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Household Waste Management Policy and Practices in Bengaluru

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Abstract*: Households play a very important role in waste management policy development and its implementation in any city. This study is done among households of 12 wards in Urban Bengaluru(India). It is observed that waste management is open of the most important issue among households and households in general are not satisfied by waste collection, segregation its transport service and maintenance of public places, provided by local municipal body. Garrett's ranking method is also used to give ranking for various waste management practices adopted by various wards. The results suggest that problems faced by households across the city is not same, also perception towards the policy and practices of local bodies towards waste management differs significantly across the city. Cleanliness of public places and waste collection process should be given highest priority by the policy makers. The study also determines a different perspective towards understanding behaviour of household. the policymakers may use this technique to identify specific geographic areas where immediate action is required.

Keyword: Households, waste management policy development, Garrett's ranking method, Cleanliness

I. INTRODUCTION

(Revi, Jain, & Sami, 2014) The city of Bengaluru was previously known as Bangalore, is located on the Deccan Plateau, in the South-Eastern part of Karnataka in India, covering an area of 2208 sq km, at 12° 39' to 13° 18' North Latitude 77° 22'to 77° 52' East Longitude. The district records a Temperature-37° C (Max.) 6° C (Min.) and an average rainfall of 831 mm. (Ministry of MSME, 2016) It has a Land Bank of 2,321 Acres and a forest cover of 5055 Hectares, its major rivers include Arkavati, Kanva and Dakshina Pinakini river. (Ministry of MSME, Govt of India, 2012) Bengaluru as a city does not host production of any major mineral however it produces Felspar as its minor mineral, approximately 1400 tones per annum (2010-11). Administratively, Bengaluru is spread across four Talukas namely: Bengaluru East, Bengaluru North, Bengaluru South, and Anekal, has a population of 95,88,910 (As per 2011 census) with population density 4378 per sq. km. and a Literacy rate of 88.48% (Ministry of MSME, 2016) (Ministry of MSME, Govt of India, 2012) The World Economic Forum has identified Bengaluru as the Innovation Cluster. Bengaluru is the fastest-growing major metropolis in the country with economic growth of 10.3%, contributes almost 34 percent to the state's Gross Domestic Product (2008-2009), is the Country's 4th largest Fast-Moving Consumer Goods market, contributes approximately 36% to the total exports.

The highest judicial body is the Karnataka High Court body situated in Bangalore. The "Bruhat Bengaluru Mahanagara Palike" (BBMP, Greater Bangalore Municipal Corporation) looks after the civic administration in Bangalore. The city council runs the BBMP. The city council comprises of 250 members, which includes 198 councilors for every ward of Bangalore. Bengaluru leads India in the implementation and valuation of Public-Private Partnership projects, the presence of the World's largest healing center and telemedicine center makes it one of the pioneers in the Medical Hub concept, and

it possesses world-class infrastructure in Housing, Education & Research.

II. CHALLENGES FACED BY THE CITY

(Revi, Jain, & Sami, 2014) Identifies the Bengaluru city-concerning its People, Economy, and its Area and Land use. Further, mentions the challenges the city is facing, the challenges the city is likely to face in the future and the required sustainable goals to eradicate poverty, enhance job opportunities and productivity, thereby improvising the quality of living for its citizens, especially in slums and informal settlements. The author notes that the district needs to concentrate on maintaining its natural resources and environment while offering fundamental facilities: accommodation, water, hygiene, and waste management; alternative energy generating technologies and economic transportation facilities for all. The policymakers also need to operate while ensuring secure air and water quality for all and incorporate carbon fuel emission cuts, effective soil and resource use, and environment and catastrophe resilience into investment & norms, using appropriate statics.

