

A STUDY ON THE SOLID WASTE COLLECTION, TREATMENT AND DISPOSAL SYSTEM OF MUNICIPALITIES IN KERALA

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Abstract

Kerala, the state lying to the south-west corner of India is having a developed modern society occupying a prime position compared to the other states in all human and social development indices. But its Solid Waste Management efforts are not up to the mark. The objectives of the study are to identify the effectiveness of waste collection, treatment and disposal systems in municipalities in Kerala. In the opinion of the respondents majority are getting waste collection services daily. Moreover municipalities are highly involved in waste collection nowadays. Waste collection equipments and technology are superior but in waste treatment it is not upto the mark. Modern waste treatment methods are not popular in municipalities of Kerala and the traditional composting method is the widely used, biomethanation comes next. The matter of concern is that almost two-third of the municipalities in the state is resorting to open dumping without proper landfilling. Now, people of the state are increasingly concerned about the health hazards due to mismanaged solid waste. So the domestic level small scale solid waste treatment techniques like biogas production and composting are getting unexpected momentum in the state. As a concept Integrated Solid Waste Management will find solutions to the manifold problems persisting in Kerala.

1. Introduction

Any human activity creates waste in one form or the other. Due to population increase and unplanned urban development unlike past, a slight mismanagement of waste will invariably damage human health and environment. Rapid urbanization and increased population density coupled with improper waste management make the state of Kerala a breeding place for a variety of life threatening, rare diseases. The state accounts for 1 per cent of the area of India but contains about 3 per cent of country's population. The population density of the state is about 859 people per square kilometer, three times the national average. So, it is one of the densest states in the country. Hence, extreme scarcity of free space for landfilling acts as a hurdle for Local Bodies to dispose waste. Kerala has five Corporations, sixty Municipalities and around one thousand Grama Panchayaths. In a rapidly urbanizing state like Kerala issues related with Municipal Solid Waste Management is a subject of utmost preference. The rapid population growth overwhelms the capacity of Municipalities in

the state to offer even the very basic solid waste services. Even though, Kerala is having a developed modern society occupying a prime position compared to the other states of India in all human and social development indices, its Solid Waste Management efforts are not up to the mark. The paper attempts to examine the major issues responsible for the mismanagement of municipal solid waste in Kerala.

2. Statement of the Problem

Kerala is known for its highly sensitive population and high social awareness. At the same time, it is a mere contradiction that, its environmental sanitation level is surprisingly low. Both the Municipal Authorities as well as the Public are equally responsible for the problems. Municipalities lack professionalism and commitment in Solid Waste Management. A group of Government Servants called '*Health Wing*' in each Municipality is responsible to manage solid waste but, they lack training and are not properly qualified either. Besides, Municipalities in Kerala, which account for about 25 per cent of the total waste generated are starving for fund and free space for waste treatment and disposal. In urban areas, as the commitment of people are too low, the efforts of the State Government and Urban Local Bodies for an organized Solid Waste Management System are not hitting the target. Even though, people are well aware about the problems and issues that, improper Solid Waste Management can create, they are highly reluctant to participate in the work for a Sustainable Solid Waste Management System. Hence, Municipal Solid Waste Management is really a burning issue in a state like Kerala where, population density is three times the national average. Hence, it is a subject which needs the immediate attention of the Government, different agencies and groups of people because of the potential health threats and environmental damage it can cause. A complete and environmentally sound Solid Waste Management requires effective contribution from all those who are involved in this problem. Everyone is part of the solid waste generation problem and everyone shall also be part of the solution of solid waste problem. Hence, it is highly required to conduct a study on different aspects of Municipal Solid Waste Management in Kerala. The problem is stated as "A STUDY ON THE SOLID WASTE COLLECTION, TREATMENT AND DISPOSAL SYSTEM OF MUNICIPALITIES IN KERALA".

3. Objectives of the Paper

1. To identify the effectiveness of waste collection system in municipalities in Kerala
2. To identify the effectiveness of waste treatment system in municipalities in Kerala
3. To identify the effectiveness of waste treatment system in municipalities in Kerala

4. Methodology and Sampling Design

The Paper uses both primary and secondary data. Secondary data is collected from different published sources of various Government Departments, other Agencies and Municipal Authorities. For the purpose of this Paper the entire state of Kerala is divided into three Regins viz. South, Central and North. Out of the total

sixty Municipalities in Kerala, three Municipalities each belong to Coastal, Plain and Hilly Areas are selected from each Region by Simple Random Sampling. Altogether, nine Municipalities are selected for the study. One expert each from each Municipality is selected to gather information for the purpose of the study. A Structured Questionnaire was administered to the selected experts to collect primary data. In each Municipality, Experts are selected from the Health Wing. One Expert each belonging to the following Municipalities has been selected for this study. The study uses responses based on an interview with the Experts and data coming out through the discussions.

