Solid Waste Management Scenario in ULBs of Dakshina Kannada District and Recommendations

Deepak Choukanpally[a], Alok Kumar[a], Madhu S Manohar[b]

[a] TATA Consulting Engineers Limited, Mumbai, India;
[b] Environmental Engineer, Mangaluru City Corporation, Mangaluru, India.

DOI: 10.29322/IJSRP.10.10.2020.p10640
http://dx.doi.org/10.29322/IJSRP.10.10.2020.p10640

ABSTRACT:
The increase in population and the improved lifestyle of people around the globe are resulting in over exploitation of resources and also generating huge amount of wastes in terms of solid and liquid waste. As per the World Bank data available in 2016, global municipal waste generation is 2.01 billion tons per year. Dakshina Kannada district is the coastal district in the state of Karnataka, India with Mangaluru as its administration headquarters. The district has one of the highest literacy rates in Karnataka state. The 8 ULBs of the district generates around 410 Tonnes per day of municipal solid waste, around 58% of this waste organic or biodegradable in nature. Per capita waste generation ranges from 0.26 to 0.6 Kg per day. Solid waste collection efficiency is between 78-95%. This study aims at providing the existing scenario of solid waste management in Dakshina Kannada district, challenges being faced, financial analysis, recommendations and specific recommendations for waste management in Covid and Post Covid situation.

Keywords: Solid Waste Management, Dakshina Kannada, Mangaluru, Processing and Disposal, Covid.

INTRODUCTION:

Solid waste management in India is a major problem for most of the Urban Local Bodies (ULBs) irrespective of the population and size due to increasing environmental pollution concerns, aesthetic concerns and resource crunch. The amount of solid waste generation is increasing day by day, by increasing urbanization and consumption patterns. There are no complete data or reports on quantity of municipal solid waste generated in India per day, the CPCB annual reports on status of implementation of MSW Rules for the years 2015-16, 2016-17 and 2017-18 are having incomplete with data from some states are missing. However, for a Lok Sabha question in 2018, it is stated that the total waste quantity generation in Urban areas is 1,45,626 TPD from 35 states and union territories. India is the third largest generator of municipal solid waste behind USA and China (What a Waste 2.0, World Bank Report, 2018).

Due to the land constraint and unscientific solid waste processing and disposal resulting in environmental issues, municipal solid waste management is becoming a major problem for the ULBs as well as the state and federal Governments. In this paper, the existing Solid Waste Management (SWM) Practices, Challenges faced in the ULBs of Dakshina Kannada District is highlighted along with the recommendation for improvement of SWM and action plans to be adopted in Covid situation. Solid Waste Management would be of prime objective in coming days for public hygiene. This is in line with the Government of India initiative under Swachh Bharat Mission. The ULB map of Dakshina Kannada District is given in Figure 1.

Table 1: Salient Details of Dakshina Kannada District

Population	20,89,649 9,96,086 (Urban Population around 47.67%)
Literacy Rate	88.57%
Urban Local Bodies	City Corporation -1 nos. City Municipal Corporations (CMC) -2 nos. Town Municipal Corporations (TMC) -2 nos. Town Panchayats (TP) – 3 nos.
Rainfall	4000 mm average
Per Capita income (2013-14)	Rs. 2,18,580

Source: 1. District Census Handbook, Dakshina Kannada and 2. Economic Survey of Karnataka 2015-16.

Figure 1: Study area of Dakshina Kannada District Map with ULBs

SOLID WASTE GENERATION:

Total estimated solid waste generation of Dakshina Kannada district ULBs' is around 410 Tonnes per day (as on the year 2016[1]). Highest solid waste generation in Dakshina Kannada district is accounted by Mangaluru City Corporation (MCC) with generation of around 331 TPD. The ULBs' per capita solid waste generation ranges from 0.26 Kg per capita (Ullal ULB) to 0.60 Kg per capita per day (MCC) in the ULBs. The highest per capita generation in MCC may be attributed to its higher hostel population since it is an education hub and due to improved lifestyle and economic status of citizens (Vijay Kumar et al. 2013 and Economic Survey of Karnataka 2015-16) and urbanization of Mangaluru City. Remaining ULBs have the per capita generation rate as per the CPCB assessed national average for medium towns and cities which is in the range of 0.3-0.4 kg per capita per day. The details of waste generation of all 8 ULBs are given in Table 2.

