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The Effectiveness of Solid Waste Treatment and Disposal Services in Municipalities of Kerala

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Abstract – Solid wastes have a dangerous impact on life on earth if not treated and disposed properly. The study is meant for knowing the level of waste processing efforts of municipalities of Kerala. Nine municipalities and two hundred and forty respondents are selected for the study for analyzing to draw conclusions about this. From the study it is found that in landfilling effort Kottayam municipality, in composting Koyilandi, in biomethanation Thiruvalla, in recycling and reusing Cherthala, in use of latest technology Pathanamthitta and with respect to ability of generate funds for waste treatment and disposal Kalpetta are leading.

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1. INTRODUCTION

Solid waste has become an inevitable part of human life. In the modern world of consumerism people carelessly use valuable resources and ending up a majority of such resources in their waste bin. In a world where the society just speak and think about their rights only and very logically escaping from their duties and responsibilities, heaps of solid waste is quite common. If we want to make commendable advancements in the minimization of solid waste generation the attitude, awareness level, commitment and mind set of the society should be changed. Kerala is a small state lying close to the Arabian Sea is famous with respect to its education level, medical initiatives and all other human development indices. Its social development indices are benchmarking for other states of India but its solid waste management efforts are extremely pathetic. Municipalities of Kerala are failing to manage their waste in a healthy manner. Those who generate waste is responsible to dispose their waste is a fact which is not till reached the minds of inhabitants of Kerala especially those who live in urban limits. They are in the clutches of NIMBY (Not In My BackYard) Syndrome and just throw away their waste in water bodies and streets. The resultant health threats are unmanageable for the authorities. The municipalities of Kerala who are expected to manage waste in municipal limits are failing to educate people regarding the need of healthy management of solid waste. Even educated people knowing of its health issues throw away wastes is just an indication of lack of their social commitment. The volume of solid waste generated in municipal limits is definitely beyond the treatment and disposal capacities of municipalities. So they have to emphasize on decentralized waste treatment and disposal system where each waste generator should treat and dispose waste in their premises without making any external threats. The paper attempts to identify the effectiveness of solid waste disposal services of municipalities of Kerala.

2. STATEMENT OF THE PROBLEM

Solid waste management in urban limits of Kerala is already grown beyond the abilities of the state. The municipalities of Kerala are groping in darkness to tackle their waste management issues. Municipalities are managers of waste and not the collectors, transporters and disposers of waste as conceived by the inhabitants. Municipalities are just expected to support the waste generators by educating, teaching and providing waste treatment and disposal techniques for them for a decentralized waste management system. But people believe that it is the municipalities' responsibility to collect, treat and dispose the waste generated by them. By casting upon the entire responsibility on the shoulders of municipality the inhabitants are ignorantly accusing them of irresponsibility. It is true that inhabitants in municipal limits are facing acute shortage of space for disposing their waste. But at the same time it is beyond the assimilative capacity of the municipalities to collect, treat and dispose the entire mass of solid wastes generated in their limits. The herculean waste problem can be tackled only through a coordinated effort on either part. The study just tries to identify the present waste treatment and disposal system's effectiveness in municipal limits. Hence, the problem is stated as **"THE EFFECTIVENESS OF SOLID WASTE TREATMENT AND DISPOSAL SERVICES IN MUNICIPALITIES OF KERALA"**

3. OBJECTIVES OF THE PAPER

Generally the study looks into the effectiveness of waste treatment and disposal services in municipal

limits of Kerala. The specific objectives of the study are;

1. To identify which municipality out of the selected sample is most efficient in landfilling of waste.

2. To know which municipality is efficient in composting services.

3. To know which municipality is most efficient in biomethanation technique.

4. To trace out the most efficient municipality in recycling and reusing efforts.

5. To identify which municipality is leading in use of latest technology.

6. To know which municipality has the highest potential to generate resource from public.

4. METHODOLOGY AND SAMPLING DESIGN

For selecting sample respondents for the current study Kerala is divided into three regions viz. South, Central and North. Then each region is divided into three areas Coastal, Plain and Hilly. From each region one municipality each from Coastal, Plain and Hilly are selected at random. So for each region three municipalities each are selected constituting a sample of nine. Again, Simple Random Sampling is used to select respondents from each municipality. In such a way the primary data is gathered for the study. The selected municipalities are Thiruvalla, Varkala, Pathanamthitta, Kottayam, Cherthala, Kothamanglam, Palakkad, Koilandy and Kalpetta. The respondents are selected from the category of households as more than fifty percent of municipal solid wastes are the contributed by them. A structured questionnaire is administered among them to collect data about the effectiveness waste collection services. The sample size is 240 split in the ratio of 30:26:26:32:24:24:31:24:23 respectively. Information from published sources of different Departments, Agencies and Municipalities are used in the study as secondary data sources.