III. ENVIRONMENTAL ISSUES IN BENGALURU

(Environmental Management and Policy Research Institute (EMPRI) Department of Forest, Ecology and Environment Government of Karnataka, 2015)

The phenomenon of Increased and unbalanced Migration,

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and Industrialization and Population growth over time in Bengaluru, have led to excessive pressure on the usage of the existing resources resulting in several Environmental issues. The root causes of environmental issues are Changes in land usage pattern, Unplanned development, Deforestation and loss of biodiversity, and Waste Management and Urbanization. (Centre for Sustainable Development, 2012) The Environment Report Card (ERC), prepared by
the Centre for Sustainable Development (CSD), has identified 13 key Environmental issues that Bengaluru city witnesses in the order of its priority, including Water Quantity & Quality, Green cover, Traffic congestion, Wastewater recycling, Hygiene, Sewage and sanitation, Health, Waste disposal, Air pollution and Industrial Emissions.

A. Water Quantity

(Centre for Sustainable Development, 2012) The total quantity of water supplied from different sources during normality, is approximately 1194 Millions of Litres Per Day (MLD), while Bengaluru requires 1215 MLD for a population of 9 million at the rate of 135 Litres Per Capita Per Day (LPCD) (National Building Code of India norms), thus there is a shortage of 21 MLD (2011). Inadequacy of water supply through pipelines by Bangalore Water Supply and Sewage Board (BSSWB), Decrease in groundwater levels due to excessive usage and Dried borewells remain a challenge. Due to the Inequitable distribution of water and remarkably low frequency of distribution, some sections of the population get less water than the average per capita requirement while only 10% of the population gets water 7 days a week and most do not get water for more than 3 days a week (2011). Thus, Water quantity remains a concern.

B. Water Quality

(Centre for Sustainable Development, 2012) Approximately 272 groundwater samples were collected from 49 locations, 77.55% of the samples were collected from hand pumps, 20.4% of mini water supplies and 2% of pipeline supply samples showed excess Fluoride than the Bureau of Indian Standards (BIS) limits prescribed for drinking water. Water loss is estimated to be between 30-50% (2011). Thus, Water quality remains a concern.

C. Air Quality

(The Hindu, 2019) Air pollution in Bengaluru is continuously increasing with degrading air quality (2011-2019), vehicular emissions and dust from construction are the major contributors causing high particulate matter (PM_{10}) levels. The number of vehicles on the city roads has exceeded 80 lakhs, in the financial year 2018-19, there is an increase of 6 lakh new vehicles since 2017-18, increasing at an average rate of 8% per annum. (Urban emissions info, 2019) The average ambient PM2.5 concentration is 36.5 ± 9.0 µg/m3 –more than 3 times the WHO guideline of 10 µg/m3.

D. Waste Management

(Upadhyaya, DowntoEarth, 2019) The Comptroller and Auditor General of India (CAG) came out with a performance audit report on solid waste management (SWM) in 35 urban local bodies (ULB) in Karnataka. (Report of the Comptroller and Auditor General of India, 2018) The report looks at SWM during 2012-13 to 2016-17, observes that Karnataka has the most outdated SWM policy and it is not revised according to SWM Act 2016. It observes that the BBMP has failed in the implementation of waste segregation. There is a serious shortage of scientific technologies being used for the treatment of landfills. The problem of waste collection and its disposal continues due to final disposal still being unsatisfactory as it is dumped on the roads, in drains, etc. No cells or committees have been formed at district levels to deal with waste management. CAG reports as high as 57% shortage of primary waste collection vehicles. This report also alarms the role and responsibility of Karnataka state pollution control board (KSPCB). (Centre for Sustainable Development, 2012) Not only has the overall satisfaction level decreased from 88% (2005) to 28.5% (2011), but this issue has also received the highest level of dissatisfaction in the primary data collection survey (62%). Thus, Solid waste remains a big concern.

E. E-waste

(Report of the Comptroller and Auditor General of India, 2018) Bengaluru generated over 37,000 metric tonnes (MT) of electronic waste in 2012 and stands third in the country after Mumbai and Navi Mumbai generating 61,500 MT followed by NCR National Capital Region) generating 43,000 MT of e-waste (DeccanHerald, 2013). The
producers or manufacturers of the specified electrical and electronic equipment are liable under the principle of Extended Producer Responsibility (EPR) to take care of their goods until their products have environmentally sound disposal. Thus, E-waste remains a concern.