Table 2: Waste Generation of ULBs

Sr. No.	Name of ULB	Population (2011)	Solid Waste Generation (TPD) (2017)	Per capita waste generation (in Kg per person per day)
1	Bantwal TMC	40155	14.5	0.33
2	Belthangady TP	7746	3.2	0.35
3	Mangaluru CC	499487	331	0.60
4	Moodbidri TMC	29431	11	0.34
5	Mulki TP	17286	6.6	0.35
6	Puttur CMC	53061	18	0.33
7	Sullia TP	19956	7	0.32
8	Ullal CMC	53061	16	0.26
	TOTAL	**720183**	**409.3**	**Min**: 0.26, **Max**: 0.6, **Avg**: 0.36

SEGREGATION:

Solid waste segregation is one of the important activities which need to be done at the source. Unfortunately, this is not happening 100% in any of the ULBs in Dakshina Kannada District. Moodbidri and Mulki being the highest with around 90% of Segregation,

[1] The solid waste management study was conducted by TATA Consulting Engineers Limited in the year 2015-16, the non-disclosure agreement with Dakshina Kannada District Urban Development Cell (DUDC) was completed in March 2020.

Belthangady and Puttur have segregation of around 35%, Mangaluru has around 27% of Segregation and Sullia, Ullal and Bantwal have the least around 20-25% segregation.

COLLECTION AND TRANSPORTATION:

Solid waste collection efficiency in Dakshina Kannada ULBs ranges from lowest 78 % in Belthangady TP to highest 95 % in MCC. Both the wet waste and dry waste are being collected on daily basis by the ULBs.

As per the Government orders, workers are being directly appointed from the ULBs and being utilized for sanitation activities like Street Sweeping, Collection, Transportation and Processing of waste. Mangaluru City Corporation has outsourced to private agencies through tenders to manage the solid waste activities. Solid Waste Collection efficiency is shown in Figure 2.

Transportation of solid waste is done by using Auto tippers, Mini Tippers and Tippers in all the ULBs, the collection vehicles picture is depicted in Figure 3. The waste is transported daily to the processing and disposal site from the ULBs.

It is seen from the graph that the waste is being collected and transported efficiently and is more than the average collection efficiency for MSW in Indian cities and states which is about 70% (Shikha Saxena et al. 2010).

Though the ULBs are making all the efforts to cover solid waste collection in the entire city or town, due to resource constraints like number of vehicles, manpower, solid waste collection is not completely covered. Dakshina Kannada District being in Western Ghat region, the ULBs have many places which are inaccessible to vehicles which are situated on hillocks or places where access is very narrow, this can be attributed as one of the reasons for not covering 100% waste collection. Many of the places in outskirts of the ULBs use their biodegradable/ organic waste in the gardens or plantation areas.

