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A Study of Two Municipal Corporations in Kerala

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Solid Waste Management, Landfill Sites, and People's Resistance: A Study of Two Municipal Corporations in Kerala

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Abstract

The choice between centralised and decentralised waste management system has been figuring in the discussions in Urban Local Bodies in Kerala for quite some time. This study addresses the issues associated with the centralised waste management system and the ways in which urban local bodies refuse to give in to the resistance against centralised waste management in certain localities while yielding to the insurmountable resistance of people in other localities. The study is based on a sample survey of 175 households located in the landfill sites and city limits of two Municipal Corporations, viz. Thrissur and Kochi. The study observed that potency of the people's resistance affects the decision making of the urban local governments. The local government does not prefer transition in solid waste management and prefers centralised waste management system over the decentralized system when they could defy people's resistance. Opposition to transition is also because decentralised waste management demands continuous and strenuous monitoring to keep the city clean which Local Self Government Institutions are unable to cater to given the lack of infrastructure and workforce.

Keywords: Solid Waste Management; Municipal Corporation; Resistance Movements; Landfills; Kerala

JEL Classification: **Q530**; **Q580**

Introduction

Kerala is experiencing a shift in solid waste management from centralised to a decentralised system. Why was the shift inevitable? How did the local resistance against unscientific solid waste management impact the decision-making of the local governments on solid waste management? This paper addresses the issues related to centralised solid waste management in Kerala and the impact of people's resistance on the decision making of local self-governments. Centralised waste management system, in which Municipal bodies collect, transport, treat and dispose waste continue to be the prominent model of solid waste management in India. Local governments in Kerala used mechanised composting for waste processing and Trenching[ii], for disposal since the colonial period. Trenching, however, became obsolete by the second half of 20th century due to the increase in plastic waste in the municipal waste stream. The landfill sites became dumping grounds for the municipal wastes which led to mobilisations against centralised waste disposal. The resistance finally forced the government to find alternatives for waste management. Kerala is now transitioning towards decentralised solid waste management. Decentralisation here refers to the treatment of the waste at the source by the households, institutions, etc. The role of local self-government in decentralised solid waste management is limited to the provision of technical support and awareness creation among the masses. People's resistance played a crucial role in this transition. Movements against solid waste management have been extensively studied in the global north (Bullard, 1990; Heiman, 1996; Foster, 1998; Pellow, 2000) However, similar movements in India have

not been understood and the insights of the global north cannot be applied to the Indian context. Particularly, since Kerala is peculiar regarding its geography and polity, the outcomes of adoption of centralised waste management in Kerala are different. Therefore, local specificities in shaping a movement against solid waste management and its impact on the waste governance need special attention.

Solid Waste Management and Related Local Resistance

Existing literature point toward the factors that determine waste creation centralised waste management system, local mobilisations, and the government interventions to improve waste management. Consumption is directly proportional to waste production. Apart from the population growth, the expansion of packaging industry, marketing strategies like planned obsolescence and advertisements considerably change the consumption pattern of people leading to increased waste production which affects the environment and health of the people (Packard, 1960; Strasser, 1999). Effective solid waste management is, therefore, crucial, and it should be executed with minimal adverse consequences on the society, Therefore, to reduce the negative impacts due to waste production, a technologically driven centralised waste management system was developed in the industrialised societies like Europe and North America. Some of the technologies have been adopted by India as well. Centralised waste management methods have its strengths and weaknesses. Strength is that mechanized systems are designed to treat large quantities of waste within a short period while its weakness is the environmental pollution and public health concerns. For.eg. while mechanised incineration can considerably reduce the

amount of waste, the dioxins emitted during the process pollute environment leading to public health consequences. Solid waste management in a centralised system is organised and sustained through identifiable social and political relationships. In this process value conversion takes place which involves the 'organisation of the labour, a negotiated pricing system, a formalised system for carrying values from one institution to another, and a political hierarchy of controls and licensing conditions'(Brien, 1999). Often, organization of labour is exploitative in nature. Waste can be a tool for oppression and exclusion of the socially and economically vulnerable communities, and solid waste sites are unevenly distributed with greater impacts on the vulnerable communities (Bullard, 1996). The strengths and weaknesses of mechanisation in solid waste management are experienced in the localised context. The local mobilisations against waste management, therefore, are an indicator of the various effects of centralised waste management system in society.