Table 1 List of Municipalities Selected for the Study

Serial Number	Name of the Municipality	Serial Number	Name of the Municipality
01	Kottayam	07	Kalpetta
02	Cherthala	08	Palakkad
03	Pathanamthitta	09	Thiruvalla
04	Kothamangalam		
05	Varkala		
06	Koilandi		

5. Waste Collection System

5.1 Frequency of Waste Collection

A technically perfect Waste Collection System needs separate strategies for Monsoon and Summer seasons. But, from the current study, it is clear that no seasonal separation is done by authorities in the State for Waste Management. In the rainy season when utmost care is required to be taken regarding the unprecedented potential for health risks, the lives of people are in at an alarmingly dangerous state. The result is the spread of various diseases at an uncontrollable level. A well thought-out Waste Collection System will definitely dilute these intensive health risk issues. Hence, an effort is made to determine the effectiveness of the Waste Collection System of Municipalities based on information gathered from Experts.

Table 2 Waste Collection Frequency of Different Groups of the Public

	Households	Shops	Hotels	Institutions
Daily	72.73%	90.91%	54.55%	36.36%
Frequently	9.09%	----	----	----
Infrequently	----	----	----	----
No Collection	18.18%	9.09%	45.45%	63.64%

Source: Survey Data

From the Table, it is observed that, according to Experts, 72.73 per cent of Households, 90.91 per cent of Shops, 54.55 per cent of Hotels and 36.36 per cent of Institutions are getting Waste Collection Service daily, while 9.09 per cent of Households are getting it frequently. Similarly, 18.18 per cent of Households, 9.09 per cent of Shops, 45.45 per cent of Hotels and 63.64 per cent of Institutions are not at all getting any type of Waste Collection Service.

5.2 Methods of Waste Collection

While creating a profile of the Waste Collection System of the Municipalities in Kerala through a preliminary study, it has been seen that there are three prominent methods commonly followed, namely,

- 1) Open Dumping to a Common Place by Public
- 2) Deposit into Community Bins
- 3) Door-to-Door Collection System

Apart from these, most of the Municipal areas are denied Waste Collection Service coverage, which is denoted as a method for convenience of data collection and called *Zero Waste Collection Service*. Among the three methods enlisted above, Door-to-Door Collection of segregated waste is the most appropriate method. In this phase of the study, it is tried to find out at what level these methods are followed in the Municipalities to which the Experts belong.

Table 3 Different Methods of Waste Collection and their Levels

	Level	Open Dumping	Community Bin	Door-to-Door
Household	High Level	27.27 %	----	54.55%
	Low level	----	----	----
	No Collection	18.18%	----	----
Shop	High Level	45.45%	----	45.45%
	Low level	----	----	----
	No Collection	9.09%	----	----
Hotel	High Level	9.09%	----	45.45%
	Low level	----	----	----
	No Collection	45.45%	----	----
Institution	High Level	27.27%	----	9.09%
	Low level	----	----	----
	No Collection	63.64%	----	----

Source: Survey Data

From the Table above it is visible that there is no entry in the Community Bin System column, as Municipalities are not promoting the System. If bins are provided in Municipal limits, the people will be inclined to deposit their waste in those bins. It will definitely transmit a wrong message to them that the responsibility of collecting the waste lies with the Municipal Authorities and not with the public themselves. Open Dumping also is not promoted as a method; is the least preferred and most primitive method in practice. But, Municipalities are forced to collect the thrown away waste, which is in fact, not a direct waste collection method. Open Dumping and thrown away waste can be minimized only through a well-organized Door-to-Door Collection System.

With respect to households, 27.27 per cent of the Experts witness Open Dumping and 54.55 per cent find Door-to-Door collection at a High Level, while 18.18 per cent find No Collection at all. Similarly, with reference to Shops, 45.45 per cent of Experts view Open Dumping, another 45.45 per cent find Door-to-Door, and 9.09 per cent find No Collection. Considering hotels/ restaurants 9.09 per cent of the Experts view Open Dumping, 45.45 per cent find Door-to-Door collection as High, and 45.45 per cent find No Collection. While dealing with institutions, 27.27 per cent of the Experts witness Open Dumping, 9.09 per cent find Door-to-Door collection as High, and 63.64 per cent see No Collection.