F. Municipal Waste Management Challenge in Bengaluru

(Ramachandra & Bachamanda, Environmental Audit of Municipal Solid Waste Management, 2007) The quantity of solid waste has been increasing in Bengaluru because of its rapidly growing population, naturally with the available dumping area reducing per capita. The different types of wastes include Recyclable, and Inert waste material, and Biodegradable, Composite, and Domestic hazardous waste. Solid waste is typically categorized into Agriculture, Industrial, Commercial, and Institutional and Municipal solid waste. Agriculture waste typically includes Spoiled food wastes, and Hazardous waste and is generated in field and row crops, Orchards, Vineyards, Diaries, Feedlots, Farms, etc. Industrial waste is typically generated in Construction, Fabrication, Light and heavy manufacturing, Refineries, Chemical plants, Power plants, Demolition, etc and includes Industrial process wastes, Scrap materials, etc. (Ramachandra & Bachamanda, Environmental Audit of Municipal Solid Waste Management, 2007) Commercial and Institutional waste is generated in Stores, restaurants, markets, office buildings, hotels, auto repair shops and includes Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes, etc. Municipal solid waste is generated in residential, and commercial institutions and includes special waste, rubbish, general waste, paper, plastics,

metals, food waste, etc. (Prahasan, Kumar, Hema, & Arya, 2016) Untreated and unsegregated solid waste when dumped anywhere harms the society, and its Flaura and Fauna. The first reason which leads to its challenging disposal is that it is not segregated before being handed over to the waste collector right at the doorstep. This often leads to complications or inability in it being recycled. While 3R's – Reduce, Reuse, and Recycle, is a known term by the urban dwellers,
they often lack the knowledge and the interest to practice the same due to a variety of reasons including time, lack of ownership towards disposal of their waste, and lack of infrastructure creating other unwanted hygiene and health problems within the society. Research and Development have helped techniques to conquer the challenge, including Incineration, Gasification, Thermal depolymerization, Pyrolysis, Plasma gasification, and Anaerobic digestion. (Environmental Management and Policy Research Institute (EMPRI) Department of Forest, Ecology and Environment Government of Karnataka, 2015) Solid waste management initiatives have also helped generate employment opportunities - Door to door waste collection, Ragpickers, Street sweepers, Recycling, Waste handling staff, etc. India has Solid waste management legislatures in place – Solid waste management rules, 2006, which impact pollution, choking of sewerage and drainage, health, climate change, choking of digestive system of animals, resource depletion, street dog menace, rodent menace, fire hazard, food chain, corrosion of material, food contamination, loss of soil fertility, infection, etc. (Joshi & Ahmed, 2016) Provisions of these legislatures are governed by the Indian Penal Code u sec 278 – Making atmosphere noxious to health, 290 – Punishment for public nuisance in cases not otherwise provided for, 291 - Continuance of nuisance after injunction to discontinue, 346 (F) of the Karnataka Municipalities Act, 1964 - responsibility on Industrial Township Authority. (Report of the Comptroller and Auditor General of India, 2018) Although there has been an improvement, several challenges still exist including Lack of funds and manpower – 32% shortage of Environment Engineers, 70% of Health Inspectors and 65% of Pourakarmikas. Efficient utilization of funds towards Fixed assets versus Revenue expenditures, Transportation of mixed waste to landfills, gap in the daily roads covered in Street sweeping, absence of functional GPS and tracking systems in garbage collection trucks, unauthorised dumping of waste near the bank of River Kabini, Nanjangud, invalid authorisation from Karnataka State Pollution Control Board (KSPBC) and necessary environmental clearance was lacking, the required buffer zones around the landfill sites were not maintained, evidence of unscientific dumping and burning of mixed waste in the landfills were found, many of the landfills test-checked lacked basic infrastructure such as waste inspection facilities, weighbridge, fire-fighting equipment, toilet, etc, Plastic waste, though found feasible for use in laying of roads, was not used for the purpose, Construction debris was dumped on roadsides, near water bodies and low-lying areas, hence there is still scope for further improvement.