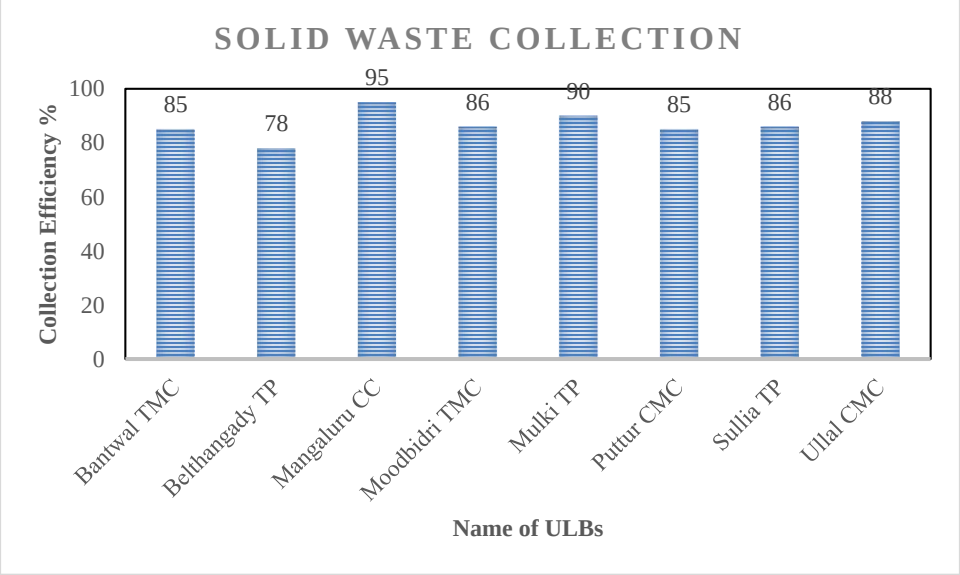
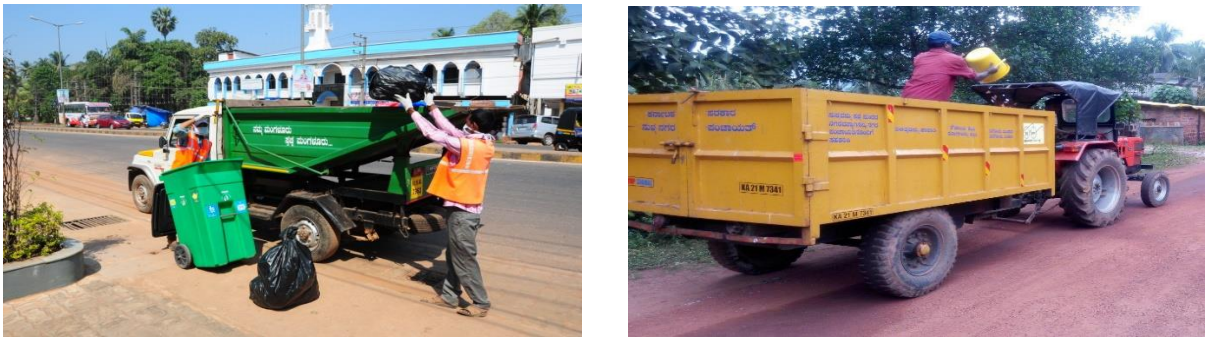


Figure 2: Solid Waste Collection Percentage



(a) (b)

Figure 3: Solid Waste Collection by Vehicles a) Mangaluru City Corporation

b) Sullia Town Panchayat

PHYSICAL COMPOSITION OF WASTE:

The waste has been categorized as Organic waste, Cloths/ rag, Paper, Plastic and Inert wastes. Average composition of waste of Dakshina Kannada District ULBs includes 58.2% organic/ bio-degradable waste, 5.48% cloths and rags, 10.74% paper, 16.87% plastics and 8.49% Inerts. The waste composition is given in Figure 4. This shows that more than half of the waste is biodegradable and around 27% of the waste is recyclable. The physical composition of the waste is in line with the various similar studies carried out (Kapil Dev Sharma et al. 2018), 40%-60% organic waste and 10-25% recyclables in the studies by NEERI and similar study carried out from IISc Bangalore for Bengaluru City (Ramachandra T.V et al. 2014).

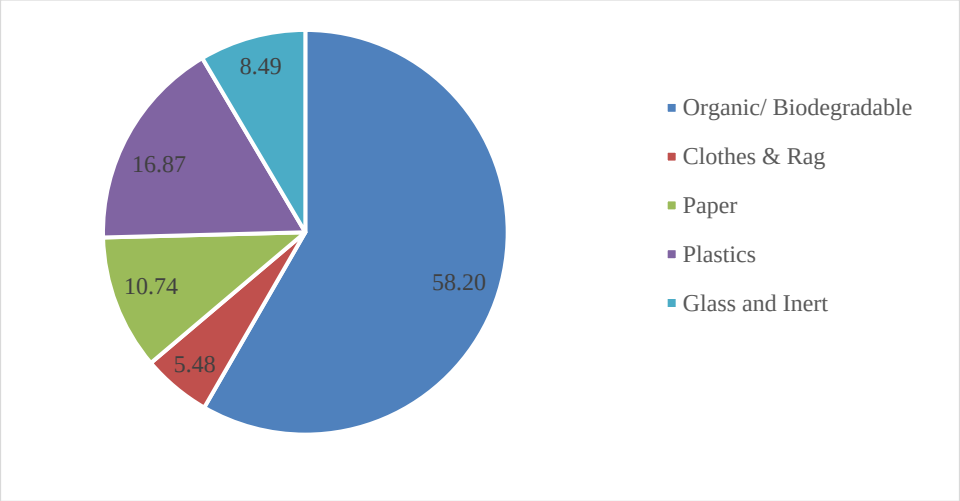


Figure 4: Solid Waste Composition

PROCESSING AND DISPOSAL:

Since Karnataka state was one of the early states to implement as per MSW Rules 2000 and had its own Solid Waste Management Policy, majority of the ULBs were identified with Solid Waste Processing Site/ Landfill site and required civil and mechanical infrastructures at Processing site. All the 8 ULBs except Ullal CMC have their own Processing and Disposal (P&D) sites in the ULB limits and they dispose the waste in the P&D site. Ullal CMC sends solid waste to MCC P&D site for processing and disposal. Bantwal TMC also sends solid waste to MCC P&D site for processing and disposal due to the litigation of its processing and disposal site. Both the Ullal CMC and Bantwal TMC pay tipping fee to MCC on tonnage basis for disposal.