Local mobilisations against waste management fall under the new social movements 'because they respond to social needs which have been more recently generated by world development'. (Frank& Fuentes, 1989) Mobilisations against waste management system exemplify the unsustainable economic development model rooted in increased material production. The negative impact of increased material production is increased waste production, and often this negativity is borne by the deprived communities. Deepening crisis within the economic projects, therefore, open up new opportunities for reforms and counter-hegemonic movements (Brenner &Theodore, 2002).

Reforms sustain the existing system with some improvements. Reforms in waste management include the changes in governance to minimise the negative impacts. In such reforms, the local government withdraws its responsibility, and a new form of labour is introduced to provide service delivery (Miraftab, 2004). The counter-hegemonic movements are sometimes drivers of such reforms. Urban centres become decisive battlegrounds for counter-hegemonic movements (Brenner & Theodore, 2002), and 'local' becomes an important site of resistance by people as well as site of reforms by hegemonic forces (Mohan & Kristian, 2000; Escobar, 1992). Mobilisations against waste management are counter-hegemonic in nature because it questions the unsustainable economic development on the one hand and trigger governance reforms on the other hand. Mobilisations against waste management have been categorized under environmental justice, and Not in my backyard (NIMBY) movements and scholars in the global north have studies this phenomenon extensively. The struggles provide a pane to the social relations and processes underlying the distributive inequities (Foster,1998) Racism in siting the landfill sites are highlighted in the debates demanding the policy reforms that help achieve environmental justice (Bullard, 1996). However, the insights from the global north cannot be applied directly to the global south because the 'local processes shape unique landscapes of waste' and therefore a differential understanding of the politics of waste management in the third world context is significant (Davies, 2010). Issues of solid waste management are experienced mainly in the urban centres. Often the waste treatment plants or landfill sites are located at the periphery of the urban centres,

and these locations are the sites of local resistance. Little information is, however, available on the factors that determine the dynamics of mobilisation against waste management in India. In the wake of local mobilisations often the reaction of the local government is to emphasize on diversion of waste from landfills by increasing the number of recycling units, replace the technologies, and increase public participation in waste management (Davies, 2010). Most often protesters' demands are considered as public opinion, and new markets are created for service delivery, and new technologies are introduced. In the neoliberal era, such changes are made across different urban spaces, but the outcomes are different in each context in which it is introduced (Miraftab, 2004; Brand, 2007).

In India, Solid Waste Management (SWM) is commensurate with the Solid Waste Management and Handling Rules, 2000 and 2016. SWM rules 2000 pitched for a centralised waste management system where municipal governments play a key role in collection, treatment and disposal of solid waste. The Solid Waste (Management and Handling) Rules, 2016 amendment is a deviation from its predecessor (SWM rules 2000) in its basic philosophy. The new rules emphasise source segregation and treatment of waste, focusing on a circular economy. i.e. decentralised waste management system is prioritised. In a decentralised system, households play a critical role in waste segregation and treatment. Kerala experienced the shift in SWM from centralised to decentralised system even before the execution of the SWM rules 2016. Kerala produces nearly 34,10,243 MT of waste annually[iii]. Kerala government is currently on its path to implementing

the decentralised waste management. In fact, Kerala's experiences and experiments with SWM have been a windfall in the changing waste management rules in the country. Kerala, however, has a unique geography and polity which is not in alignment with the country as a whole. Therefore, Kerala's experience with local mobilisations and solid waste management might not be very similar to that of the other states in India, and it is important to study the experience of Kerala on solid waste management systematically. Existing literature on resistance against solid waste management gives a glimpse of discontent of the people living near the landfill sites and the need for an alternative strategy for waste management (Isaac & Gopakumar, 2014; Vasuki, 2014). But these studies have not addressed the dynamics of social mobilisations and its impact on the institutional decision making in different urban centres. The objectives of the study are i) To analyse the factors influencing the selection of landfill sites by urban local bodies; ii) To study people's resistance to landfill sites on solid waste management system and examine the outcomes in Kerala. To comprehend the two cases effectively, the paper is divided into three sections. The first section mentions the methods and locale of the study. The second section discusses the existing waste management system in the two cities, and the third section discusses the emergence, growth and impact of mobilisations against waste management followed by a conclusion.