G. Role of households in Solid Waste Management

Households play a crucial role in Solid Waste Management. The primary task in Solid Waste Management is Segregation, must start at the household itself to ensure maximum efficiency and effectiveness in Solid Waste Management. (Kumar & Nandani, 2013) The community participation towards Solid Waste Management in Bengaluru remains poor by only a minority showing interest towards it measured through Participation levels, Daily waste collection, and Segregation requirements, and Willingness to use recycled products. (Dhokhikah, Trihadiningrum, & Sunaryo, 2015) (Machio, 2017) Observes that Men participate more in Solid Waste Management as compared to Women although the women are more engaged in segregation activities as compared to men. (Kumar & Nandani, 2013) (Dadson Awunyo-Vitor, 2013) (Dhokhikah, Trihadiningrum, & Sunaryo, 2015) Observe that Investment towards Solid Waste Management in manpower, Machinery, and Equipment, research and development is much needed considering the volume of solid waste generated against the existing infrastructure to manage the same, however, not all the residents are willing to pay towards Solid Waste Management due to the poor Solid Waste Management services provided in their residential areas, the mindset of onuses of Solid Waste Management lying with the government, different financial priorities, lack of time and knowledge, and laziness towards Sorting, Recycling, and Composting activities. Married couples, employed individuals, and people of younger age participated more in Solid Waste Management as compared to their peers. The level of education and income were directly proportionate to contribution to Solid Waste Management. (Dhokhikah, Trihadiningrum, & Sunaryo, 2015) (Kumar & Nandani, 2013) (Machio, 2017) Suggest that intensifying the training, and information provided on Solid Waste Management and its technical know-how, Rapid increase in environmental teams, stiff penalty, and law and order for household sorting, and composting, proper disposal of waste and Increase in waste banks will help in better
solid waste management. (Dadson Awunyo-Vitor, 2013) Focus on influencing the household's willingness to pay in Ghana, and observe that income influences the willingness and amount to pay positively, female are willing to pay more as compared to men, it is also determined that age and the number of children in the family affect the willingness to pay negatively, education, duration of stay, quantity of waste generated, house ownership and married marital status affect the willingness to pay positively. Observed that the reasons for Unwillingness to pay include lack of services provided in their area, dumping, government responsibility mindset and different financial priorities. Thus the Polluter pay principle must be utilized by implementing Solid Waste Management body as a collective responsibility and rationally. A variation in approach has been adopted, (Dhokhikah, Trihadiningrum, & Sunaryo, 2015) identifies participation of households in solid waste management by dividing the factors affecting into 2 major categories Socio-economic characteristics and supporting factors in eastern Surabaya. The Socio-economic characteristics included Gender, Age, Educational background and Family income while the supporting factors include individual's knowledge about solid waste management, information from mass media, household waste reduction training, environmental team, and availability of waste bank.

The supporting factors had a more dominant effect on solid waste management compared to economic factors. The results indicated lack of time and knowledge, and laziness were the primary reasons for the lack of sorting, recycling and composting. It is also observed that there is a strong correlation between environmental knowledge and behavior. (Machio, 2017) Has used Profile of household as an independent variable and Household support as the intervening variable, while the dependent variable was Level of household participation (Quantity, Type of waste generated, separation in household and household recycling). It is observed that younger age group (30-39 yrs) participates more in solid waste management, level of education and level of income were directly proportionate to solid waste management, (Kumar & Nandani, 2013) Waste collection fees charged based on waste volume or weight also determines waste segregation attribute. (Scheinberg, 2011) If waste segregation is done at source preparation of compost at home is possible using kitchen and garden waste. In India preparation of compost at home is not much in practice, unlike the west. (Goel, 2008) Concern and Awareness among the citizens of a country also drive its SWM practices and its effectiveness In a few developing countries people are concerned about hazardous effect due to garbage but have a "Not In My Backyard" NIMB attitude. (Schubeler, 1996) In India market for products manufactured from recycled waste is not strong to provide funds to local bodies. There has to be an incentive to households and commercial for a reduction in waste generated. (Pandey & Malik, 2015) (Zhu, Asnani, Zurburgg, Anapolsku, & Mani, 2008).