Table 1.1 Sample Size Distributions of Selected Municipalities

	South	Central	North
Plain	Thiruvalla (30)	Kotayam (32)	Palakkad (31)
Hilly	Pathanamthitta (26)	Kothamangalam (24)	Kalpetta (23)
Coastal	Varkala (26)	Cherthala (24)	Koyilandi (24)

Source: Primary Data, Number of respondents given in brackets

5. TOOLS USED FOR DATA ANALYSIS

The basic tools used for analysis of primary data are Arithmetic Mean and Standard Deviation. For testing of hypothesis Standard Error and MANOVA (Multivariate Analysis of Variance) are used.

6. WASTE TREATMENT AND DISPOSAL SERVICES BY MUNICIPALITIES

The prominent waste treatment techniques used by municipalities of Kerala for treating biodegradable waste are Composting, Biomethanation. The most suitable Composting technique is vermi composting. The problem with municipalities are that they are getting waste in un segregated combined form. Waste suitable for bio processing should be segregated and each and every waste generator should be informed of the importance of waste segregation. Then only it will produce quality bio-fertilizer as output. The non-biodegradable wastes are collected separately and used for recycling and reusing. Advanced treatment techniques like pyrolysis, gasification and pelletization are not much used in Kerala. Sanitary landfills prepared in the scientific manner are not much visible in Kerala but most of the municipalities are using the unscientific open dumping practices. In this study the waste treatment and disposal system efficiency is measured by using the variables efficiency in landfilling, efficiency in composting, efficiency in biomethanation, efficiency in recycling and reusing, efficiency in use of latest technology and ability to generate resource from public.

7. ANALYSIS AND INTERPRETATION

The analysis tools used in the study are descriptive statistics like mean score, standard deviation and standard error. For testing of hypothesis it is using Multivariate Analysis of Variance (MANOVA) with the help of SPSS Software.

Table 1.2 Descriptive Statistics

	Name of the Municipality	Mean	Std. Deviation	N
Effeciency in Landfilling	Thiruvalla	17.5333	3.35007	30
	Varkala	19.6154	.98293	26
	Pathanamthitta	15.2308	1.92474	26
	Kottayam	**20.3750**	.70711	32
	Cherthala	9.0000	.00000	24
	Kothamanglam	17.0833	4.10638	24
	Palakkad	17.6129	3.95540	31
	Koilandy	19.3333	2.54809	24
	Kalpetta	15.4783	3.20326	23
	Total	16.9833	4.11850	240
Effeciency in Composting	Thiruvalla	8.3000	4.34027	30
	Varkala	5.2692	3.62831	26
	Pathanamthitta	5.6923	1.89250	26
	Kottayam	10.9062	2.79815	32
	Cherthala	3.0000	.00000	24
	Kothamanglam	9.5833	3.56208	24
	Palakkad	10.7419	4.13092	31
	Koilandy	**13.7083**	2.25503	24
	Kalpetta	8.2174	3.07418	23
	Total	8.4833	4.36893	240
Effeciency in Biomethenation	Thiruvalla	**18.0667**	5.89525	30
	Varkala	8.2692	5.92998	26
	Pathanamthitta	15.0000	9.91968	26
	Kottayam	6.7812	1.84451	32
	Cherthala	6.0000	.00000	24
	Kothamanglam	12.5833	9.12196	24
	Palakkad	6.7742	2.04466	31
	Koilandy	6.5000	2.44949	24
	Kalpetta	15.7391	8.75016	23
	Total	10.5750	7.42174	240

Effeciency in Recycling and Reusing	Thiruvalla	33.5000	4.93929	30
	Varkala	27.4615	6.91220	26
	Pathanamthitta	31.0000	6.64530	26
	Kottayam	27.5625	2.82771	32
	Cherthala	**37.0000**	.00000	24
	Kothamanglam	32.5833	5.68688	24
	Palakkad	33.8710	6.05938	31
	Koilandy	35.6667	2.44357	24
	Kalpetta	28.5217	6.92735	23
	Total	31.8292	6.08929	240