ULBs have solid waste processing sheds for Windrow Composting and Vermi-compost pits for processing bio-degradable wastes and sanitary landfills for waste dumping. The details of ULBs' P&D sites and available existing facilities are given in Table 3 below.

Table 3: **Details of Existing Processing and Disposal Sites**

Sr. No.	Name of ULB	Area of P & D Site (in Acres)	Facilities at P&D Site
1.	Bantwal TMC	8.55	i.Sanitary Landfill
2.	Belthangady TP	3	ii.Waste receiving platform iii.Vermi Compost pits iv.Sanitary landfill
3.	Mangaluru CC	77.93	i.Waste receiving platform ii.Vermi Compost pits iii.Windrow Platform iv.Weighbridge v.Sanitary landfill vi.Leachate treatment plant vii.Bio-methanation plant
4.	Moodbidri TMC	4.25	i. Waste receiving platform ii. Windrow Platform iii. Bio-methanation plant

Sr. No.	Name of ULB	Area of P & D Site (in Acres)	Facilities at P&D Site
5.	Mulki TP	2.46	i.Waste receiving platform ii.Vermi Compost pits iii.Sanitary landfill
6.	Puttur CMC	7.15	i.Waste receiving platform ii.Vermi Compost pits
7.	Sullia TP	3	i.Waste receiving platform ii.Vermi Compost pits
8.	Ullal CMC	No Site	--

Moodbidri, Mulki and Mangaluru ULBs are practicing waste processing at the processing sites. The bio-degradable wastes are processed by windrow and vermi composting.

(a) (b)

Figure 5: Solid Waste Collection by Vehicles a) Vermi Composting at Mangaluru City Corporation
b) Screening of Vermi-Compost at Mangaluru City Corporation

Since 2017, Moodbidri ULB is processing hotel waste and organic waste from vegetable and fruit market to Bio-methanation plant of 2.0 TPD capacity at the Processing and Disposal Site, Karinje.

Mangaluru City Corporation also has a 2 TPD Bio- methanation plant near Urva Market, the kitchen waste from the nearby hotels and hostels is being feed to the bio-gas plant.

Apart from these, most of the waste is being dumped in open in other ULBs without any substantial processing.

FINANCIAL ANALYSIS:

Based on the solid waste generation, existing available infrastructure in the ULBs, solid waste collection and processing facilities have been proposed including the Vehicles for Solid Waste Collection, Transportation and Processing, Equipment for Collection and Processing engaged in the SWM activities, Financial details are given in Table 4 . The vehicles and equipment are proposed as per Karnataka Solid Waste Normative Standards. The solid waste management proposals are made for design year of 2022.

Except for Mangaluru and Ullal, the cost per ton for the processing and disposal involving Conventional Aerobic Composting of solid waste are above the limits specified (Rs. 5 crores per 100 tons) by 'Report of the Task Force on Waste to Energy, 2014'. This can be attributed to lesser waste generation in the ULBs, requiring all the resources for processing and disposal. Mangaluru CC has higher waste generation and also Mangaluru CC has completely outsourced the entire activities like street sweeping, collection and transportation for duration of 7 years and processing and disposal through outsourcing. Hence, the capital cost (capex) required is lesser. Since, Ullal is not having processing and disposal site and sending organic waste to MCC P&D site, the capital cost is less.

The cost of processing and disposal is higher for smaller ULBs, this shows that the centralized waste processing is ideal for cost efficient operation. However, the modalities of the centralized waste processing are to be developed and it is not practiced extensively in India.

