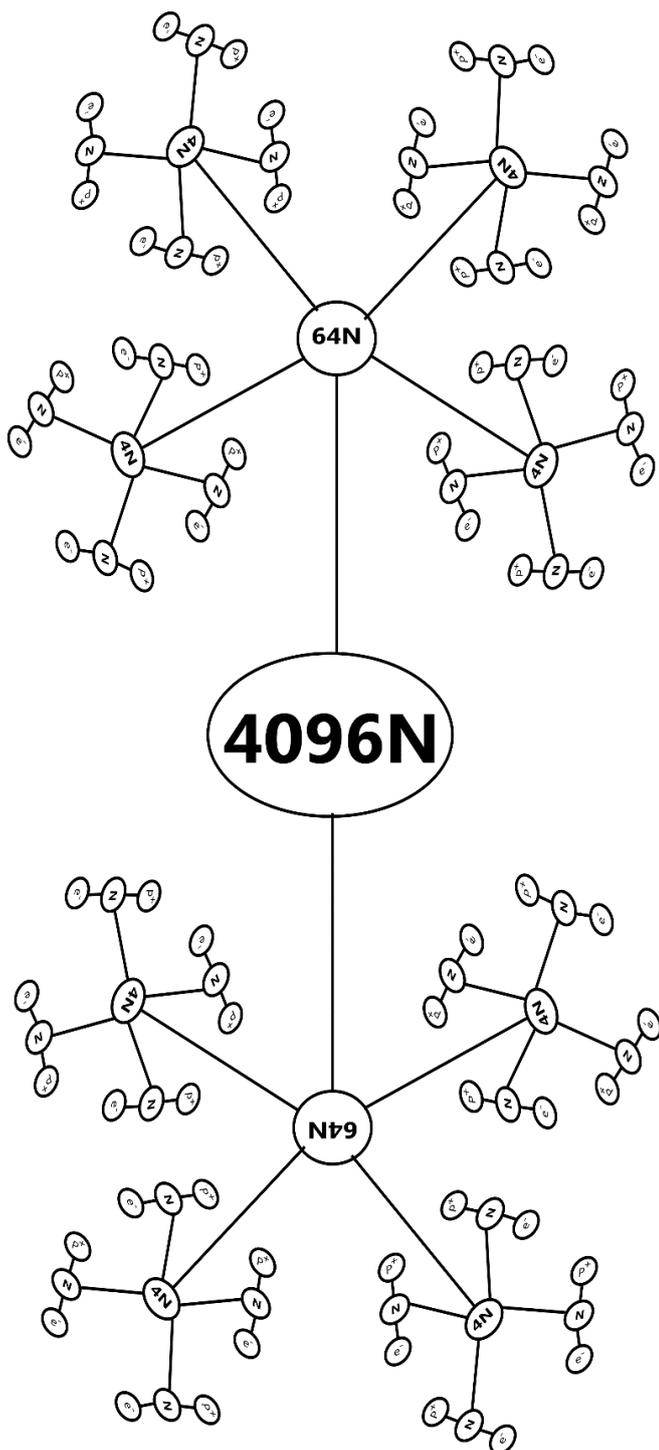
and  $N = 4$ , is the potential received.

Thus  $A + B = 64$

The nucleus of stage C is  $N = (A + B)(A + B)$ ,  
 therefore  $N = 64 \times 64 = 4096$

fig9. Galactic system

fig10. Universal system



Beta decay processes happens at the level of potential and that is the level of the subatomic particles. When a system has successfully fulfilled the universal law of gravitation it remains balanced until exposed directly to a new wave of dark matter and that triggers the process of beta decay. The subatomic level is the level that shields our environment from the waves of dark matter. This map of the nucleus shows that the nucleus of stage A and the nucleus of stage B ultimately enhance to form the nucleus of stage C.

Thus, (Stage A)(Stage B) = Stage C

In simplicity,  $A \times B = C$

This is,  $16 \times 256 = C$

Then  $C = 4096$

## XXII. CONCLUSION

Existence is based on the balance of dark matter and the universal system, once this is achieved, life will thrive naturally without interference. The major force used by dark matter to gravitate towards itself is the same force observed when the universal law of gravitation is fulfilled, and that is the force of gravity. Dark matter is only mass in motion, whereas, the formation of subatomic particles comes from the product of mass in motion, yielding particles that have weight. Nuclear enhancement is the continuous annihilation of mass until a level is reached where mass cannot interfere with the opposing weight of the universal system. The law of potential is fulfilled at the subatomic level and sets the tone for nuclear enhancement to begin and the law of support provides temporary balance until the environment is conducive for particles to fulfil Newton's 3<sup>rd</sup> law. Mass is always one and it never changes, but only the speed at which it is moving or vibrating, and this influence of speed therefore dictates the state of any given particle. When unchecked, mass in motion can be a source of uncertainty when observing or studying the natural environment. The nuclear enhancement table is like coordinates of the nucleus throughout the universe and for it to be properly understood, it should be studied in conjunction with the nuclear map and the nuclear waves. The expansion of the environment happens every time a wave of dark matter is conquered. Its like dark matter recede, giving more space for the universal system to expand. The subatomic level of particles is the bridge between dark matter and the enhancing universal system. Continuous nuclear enhancement is driven by the process of beta decay, beta minus decay is responsible for the expansion and beta plus decay is responsible for stability of the nucleus.

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