Effeciency in Use of Latest Technology	Thiruvalla	35.1333	6.04998	30
	Varkala	31.1923	3.08570	26
	Pathanamthitta	**37.3462**	4.95534	26
	Kottayam	33.1875	1.53323	32
	Cherthala	33.6250	1.90680	24
	Kothamanglam	36.1250	7.09753	24
	Palakkad	33.8065	4.46781	31
	Koilandy	32.7083	1.85283	24
	Kalpetta	33.2174	5.80718	23
	Total	34.0375	4.74040	240

Ability to Generate Resources from Public	Thiruvalla	23.0000	8.69007	30
	Varkala	17.8462	4.69632	26
	Pathanamthitta	23.9615	4.09371	26
	Kottayam	18.3750	2.91548	32
	Cherthala	19.5833	.77553	24
	Kothamanglam	22.5000	6.75664	24
	Palakkad	25.3548	6.22655	31
	Koilandy	20.4583	2.20630	24
	Kalpetta	**26.6522**	8.50993	23
	Total	21.9375	6.27276	240

From the above table it is visible that with respect to efficiency in landfilling Kottayam municipality is leading with the highest Mean Score of **20.3750.** That means among the nine municipalities selected for the study Kottayam is performing better in terms of landfilling method of waste disposal. In the case of composting Koyilandy is leading with a Mean Score of **13.7083** indicating that municipality is most efficient in composting as a treatment technique. Considering biomethanation as a technique of waste treatment, Thiruvalla municipality is performing better with the highest Mean Score of **18.0667**. But in recycling and reusing, Cherthala leads with a Mean Score of **37.0000** indicating best municipality in that method. Pathanamthitta is most efficient in use of latest technology, leading with an Average Score of **37.3462**. With respect to the ability of generating funds for waste treatment and disposal Kalpetta leads with a Mean Score of **26.6522**.

It is normal to test whether the variations in the Mean Scores are significant or not. MANOVA is used for testing the significant difference by formulating the following hypotheses;

H_0: There is no difference in the mean scores of waste treatment and disposal techniques among Municipalities of Kerala.

H_1: There is difference in the mean scores of waste treatment and disposal techniques among Municipalities of Kerala.

Table1.3 MANOVA-Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.991	4258.600[b]	6.000	226.000	.000*
	Wilks' Lambda	.009	4258.600[b]	6.000	226.000	.000*
	Hotelling's Trace	113.060	4258.600[b]	6.000	226.000	.000*
	Roy's Largest Root	113.060	4258.600[b]	6.000	226.000	.000*
Municipality	Pillai's Trace	1.843	12.802	48.000	1386.000	.000*
	Wilks' Lambda	.061	17.732	48.000	1116.077	.000*
	Hotelling's Trace	5.028	23.497	48.000	1346.000	.000*
	Roy's Largest Root	3.365	97.159[c]	8.000	231.000	.000*

Source: Primary Data
**Significant at 5% Level of Significance*

As per the above table all the factors as a bundle is found to be significant at 5% Level of Significance. It is so because Pillai's Trace-the most reliable test for testing significance as a bundle proves the variation ***(p<0.05 vide last column)***.

Table 1.4 Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	Efficiency in Landfilling	2363.937[a]	8	295.492	40.390	.000*
	Efficiency in Composting	2225.621[b]	8	278.203	27.507	.000*
	Efficiency in Biomethenation	4850.512[c]	8	606.314	16.846	.000*
	Efficiency in Recycling and Reusing	2569.770[d]	8	321.221	11.793	.000*
	Efficiency in Use of Latest Technology	722.430[e]	8	90.305	4.488	.000*
	Ability to Generate Resources from Public	2048.111[f]	8	256.014	8.040	.000*
Intercept	Efficiency in Landfilling	66053.979	1	66053.979	9138.048	.000*
	Efficiency in Composting	16619.762	1	16619.762	1643.258	.000*
	Efficiency in Biomethenation	26767.938	1	26767.938	743.720	.000*
	Efficiency in Recycling and Reusing	240953.952	1	240953.952	8845.893	.000*
	Efficiency in Use of Latest Technology	274206.249	1	274206.249	13627.061	.000*
	Ability to Generate Resources from Public	114239.665	1	114239.665	3587.484	.000*
Municipality	Efficiency in Landfilling	2363.937	8	295.492	40.390	.000*
	Efficiency in Composting	2225.621	8	278.203	27.507	.000*
	Efficiency in Biomethenation	4850.512	8	606.314	16.846	.000*
	Efficiency in Recycling and Reusing	2569.770	8	321.221	11.793	.000*
	Efficiency in Use of Latest Technology	722.430	8	90.305	4.488	.000*
	Ability to Generate Resources from Public	2048.111	8	256.014	8.040	.000*