5.3 Performance of Municipalities in Waste Collection

Performance of a Municipality is determined, based on a number of parameters like Segregation of Waste, Treatment of Specialized Waste, Service Coverage, Availability of Community Bins, Implementation of Door-to-Door Collection, Implementation of Street Sweeping and Effectiveness of Transportation. In order to measure the performance, the Scores of the nine Municipalities to which the Experts belong are calculated. The Average Score is compared with the Individual Score and anything equal to or more than the Average Score marks a High Involvement and anything less than the Average Score indicates Low Involvement. The Average Score is 69.

Table 4 Score Sheet of Different Municipalities in Waste Collection

Municipality	Score	Involvement in WC
1. Kottayam	110	High Involvement
2. Cherthala	33	Low Involvement
3. Pathanamthitta	84	High Involvement
4. Kothamangalam	82	High Involvement
5. Varkala	41	Low Involvement
6. Koilandi	71	High Involvement
7. Kalpetta	44	Low Involvement
8. Palakkad	96	High Involvement
9. Thiruvalla	57	Low Involvement
Total	618	Average Score = $618/9 = 69$

Source: Survey Data

Table 5 Classification of Municipalities Based on Level of Involvement

	High Involvement	Low Involvement	Total
Percentage	55.56%	44.44%	100

Source: Survey Data

It is evident from the Tables that, in the opinion of Experts from whom information is gathered, 55.56 per cent of the Municipalities register High Involvement and 44.44 per cent Low Involvement in Waste Collection efforts.

5.4 Equipment and Technology

In this phase of analysis, it is attempted to trace out the sufficiency of Equipment and Technology used by Municipalities in Waste Collection and Waste Transfer. The sanitation workers are in close contact with

solid waste and they are subjected to severe health threat. Sufficient Equipment can minimize the quantum of health risk taken by them. Moreover, good, and sufficient and quality equipment can make Waste Collection and Transfer more effective and thereby, enhance the environmental sanitation level. The following Tables explain the sufficiency of equipment and Technology as per information gathered from Experts. The information is collected on a *Seven-Point Scale* and so the Average Score is 4. Any Score equal to or more than 4 indicates a well-equipped system, meaning sufficiency of equipment and any Score less than 4 is ill-equipped, meaning insufficiency of the same.

Table 6 Score Sheet of Various Municipalities Regarding Equipment and Technology

Municipality	Equipment for Collection	Equipment for Transfer	Level of Equipment for Collection	Level of Equipment for Transfer
1. Kottayam	7.00	2.83	Well Equipped	Ill Equipped
2. Cherthala	6.00	2.33	Well Equipped	Ill Equipped
3. Pathanamthitta	6.67	3.00	Well Equipped	Ill Equipped
4. Kothamangalam	4.67	3.33	Well Equipped	Ill Equipped
5. Varkala	6.00	3.17	Well Equipped	Ill Equipped
6. Koilandi	6.33	3.17	Well Equipped	Ill Equipped
7. Kalpetta	4.33	1.83	Well Equipped	Ill Equipped
8. Palakkad	4.00	3.00	Well Equipped	Ill Equipped
9. Thiruvalla	5.33	3.00	Well Equipped	Ill Equipped

Source: Survey Data

Table 7 Number and Percentage of Well-Equipped and Ill-Equipped Municipalities

	Waste Collection	Waste Transfer
Well Equipped	100%	0%
Ill Equipped	0%	100%

Source: Survey Data

From the above Tables it is observed that 100 per cent of the Municipalities to which the Experts belong, from whom information is collected, are Well Equipped for Waste Collection and Ill Equipped for Waste Transfer.

5.5 Secondary Storage of Collected Waste

In Municipal limits of Kerala, where the current study is conducted, no organized Secondary Storage facilities are provided. The waste collected is directly taken for disposal or treatment. Well-organized Secondary Storage devices result in controlled waste transportation and minimum public nuisance, leading to an ultimate saving on productive Waste Management Resources. 'Well-organized' implies that the Secondary Storage facilities should be well covered to prevent the entry of rain water and scavenging of stray animals and birds. Moreover, it should be well attended and cleaned frequently for hygienic reasons. Secondary Storage facilities are indicators of organized Solid Waste Management. The same is given very meagre attention in the Municipalities of Kerala.