Section I
Methodology

1.1. Data and Method

Urban Kerala consists of six Municipal Corporations and 87 Municipalities which follow Kerala Municipalities Act, 1994 & Solid

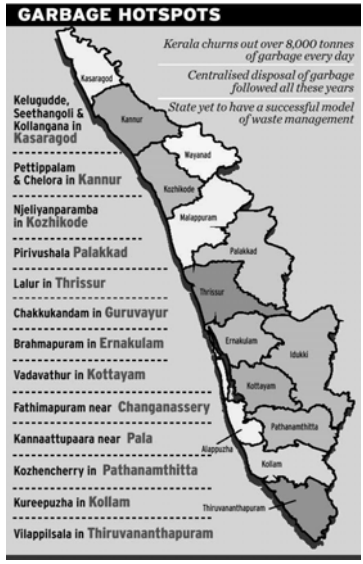

Figure 1 Landfill sites with protests in Ker ala
Source: The Hindu 13 July 2012

Waste Management and Handling Rules, 2000 for carrying out waste management. Municipal solid waste includes commercial and residential wastes generated in municipal or notified areas (Ministry of Environment and Forests, 2000). Since residential wastes constitute a significant share of the waste stream, this study focuses on the biodegradable kitchen wastes and non-biodegradable wastes produced by households. Non-biodegradable wastes in the households mainly include the recyclables like paper, plastics, glasses, etc. and inert wastes. Social influence in waste management could also be understood effectively by studying the residential waste management.

A combination of survey and case study methods were used to understand the complex dynamic of solid waste management. Survey research was used to pose questions to the two kinds of respondents. It is also a case study because cases of waste management in Kochi and Thrissur is examined in depth. Data from the officials were collected using semi-structured interviews. In the year 2012, nearly 13 waste disposal sites on the outskirts of the cities in Kerala marked regular protest events against waste management. The sample frame consisted

of waste disposal sites where protests were held (Figure 1). Out of the thirteen sites of resistance two landfill sites Lalur (Thrissur district), Brahmapuram (Ernakulam district) located in central Kerala were selected. Site selection was influenced by the historical considerations regarding waste treatment, technologies used for mechanised composting, and nature of government intervention to the issue. In 2014 High Court of Kerala ordered the closure and tapping of Lalur waste dump. After that, Thrissur Municipal Corporation has been carrying out decentralised waste management. Kochi Municipal Corporation, on the other hand, continues with centralised waste management.

The study had two sample groups 1) Households near landfill site (direct and immediate victims of the landfill), and 2) households in the city (waste generators). Total sample size was 175. A hundred households were equally distributed among the two sample groups in Thrissur. The number of households is unevenly distributed in Kochi because the families from Chellippadam (Brahmapuram landfill site) had moved out. Interviews were held with 25 affected but rehabilitated families. The primary unit of the study was a ward, and the ultimate unit was a household. Data was elicited using printed schedules and direct personal interviews. Personal Interviews were semi-structured based on the information provided in the printed schedules. Every 10th household was selected as a sample household in Lalur. The same sampling procedure was adopted for selection of households in both Thrissur and Kochi city centres. In Brahmapuram all rehabilitated households that the researcher could reach out were interviewed. The data gathered through semi-structured interviews with officials of two

municipal corporations supplement further information on the administration of municipal services for waste management. Collected data was used to create frequency tables and understand the proportion of responses. Interview data was coded and analysed to find the common themes. Data (quantitative and qualitative) was analysed, and an explanation building technique was used to derive at the conclusion.

1.2. Locale

Municipal Corporations of Thrissur and Kochi belongs to the state of Kerala, located on the south-west coast of the Indian peninsula. Kerala is peculiar for its urbanisation pattern with high rural density within an urban unit making it neither rural nor urban in character (Sreekumar, 1990). Usually, urban systems have a dominant node or primate city. One fundamental feature of Kerala's urban system is the absence of such a primate city. Even when the population density is high in Kerala, a concentration of population in the towns is low. Large scale industrialisation did not take place in Kerala, but by the end of 1980s Kerala's economy was booming due to the foreign remittances from the overseas migration of educated people. Kerala has 19 urban agglomerations, 7 tier II cities, and 40 tier III cities (Census of India, 2011). Coastal Belt of Kerala is urbanising rapidly. Kochi and Thrissur are cities located in the coastal belt of central Kerala.