IV. DATA COLLECTION AND ANALYSIS

A study was done in 200 households across 12 wards in Bengaluru, to study household practice related to waste management, with the purpose to understand waste management practice being followed by them, perception towards municipalities waste collection and segregation practices and to understand ground realities and difficulties being faced by them.

Table- I: Kruskal Wallis ANOVA Test for the Various Wastages Ejected by the Household concerning their Size across the Regions

Test Statistics	Plastic Packaging Bags/Paper/Card Board Packaging	Food/ Kitchen Wet Waste/Garden Waste	Clothes	Diapers/Sanitary Wastes	Other Wastes
Chi-Square	46.725*	28.230*	16.049	8.693	16.548
Prob. Value	0	0.003	0.139	0.65	0.122
Notes: Grouping Variable: Region. * - indicates the significance at one percent level.					

Table I provides the Kruskal Wallis ANOVA Test for the Various Wastages Ejected by the Household concerning their Size across the selected regions. A significant difference is observed between the regions concerning the size of the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging (Chi-Square Statistics=46.725, Prob. Value<0.05) at 5% level of significance. It means that the size of the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging varies among the selected regions. It is also observed that the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging is significantly higher among the selected regions.

A significant difference is observed between the regions concerning the size of the waste ejected in terms of Food/ Kitchen Wet Waste/Garden (Chi-Square Statistics=28.230, Prob. Value<0.05) at 5% level of significance. It means that the size of the waste ejected in terms of Food/ Kitchen Wet Waste/Garden varies among the selected regions and is significantly higher among the selected regions.

Table- II: ANOVA F Test for the Various Wastages Ejected by the Household concerning their Size across the Regions

	Region	N	Mean	Std. Deviation	F-Statistics	Prob. Value
Plastic Packaging Bags/ Paper/ Card Board Packaging	Tavarakare	37	1.73	0.80445	3.766*	0
	Chandrappa Vattara	13	1.692	0.48038		
	R R Layout	12	1.917	0.9962		
	Bhagvati Layout	9	1.778	0.83333		
	Someshwara Layout	11	1.364	0.50452		
	Pai Layout	13	1.846	0.68874		
	Mico Layout	19	1.632	1.16479		
	Mahadeshwara Layout	18	1.5	0.61835		
	Lakkasandra	15	1.2	0.41404		
	Maruti Nagar	19	1	0		
	S G Palaya	16	1.25	0.44721		