7. Waste Treatment

Waste Treatment is the most prominent way to control the multiplicity of unparalleled trouble solid wastes can cause to the environment and society. History witnesses that, many technologically advanced solid waste disposal and treatment techniques experimented in advanced countries have miserably failed. As a result, a total turnaround has happened the world over, leading to the adoption of traditional treatment techniques like Composting and Biomethanation as the most preferred options. Especially because of the high degree of presence of biodegradable waste, traditional methods like Composting and Biogas production are highly suitable in the Indian conditions. The following Table depicts different methods of Waste Treatment used by Municipalities based on the information gathered from Experts.

Table 8 Classification of Municipalities Based on Different Treatment Methods

Municipality	Composting	Biomethanation	RDF (Waste to Energy)	Recycling	No Methods
1. Kottayam	Yes	Yes	No	No	---
2. Cherthala	No	No	No	No	Yes
3. Pathanamthitta	No	Yes	No	No	---
4. Kothamangalam	No	No	No	No	Yes
5. Varkala	Yes	No	No	No	---
6. Koilandi	Yes	Yes	No	No	---
7. Kalpetta	No	No	No	No	Yes
8. Palakkad	Yes	Yes	No	No	---
9. Thiruvalla	No	Yes	No	No	---

Source: Survey Data

Table 9 Percentage of Municipalities Using Different Waste Treatment Methods

	Composting	Bio methanation	Refuse Derived Fuel (Waste to Energy)	Recycling	No Methods
Number	5	4	Nil	Nil	3
Percentage	55.56%	44.44%	0%	0%	33.33%

Source: Survey Data

From the above Tables, it is observed that Refuse-Derived Fuel and Recycling are not at all popular in the State, as no Municipality is using those Waste Treatment methods. Similarly, 33.33 per cent of the Municipalities do not employ any method for Waste Treatment. Composting is the mostly used method as 55.56 per cent of the Municipalities employ the same and Biomethanation comes next with 44.44 per cent. Both Composting and Biomethanation are used in three Municipalities, Kottayam, Koilandi and Palakkad.

8. Waste Disposal

After Treatment, Reuse and Recycling, the leftover waste is disposed properly. Waste disposal should be well controlled so that the minimum waste would hit the land. Well-engineered Sanitary Landfilling is the most preferred option for safe disposal of ultimate waste. But, most of the Municipalities where this study is concentrated are following the same primitive method called Open Dumping. The Table given below explains the Waste Disposal Methods used in different Municipalities.

Table 10 Classification of Municipalities Based on Waste Disposal Methods

	No Method	Open Dumping	Landfilling	Engineered/Sanitary Landfilling
Percentage	11.11%	66.67%	22.22%	0%

Source: Survey Data

It is evident from the Table that, in the opinion of Experts selected for study, out of the nine selected Municipalities, six (66.67 per cent) are following Open Dumping and two (22.22 per cent) are following Landfilling, not in a scientific manner. Technically perfect Sanitary Landfilling is not used by any Municipality, and one Municipality, Cherthala, does not have any method at all to dispose of waste. In this context, an effort is made to find out the Waste Disposal efficiency of Municipalities based on information gathered from Experts representing those Municipalities. Mainly, the efficiency of Landfilling is tested. Here also, the Score of each Municipality is calculated and compared with the Average Score. Anything equal to or more than the Average Score is Effective Waste Disposal and anything less than the Average Score is Ineffective Waste Disposal. The Average Score calculated for this purpose is 46.

In order to measure the Landfilling efficiency, seven factors are used, namely Planning Factor, Distance Factor, Protective Factor, Infrastructure Factor, Routine Factor, Sanitary Factor and Closure Factor. The following Table presents the Score Sheet, based on these Factors.

Table 11 Score Sheet of Performance of Municipalities in Waste Disposal

Municipality	Score	Effectiveness
1. Kottayam	68	Effective
2. Cherthala	0	Not Effective
3. Pathanamthitta	46	Not Effective
4. Kothamangalam	50	Effective
5. Varkala	41	Not Effective
6. Koilandi	50	Effective
7. Kalpetta	60	Effective
8. Palakkad	53	Effective
9. Thiruvalla	42	Not Effective
Total	410	Average Score = $410/9 = 46$

Table 12 Classification of Municipalities Based on Effectiveness of Waste Disposal System

	Effective	Ineffective
Percentage	66.67%	33.33%

Source: Survey Data

From the Tables, it is visible that, 66.67 per cent of the Municipalities are effective in the Waste Disposal System, while the rest 33.33 per cent are ineffective.