Kochi is a major port city and the nerve centre of commercial and industrial activities. After the formation of the state of Kerala in 1956, all the three municipalities of Kochi, Mattancherry, and Ernakulam along with the Wellington Island was merged to form Corporation of Kochi in 1967. Currently, Corporation of Kochi holds an area of

94.88sq.km with a total population of 612343 (Census of India, 2011). The population density is 1069 persons per sq. km. In the urbanisation chart of the state, Kochi Urban Agglomeration constitutes nearly 94.86 percent of the total urban population of Ernakulam District. The land use pattern of Kochi reveals that approximately 18.30 percent represent water body and 8.08 percent agricultural/wetland which is fast depleting due to reclamation. The landfill site of Corporation of Kochi is located inBrahmapuram which is a village located in Vaduvakkode-Puthencruz panchayat of Kunnathunadu Taluk in Ernakulam district. Municipal Corporation of Kochi acquired land in Chellippadam area of Brahmapuram to establish a waste treatment plant. Chellippadam had 53 families hailing mostly from the Muslim community at the time of acquisition of land. The people were engaged in agricultural activities and petty labour. In 2009 these families were however evacuated in the wake of protests.

Similarly**, Thrissur** is the fourth largest city in Kerala and known as the cultural capital of the state. Thrissur rose to its prominence when Kochi ruler Raja Rama Varma (known as *ShakthanThampuran*) decided to shift the royal administration to Thrissur. The population density of the city is 3130 persons per sq.km. Thrissur town alone carries 38 percent of the urban population of the district. On July 1st, 1941 Thrissur was established as a municipality under Kochi Municipal Regulations. On 2nd October 2000, the Municipality became a Corporation incorporating nearby panchayats namely Ayyanthole, Ollukkara, Koorkenchery, Ollur, Vilvattoru, and Nadathara. Thrissur Municipal Corporation covers an area of 101.3sq.km with a population of 315,596 and 77,999 households

(Census of India, 2011). Corporation area has 52 wards for the administrative purpose and nine sanitation circles. The landfill site of Thrissur Corporation was located in Lalur, a village under the jurisdiction of Ayyanthole Gramapanchayat till its merger with Thrissur Municipal Corporation in 2000. It was primarily a residential site of agricultural labourers. Lalur was chosen as a landfill site during the reign of Kochi ruler *ShakthanThampuran* before Independence. At the time of the study, Lalur was the 50thward of Thrissur Municipal Corporation and had 480 households in the vicinity of the landfill site.

Section II
Waste Production and Management

2.1 . Waste Management System and Citizen Involvement in Thrissur and Kochi

Urbanization, economic growth, and waste production are related. As the living standards of the people rises, the consumption increases. A sizeable amount of waste generation is also market induced. Planned obsolescence is a marketing strategy designed to prevent the market stagnation by the increase in consumption of people (Packard, 1960). In Planned obsolescence, products have an expiry date which promotes a throwaway culture. That is, even when a product like the plastic cup is the same before and after usage, it is to be thrown away after use because it has crossed its expiry(Kennedy, 2007). The impact of such change in consumption pattern is strongly felt at the micro level where waste management becomes an issue. The impact of waste production is experienced mainly in the urban centres due to the

population density, increased consumption, and lack of land area for effective treatment. In a day, Thrissur and Kochi generate about 150 and 600 Tonnes of waste, respectively. The per capita waste generation is 476 and 482 grammes per day. The proportion of household waste in municipal waste is 70 percent in Thrissur and 55 percent in Kochi.

Table 1. Daily Waste generated in Thrissur and Kochi Municipal Corporation

Waste Generation	Thrissur	Kochi
Total waste generated in MT/day	150	600
Per capita waste generated (Kg)	0.47	0.48

Source : Thrissur and Kochi Corporation

2.1.1. Waste Storage and Removal by Households

Out of the houses selected for the survey in the city limits, nearly 70 percent of the houses were independent houses and 30 percent flats in Thrissur. In Kochi, however, 52.5 percent houses were independent houses, and 47.5 percent houses were flats. The significance of the type of house stems from the fact that independent households treat the biodegradable wastes in the courtyard, while flats depend on the municipal services for waste treatment. Unlike flats, independent households in Kerala are often perceived to possess land area for the treatment of the biodegradable wastes within the premises. The method of waste storage in the households and its disposal pattern determine the type of waste management system and its effectiveness. Storage of mixed wastes and its removal to the municipal waste stream lead to increased use of landfill sites. Waste storage and removal patterns act as a revealing indicator of the citizen perception of waste management, their awareness and compliance to waste segregation. The primary survey

shows that 55 percent households store both bio-degradable and non-bio degradable wastes in a single bin in Thrissur and 42.5 percent in Kochi.