	Koramangla	19	1	0		
	Total	201	1.483	0.72866		
Food/ Kitchen Wet Waste/ Garden Waste	Tavarakare	37	1.676	0.91451	2.028**	0.028
	Chandrappa Vattara	13	1.385	0.65044		
	R R Layout	12	1.833	0.93744		
	Bhagvati Layout	9	1.889	1.2693		
	Someshwara Layout	11	1.636	0.50452		
	Pai Layout	13	1.462	0.66023		
	Mico Layout	19	2.368	1.38285		
	Mahadeshwara Layout	18	1.611	0.50163		
	Lakkasandra	15	2	0.65465		
	Maruti Nagar	19	2	0		
	S G Palaya	16	1.813	0.54391		
	Koramangla	19	2	0		
	Total	201	1.816	0.80059		
Waste Clothes	Tavarakare	37	3.622	0.9531	1.753	0.065
	Chandrappa Vattara	13	3.462	0.66023		
	R R Layout	12	3.083	1.31137		
	Bhagvati Layout	9	3.111	1.16667		
	Someshwara Layout	11	4.091	0.83121		
	Pai Layout	13	3.231	0.72501		
	Mico Layout	19	3.474	1.07333		
	Mahadeshwara Layout	18	4	0.90749		
	Lakkasandra	15	3.467	0.63994		
	Maruti Nagar	19	3.526	0.51299		
	S G Palaya	16	3.813	0.91059		
	Koramangla	19	3.842	0.83421		
	Total	201	3.592	0.91254		
Diapers/ Sanitary Wastes	Tavarakare	37	3.676	0.88362	1.025	0.426
	Chandrappa Vattara	13	3.923	0.75955		
	R R Layout	12	3.25	1.3568		
	Bhagvati Layout	9	4	0.5		
	Someshwara Layout	11	3.636	0.6742		
	Pai Layout	13	3.923	0.75955		
	Mico Layout	19	3.684	0.67104		
	Mahadeshwara Layout	18	3.889	0.4714		
	Lakkasandra	15	3.933	0.79881		
	Maruti Nagar	19	3.579	0.60698		
	S G Palaya	16	3.625	0.7188		
	Koramangla	19	3.632	0.49559		
	Total	201	3.716	0.75775		
Other Wastes	Tavarakare	37	4.297	1.02374	1.758	0.064
	Chandrappa Vattara	13	4.462	1.1266		
	R R Layout	12	4.333	1.30268		
	Bhagvati Layout	9	3.889	1.36423		
	Someshwara Layout	11	4.273	0.90453		
	Pai Layout	13	4.846	0.37553		
	Mico Layout	19	3.842	1.34425		
	Mahadeshwara Layout	18	4.111	1.02262		
	Lakkasandra	15	4.533	0.74322		
	Maruti Nagar	19	4.895	0.45883		
	S G Palaya	16	4.5	0.7303		
	Koramangla	19	4.526	0.84119		
	Total	201	4.378	0.99314		

Notes: *, ** & *** - indicates the significance at one and five percent level, respectively.

Table II depicts the ANOVA F Test for the Various Wastages Ejected by the Household concerning their Size across the selected regions. A significant difference is observed between the regions concerning the size of the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging (F-Statistics=3.766, Prob. Value<0.05) at 5% level of significance. It means that the size of the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging varies among the selected regions.

It is also observed that the waste ejected in terms of Plastic Packaging Bags/Paper/Card Board Packaging is significantly higher among the selected regions.

A significant difference is observed between the regions concerning the size of the waste ejected in terms of Food/ Kitchen Wet Waste/Garden (F-Statistics=2.028, Prob. Value<0.05) at 5% level of significance. It means that the size of the waste ejected in terms of Food/ Kitchen Wet Waste/Garden varies among the selected regions and is significantly higher among the selected regions.

While in the case of size of the waste ejected in terms of Clothes, Diapers/Sanitary, and Other wastes, the Chi-Square Statistics is found to be statistically insignificant (Prob. Value>0.05) implying that the size of the waste ejected in terms of Clothes, Diapers/Sanitary and Other wastes do not vary among the selected regions.

Table- III: Kruskal Wallis ANOVA Test for the Degree of Seriousness of Public Nuisances across the Regions

Test Statistics	Noise Pollution	Water Pollution	Solid Waste	Air Pollution	Poor Road Conditio
Chi-Square	13.015	27.877*	40.048*	38.604*	36.452*
Prob. Value	0.292	0.003	0.000	0.000	0.000
Notes: Grouping Variable: Region. * - indicates the significance at one percent level.					

Table III provides the Kruskal Wallis ANOVA test for the degree of seriousness of public nuisances across the regions. The results show that no significant difference is observed between the selected regions concerning the degree of seriousness of public nuisances resulting from noise pollution. Besides the significant difference is observed between the regions concerning water pollution, solid waste, air pollution, and

poor road conditions at a 5% level of significance. It means that the degree of seriousness concerning water pollution, solid waste, air pollution, and poor road conditions varies among the selected regions.