Source: Primary Data
**Significant at 5% Level of Significance*

At individual level all the six variables considered for the study are found to be varying at 5% Level of Significance because p value as per the last column of the above table is only zero in all cases. So the null hypotheses are rejected in all cases and the alternate hypotheses are accepted. The waste treatment and disposal techniques used by the municipalities are varying considerably.

8. FINDINGS OF THE STUDY

From a critical study and evaluation of the data collected from the selected sample of respondents from the nine municipalities of Kerala the following findings are evolved;

1. With respect to efficiency in landfilling Kottayam municipality is leading with the highest Mean Score of **20.3750.** That means among the nine municipalities selected for the study Kottayam is performing better in terms of landfilling method of waste disposal.

2. In the case of composting Koyilandy is leading with a Mean Score of **13.7083** indicating that municipality is most efficient in composting as a treatment technique.

3. Considering biomethanation as a technique of waste treatment, Thiruvalla municipality is performing better with the highest Mean Score of **18.0667**.

4. In the case of recycling and reusing, Cherthala leads with a Mean Score of **37.0000** indicating best municipality in that method.

5. Pathanamthitta is most efficient in use of latest technology, leading with an Average Score of **37.3462**.

6. With respect to the ability to generate resource from public for waste treatment and disposal Kalpetta leads with a Mean Score of **26.6522**.

9. SUGGESTIONS

From the above findings of the study the following suggestions are being evolved:

1. The technology used for waste treatment and disposal by municipalities of Kerala are outdated. The landfills are just places of open dumping. No municipality under study is following sanitary landfilling. The leachate flowing from the waste dumps are neither collected nor treated scientifically. It will lead to a lot of health issues to the inhabitants. Measures to be taken by the Govt. to improve the technology used for waste treatment and disposal services to reduce its health impact.

2. Waste treatment techniques are not constantly practiced in municipalities. Biogas units are the most healthy way of treating waste where methane gas is completely collected without escaping to atmosphere. Methane is a greenhouse gas and responsible for global warming. A handful of municipalities are using biomethanation as a treatment method. It should be implemented in all municipalities in a war footing.

3. Composting- the most friendly treatment method for Indian conditions-are used without proper segregation. The success of composting depends on the source segregation of waste thereby the biodegradable waste only reach the composting pit. Unfortunately municipalities are collecting waste unsegregated and toxic substances and plastic reach the compost pit severely contaminating the believed to be the best bio-fertilizer available in the earth.

3. Urgent steps should be taken to increase the staff strength of solid waste management team of municipalities as a handful of health inspectors are handling the entire solid waste management system.

4. Municipalities should be provided with sufficient funds for effective waste management as they are finding acute shortage of resources for waste treatment and disposal.

5. Municipalities should be relieved of waste treatment and disposal by implementing effectively a decentralised waste treatment system.

10. CONCLUSION

Waste treatment and disposal being one among the major waste management activities should be planned and implemented in an organized way. Otherwise it will have a long standing repercussion on human health. The toxic gases emitted by unhealthy processing of waste like burning are extremely dangerous. Similarly burial and throwing away contaminate ground water and underground water sources. Being the authorities responsible for managing waste in municipal limits the municipalities must be provided with better equipments, human resources and funds for effective planning and implementation. Methane escaping to atmosphere is a greenhouse gas and liable for increased temperature leading to greenhouse effect. If waste generators are committed for source segregation and source processing of their own waste the waste menace can be tackled effectively without depending on any external body. A mass campaigning drive for effectively injecting this consciousness in their minds is the ultimate remedy for an easiest way of waste treatment and disposal.

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