Operation cost (Opex) is inclusive of the amount required for Collection, Transportation, Processing and Disposal including payment of salary, wages, vehicle and equipment maintenance, fuel required, electricity required

Table 4: **Financial Analysis of Capital and Operational Cost**

Sr.	ULBs	Capex in Rs. Lakhs	Design	Per ton cost	Opex in

No. (1)	(2)	Collection & Transportation (3)	Processing & Disposal (4)	Total (5)	Capacity in tons per day (6)	for Processing & Disposal in Rs. Lakhs (7)=4/6	Rs. Lakhs (8)
1.	Bantwal TMC	63.27	248.34	311.61	17.20	14.44	183.16
2.	Belthangady TP	22.14	33.57	55.86	3.48	9.65	35.27
3.	Mangaluru CC	0*	1256.00	1256.00	422.00	2.98	4556.57
4.	Moodbidri TMC	59.36	148.45	207.81	13.50	11.00	153.82
5.	Mulki TP	27.67	106.61	134.28	7.74	13.77	82.50
6.	Puttur CMC	119.13	330.25	449.38	22.00	15.01	263.91
7.	Sullia TP	20.07	203.99	224.06	8.62	23.66	95.04
8.	Ullal CMC	60.47	27.75	87.72	22.00	1.26	165.27

Note: * Mangaluru City Corporation has existing collection and transportation set-up from third party agency, hence, only up-gradation of the processing and disposal facility is proposed..

CHALLENGES BEING FACED:

1. Non-Segregation of waste at source by the public.
2. Unavailability of sufficient manpower and equipment for processing.
3. Less awareness of processing and disposal.
4. Lack of strong will power from political bodies.
5. Being a coastal district, there is good amount of fish, chicken and meat consumption. This also generates huge quantity of meat waste. In Mangaluru City Corporation alone, there is generation of around 30-40 TPD meat waste, which needs to be processed separately.
6. Dakshina Kannada district ULBs being rapidly developing due to economic improvement generates C&D waste. Mangaluru city generates around 20-30 TPD of Construction and Demolition waste, which is not processed or recycled at present.

RECOMMENDATIONS:

Recommendations for overall improvement in Solid Waste Management with various components of SWM are given in Table 5.

Table 5: **Recommendations for Improvement in SWM**

Sr. No.	SWM Component	Existing Condition	Recommendations
1.	Collection and Transportation	• Lack of source segregation in households. • No system of tracking Collection and Transportation vehicles. • No separate collection system for household Hazardous waste, Bio-medical waste and E-wastes.	• The source segregation of waste is to be encouraged and enforced more and more for the ease in waste processing. • GPS tracking to be provided for Collection and Transportation vehicles of ULBs. • Households and apartment complexes shall be asked to segregate the waste as Hazardous waste, Bio-medical waste and E-waste apart from the existing biodegradable and non-biodegradable wastes.
2.	Processing and Disposal	• ULBs are practicing conventional Windrow and Vermi-Composting, requiring huge area and time consumption.	• The conventional processing needs to be replaced with technologies like Waste to Energy (WtE), Incineration Refuse Derived Fuel (RDF) and Bio-CNG through wet waste produced. This requires policy intervention from State Government.

Sr. No.	SWM Component	Existing Condition	Recommendations
			• MCC being a city with waste generation of around 350 TPD at present can opt for these technologies in PPP mode. • Only dry wastes like paper, plastics, cloths etc., will increase the efficiency of WtE, Incineration and RDF processes.
3.	Policy Intervention	• There are no policies at present to incentivize the public/ residential or commercial complexes that are practicing organic waste processing on their own.	• Based on solid waste composition of the waste, it is seen that more than 50% of the waste is organic/ compostable in nature and people should be encouraged to process the organic waste in their premises using methods like pipe composting, pot composting, kitchen bin composting and usage of organic waste for garden areas. • Individual households, Apartment Complexes and Housing societies practicing organic waste processing in their premises shall be exempted or given concession in SWM cess/ fee.
4.	Capacity Building	• Lack of training and awareness. • Effective IEC for source segregation. • Lack of manpower, resources, will power and management of SWM facilities.	• It was observed that most of the ULBs' officials/ engineers responsible or deputed for solid waste management are not trained on aspects of waste collection, transportation and processing strategies and their implementation. • Citizens and municipal waste collection staff shall be trained and made aware on the segregation and its effect on waste processing. • ULBs shall be provided with enough manpower and resources for municipal solid waste management. • Periodic encouragement to efficient ULBs, officials and solid waste management staff is to be happened.