Table- IV: Kruskal Wallis ANOVA Test related to the Waste Disposal across the Regions

S. No.	Questions related to the Waste Disposal across the Region	Chi-Square Statistics	Prob. Value
1	Segregate Waste Before Disposal	65.315*	0.000
2	Dry Waste Stored in Household Before Disposal	40.609*	0.000
3	Wet Waste Stored in Household Before Disposal	40.961*	0.000
4	Provision of Waste Collection Methods by The Municipality	39.185*	0.000
5	Regularity in arrival of waste collection van	30.164*	0.000
6	Timely arrival of Waste Collection Van	36.193*	0.000
7	Waste Collection from Doorstep	32.593*	0.000
8	Carry Waste to the Collection Van	20.104**	0.044
9	Waste Collectors Collect Dry and Wet Wastes Separately	45.192*	0.000
Notes: Grouping Variable: Region. * and ** - indicates the significance at one and percent level, respectively.			

Table IV presents the Kruskal Wallis ANOVA Test related to waste disposal management across the selected regions. The Chi-Square statistics under the Kruskal Wallis ANOVA Test for the questions related to waste disposal management that shown in the Table are found to be statistically significant (Prob. Value<0.05) at 5% level. It implies a significant difference is observed between the regions concerning waste disposal management practices. It means that waste disposal management practices vary among the selected regions. Solid waste management in the selected regions has sufficient planning and proper execution process.

It is also observed that at the present condition public bin sites, waste collection frequency, waste collection methods, waste separation methods and waste recycling system implemented in municipalities are satisfactory in the selected regions, namely Tavarakare, Chandrappa Vattara, R R Layout, Bhagvati Layout, Someshwara Layout, Pai Layout, Mico Layout, Mahadeshwara Layout, Lakkasandra, Maruti Nagar, SG Palaya and Koramangla.

Further Garrett's ranking technique is used to rank the preference indicated by the respondents on different factors. As per this method, respondents have been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value with the help of the following formula:

Percent position = $100 (R_{ij} – 0.5) / N_{j,}$

where

R_{ij} = Rank given for the i^{th} variable by j^{th} respondents

N_j = Number of variable ranked by j^{th} respondents.

With the help of Garrett's Table, the percent position estimated is converted into scores. Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important factor. The output is shown in table V.

Table- V: Garrett's Ranking for Municipality practice on Solid Waste Management Performance

	TIMELY COLLECTION OF WASTE			WASTE DISPOSAL METHODS			SEPARATE COLLECTION OF DRY AND WET WASTE			PLACEMENT AND NUMBER OF PUBLIC BINS			REGULAR REPLACEMENT OF PUBLIC BINS			ADEQUATE EQUIPMENTS FOR WASTE COLLECTION		
	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank
Tavarakare	3093	83.595	6	3171	85.7	5	3309	89.4324	2	3320	89.7297	1	3278	88.5946	4	3300	89.189	3
Chandrappa Vattara	1006	77.385	6	1028	79.08	4	1017	78.2308	5	1072	82.4615	2	1083	83.3077	1	1061	81.615	3
R R Layout	771	64.25	6	816	68	4	810	67.5	5	849	70.75	3	872	72.6667	2	894	74.5	1
Bhagvati Layout	509	56.556	6	580	64.44	4	569	63.2222	5	680	75.5556	1	634	70.4444	2	620	68.889	3
Someshwara Layout	799	72.636	6	805	73.18	5	817	74.2727	3	851	77.3636	1	844	76.7273	2	810	73.636	4
Pai Layout	832	64	6	864	66.46	5	866	66.6154	4	890	68.4615	3	895	68.8462	1	894	68.769	2
Mico Layout	1436	75.579	6	1462	76.95	5	1478	77.7895	4	1508	79.3684	1	1494	78.6316	3	1498	78.842	2
Mahadeshwara Layout	1369	76.056	5	1362	75.67	6	1375	76.3889	4	1379	76.6111	3	1417	78.7222	1	1411	78.389	2
Lakkasandra	1162	77.467	6	1174	77.57	5	1176	78.4	3	1261	84.0667	1	1188	79.2	2	1168	77.867	4
Maruti Nagar	1510	79.474	6	1520	80	3	1514	79.6842	5	1530	80.5263	1	1524	80.2105	2	1518	79.895	4
S G Palaya	1230	76.875	5	1220	76.25	6	1250	78.125	4	1270	79.375	3	1260	78.75	2	1264	79	1
Koramangla	1522	80.105	5	1384	72.84	6	1550	81.579	1	1528	80.4211	4	1534	80.7368	3	1538	80.947	2