9. Findings

9.1 Waste Collection System

9.1.1 Frequency of Waste Collection

- 1) In the opinion of Experts, 66.67 per cent of households, 88.89 per cent of shops, 55.56 per cent of hotels and 33.33 per cent of institutions are getting Waste Collection Service daily.
- 2) As many as 11.11 per cent of households are getting the Waste Collection Service frequently.
- 3) About 22.22 per cent of households, 11.11 per cent of shops, 44.44 per cent of hotels and 66.67 per cent of institutions are not at all getting any type of Waste Collection Service.

9.1.2 Methods of Waste Collection

While creating a profile of the Waste Collection System of the Municipalities in Kerala through a preliminary study, it has been seen that there are three prominent methods commonly followed, namely,

- 4) Open Dumping to a Common Place by Public,
- 5) Deposited into Community Bins, and
- 6) Door-to-Door Collection System.

Apart from these, most of the Municipal areas are denied Waste Collection Service coverage, which is denoted as a method for convenience of data collection and called *Zero Waste Collection Service*.

- 1) With respect to households, 22.22 per cent of the Experts witness Open Dumping and 55.56 per cent view Door-to-Door collection to be of a High Level, while 22.22 per cent report that there is No Collection.
- 2) In the case of shops, 44.44 per cent of the Experts have Open Dumping at a High Level, the same 44.44 per cent have Door-to-Door collection and 11.11 per cent have No Collection.
- 3) In the case of hotels/restaurants 11.11 per cent of the Experts view Open Dumping at a High Level, and 44.44 per cent view Door-to-Door collection as High, and 44.44 per cent report that there is No Collection.
- 4) In the case of institutions, 33.33 per cent of the Experts witness Open Dumping as High, and 66.67 per cent find that there is No Collection.

9.1.3 Performance of Municipality in Waste Collection

- 1) In the opinion of Experts, 55.56 per cent of Municipalities register High Involvement and 44.44 per cent have Low Involvement in Waste Collection efforts.

9.1.4 Equipments and Technology

- 1) It is found that 100 per cent of the Municipalities to which the Experts, from whom the information is collected, belong are Well Equipped for Waste Collection and the same 100% is Ill equipped for Waste Transfer. This implies that all Municipalities are well equipped for Waste Collection, but are not equipped with facilities for Waste Transfer.

9.2 Waste Treatment

- 1) Waste Treatment facilities like Refuse-Derived Fuel and Recycling are not at all popular in the State, as no Municipality is found using those methods.
- 2) It is found that 33.33 per cent of the Municipalities do not employ any method for Waste Treatment.
- 3) Composting is the most used method, as 55.56 per cent of the Municipalities employ the same.
- 4) Biomethanation comes next, with 44.44 per cent of the Municipalities using that method.
- 5) Both Composting and Biomethanation are used in three Municipalities, which are Kottayam, Koilandi and Palakkad.

9.3 Waste Disposal

- 1) As many as 66.67 per cent Municipalities are following Open Dumping and 22.22 per cent are following Landfilling though not in a scientific manner.
- 2) Technically perfect Sanitary Landfilling is not used by any Municipality.
- 3) The Cherthala Municipality is not having any method to dispose of waste.
- 4) It is found that 66.67 per cent of the Municipalities have effective Waste Disposal System, while the rest do not have.

Conclusion

Human activities essentially generate waste. Unprocessed and untreated waste creates immense environmental damage and health problems. Sensing the potential health threats it can cause, a variety of treatment and disposal options are available presently. In Kerala, almost a quarter of the total waste generated is contributed by the Municipalities. But, Waste Management is not yet considered as a high priority area by Government which, extends only a handful of efforts to tackle the ever mounting waste issues. Here, the health scenario is extremely fragile as the drinking water sources are highly polluted through the unplanned disposal of solid waste. Being an area, which should be highly prioritized but, currently receiving very little attention, it is high time, at the part of the Government, to come up with a series of legislative and other measures to tackle the unparalleled solid waste issues.

Now, people of the state are increasingly concerned about the health hazards due to mismanaged solid waste. The false notion that, Waste Management is the sole responsibility of the Municipalities in Municipal limits is getting changed and people are getting actively involved in treating and disposing the self generated waste. So the domestic level small scale solid waste treatment techniques like biogas production and

composting are getting unexpected momentum in the state. As a concept Integrated Solid Waste Management will find solutions to the manifold problems persisting in Kerala.

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