RECOMMENDATION FOR THE STEPS TO BE TAKEN IN COVID AND POST COVID SITUATION:

In the Covid era, the Solid Waste Management will require an overhaul from its traditional practices in terms of Solid Waste Collection and Processing.

Table 6: **Recommendations for Improvement in SWM**

Sr. No.	SWM Component	Recommendations
1.	Solid Waste Generation	• There will be additional generation of Face masks, Gloves and Covid PPE kit used by people in residential and commercial areas, these wastes shall be sent to authorized Bio-medical waste incineration plants.
2.	Collection and Transportation	• Workers involved in collection and transportation shall be strictly asked to be equipped with required PPEs during solid waste handling. • Waste generated from household with persons affected by Covid shall be handled with proper precautions using all PPEs and it shall be incinerated. • Requirement of mechanical handling of solid waste avoiding human touch. • Discontinue the practice of hand segregation of wastes, the segregation

Sr. No.	SWM Component	Recommendations
		and sorting shall be done by mechanical means. • Provide hand sanitizers to the waste collection and transportation workers.
3.	Processing and Disposal	• Workers engaged in processing site shall be routinely screened for Covid test. • Workers shall be provided with and ensured to use required PPEs. • Manual segregation of waste shall be discontinued at waste receiving and segregation platforms. • Provide hand sanitizers and washing facilities to the workers.

ACKNOWLEDGMENT:

1. All the 8 ULBs Officials, Environmental Engineers and Health Officers.
2. Mr. V Prasanna, KAS, Project Director, DUDC, Dakshina Kannada for his support during the study.
3. All the officials of DUDC, Dakshina Kannada.

REFERENCES:

1. World Bank Group Publication 2018, 'What a Waste 2.0 - A Global Snapshot of Solid Waste Management to 2050'.
2. CPCB Annual Reports on Implementation of MSW Rules, 2015-16, 2016-17 and 2017-18.
3. Government of India, Ministry of New and Renewable Energy, Lok Sabha unstarred question no. 2974 answered on 04.01.2018.
4. Census of India 2011, 'District Census Handbook, Dakshina Kannada', Directorate of Census Operations, Karnataka.
5. Economic Survey of Karnataka 2015-16, Department of Planning, Programme Monitoring & Statistics Government of Karnataka.
6. Shikha Saxena, R K Srivastava and A B Samaddar (2010) "Sustainable Waste Management Issues in India". *The IUP Journal of Soil and Water Sciences*, Vol. III, No. 1, 2010.
7. Kapil Dev Sharma and Siddharth Jain (2018) "Overview of Municipal Solid Waste Generation, Composition, and Management in India". *Journal of Environmental Engineering*, © ASCE, ISSN 0733-9372.
8. NEERI 2004-05, "Assessment of Status of Municipal Solid Wastes Management in Metro Cities and State Capitals".
9. Ramachandra T.V, Shwetmala, Dania M. Thomas (2014) "Carbon Footprint Of Solid Waste Sector In Greater Bangalore". *Assessment of Carbon Footprint in Different Industrial Sectors*, Volume 1, Eco Production, Pages 265–292. DOI: 10.1007/978-981-4560-41-2_11
10. Vijay Kumar, R.K.Pandit (2013) "Problems of Solid Waste Management in Indian Cities". *International Journal of Scientific and Research Publications*, Volume 3, Issue 3, March 2013.
11. CPHEEO Municipal Solid Waste Management Manual (2016).
12. CPHEEO (2018) "Advisory on On-Site and Decentralized Composting of Municipal Organic Waste".
13. Da Zhu, P. U. Asnani, Chris Zurbrügg, Sebastian Anapolsky, Shyamala Mani (2008) "Improving Municipal Solid Waste Management in India", A Sourcebook for Policy Makers and Practitioners. Pp. 72-90.
14. Report of the Task Force on Waste to Energy (Volume I), by Planning Commission of India.
15. Data from ULBs

AUTHORS

First Author – Deepak Choukanpally, B.E and M.Tech (Environmental Engineering), TATA Consulting Engineers Limited, deepc88@gmail.com.
Second Author – Dr. Alok Kumar, Ph.D (Ecology & Env. Science), TATA Consulting Engineers Limited.
Third Author – Madhu S Manohar, B.E (Environmental Engineering), Environmental Engineer, Mangaluru City Corporation.

Correspondence Author – Deepak Choukanpally, deepc88@gmail.com, deepakc@tce.co.in, contact number-9844993485