Overall, the evidence from the Garrett Ranking technique on the performance of solid waste management practices of the municipality of the selected region shows that the placement and number of public bins in the respective area, and the regular replacement of public bins, and the separate collection of dry and wet waste shared the top three positions. It is also observed from the table, the timely collection of waste got last rank preferred by the respondents.

Table- VI: Garrett Ranking technique on the practices adopted by the Municipalities related to collection of solid waste

	PUBLIC BIN SITES CONDITION			COLLECTION FREQUENCY			COLLECTION METHOD			SOLID WASTE SEPARATION			SOLID WASTE RECYCLING		
	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank	Garrot Score	Mean Percent Score	Rank
Tavarakare	3108	84	1	2941	79.487	3	3094	83.622	2	2886	78	4	2851	77.054	5
Chandrappa Vattara	983	75.615	1	896	68.923	4	838	64.462	5	955	73.462	2	938	72.154	3
R R Layout	862	71.833	1	821	68.417	2	808	67.333	4	784	65.333	5	809	67.417	3
Bhagvati Layout	628	69.778	1	543	60.333	3	548	60.889	2	538	59.778	4	516	57.333	5
Someshwara Layout	785	71.364	1	773	70.273	3	778	70.727	2	718	65.273	4	713	64.818	5
Pai Layout	933	71.769	1	879	67.615	4	884	68	3	889	68.385	2	873	67.154	5
Mico Layout	1502	79.053	1	1488	78.316	2	1455	76.579	3	1380	72.632	4	1357	71.421	5
Mahadeshwara Layout	1413	78.5	1	822	45.667	5	1336	74.222	2	1318	73.222	3	1300	72.222	4
Lakkasandra	1098	73.2	2	1092	77.567	1	1086	72.4	3	1020	68	5	1025	68.333	4
Maruti Nagar	1470	77.368	1	1458	76.737	3	1464	77.053	2	1319	69.421	4	1305	68.684	5
S G Palaya	1154	72.125	1	1144	71.5	3	1148	71.75	2	1080	67.5	4	1076	67.25	5
Koramangla	1568	82.526	1	1558	82	2	1548	81.474	3	1314	69.158	4	1292	68	5

Overall, the evidences from the Garrett Ranking technique on the practices adopted by the Municipalities related to collection of solid waste shows that public bin sites should be in good and clean condition in the area, the collection frequency is important and the collection method should be updated as these shared the top three positions in the selected region. It is also observed that the solid waste recycling facilities have not been enforced as they have got last rank preferred by the respondents.

V. CONCLUSION

Fast developing, cosmopolitan cities like Bengaluru, have to equip itself to also deal with environmental issues arising due to continuous increase in population and its requirement. One of the most neglected and significantly issue is of improper waste management. Although there is a role assigned to each stakeholder in the policy document framed by concerned authorities but on records it's not practiced by most of them. Households can play a pivotal role in continuously increasing pile of waste in the city and the landfills. Proper facilities, regular support and awareness if provided to residents, each geographical bifurcation of a city can become an exemplary case of reduction, recycle renew and reuse of domestic trash. The study observes that solid waste is a serious concern into the mind of most of the residents . If the local bodies ensure regular collection of segregated waste from the households, closed waste collection Vehicles (which avoids dripping across the city roads) and maintain public places by providing sufficient bins , its regular cleaning, they can get local residents support and confidence appreciation towards usage of stringent policy and hefty fine for offenders. Technological development in waste management can bring a significant change in current issue related to increasing garbage in municipality, but it also requires support and contribution of residents of those areas. Policymakers need to synchronize role of household, technology and legal structure in order to save cities from getting converted to landfills.

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