Table 2. Waste storage and disposal by households in sample area (%)

Storage and disposal of waste	Thrissur	Kochi
Biodegradable waste collection and disposal		
Home treatment	25	20
Dependent on Self-Help Groups (SHG)	35	52.5
Street discard	40	27.5
Collection and Disposal of Recyclable Wastes		
Home treatment	12.5	20
Dependent onSHGs	42.5	52.5
Street discard	45	27.5

Source: Primary Survey

These households are found to engage in three types of waste removal practices. They are 1) household treatment of waste (composting or burning); 2) using Self Help Group (Kudumbashree/ Sevanasree) services to remove waste, and 3) street discard. In the case of biodegradable waste, the primary survey shows that only 20-25 percent of all the households treated their waste at home. In Kochi, the sample households mostly depended on Kudumbashree for removal of both biodegradable and non-biodegradable waste. However, Kochi has 71 wards out of which only 15 wards had the service of Kudumbashree. This means that the chance of street discard of mixed waste is higher in other parts of the city where the service is not available. The trend in Thrissur was to street discard the waste even when Kudumbashree services were available. The reasons for this behaviour were people's unwillingness to pay the user charges associated with door to door waste collection and unsatisfactory service delivery. Nearly 70-80 percent of

the total waste generated in the households in both sites reaches the treatment/ landfill site either through Kudumbashree women or Municipal staff that collect waste from the local pick-up points (Table 2). Houses which chose to street discard their waste used polyethene bags to dispose biodegradable wastes which affect the degradation process and effective treatment.

Similarly, number and types of plastic bags in the waste stream have an impact on the amount of waste accumulated at the landfill site. Non-segregated plastics and plastics with non-recyclable quality often end up in landfills. Plastics are considered a threat to the environment due to its lightweight and non-decomposability. Plastic waste in Kerala accounted for nearly 4-6% of municipal waste (Verma 2006). Recycling of plastic waste into high-quality materials require the collection of clean, single type of plastic. The primary survey in two sites shows that nearly 60-67 % of households discard about 10-20 plastic bags per week which reaches the landfills. During the survey, the contractor of compost plant in Thrissur said, “Plastics reaching the site are of low quality, and there are no buyers for such plastic”. Increased number of plastic wastes in the landfill affects the natural decomposition process. In Kochi, though Refuse Derived Fuel (RDF) technology was installed to treat the non-degradable waste, at the time of field visit the technology was unused.

The study found that waste segregation at the source was less, and most households in the city indulged in waste discard in the streets. This may be due to the small share of land for processing waste, or the convenience to remove the waste or may be due to the lack of waste collection services. Street discard of waste for convenience demonstrate

a serious lack of awareness among the households. The impact of such street discard behaviour was that the mixed waste reached the processing plant reducing the efficiency of mechanical composting leading to increased landfill use.

2.1.2. Waste Collection and Transport

Waste collection and transportation is done mainly by the municipal staff. They collect waste produced in the city at regular intervals from the pickup points including the markets. In Thrissur, nearly 100 tonnes of waste out of 150T (66.6%) and in Kochi 240 tonnes out of 600T (40%) were collected and transported to the treatment plant.

Table 3. Basic information on waste collection and transport in Thrissur and Kochi

Waste Collection and Transport	Thrissur	Kochi
Waste collected and transported per day per population (in Kg)	100000	240000
Number of sanitation circles per 100000 population	9 (2.85)	21 (3.42)
No of sanitation workers in Corporation per 100000 population	250(79.21)	920 (150.2)
No of Sevanasree women for door to door waste collection per 100000 population	150 (47.52)	200 (32.66)
No of vehicles for waste transport	26	107

Note: Percentage is given in parenthesis
Source: Health Department- Thrissur and Kochi Municipal Corporations

Mechanised composting requires source segregated waste for increased efficiency. However, mixed waste reached the treatment plant

Figure2 Mixed Waste in Lalur Compost Plant

Figure 3 Mixed Waste in Lalur Compost Plant

on a daily basis (Figure 2). Therefore, to enable the segregation at the source, after the introduction of mechanised composting the Thrissur and Kochi Municipal Corporation initiated door to door waste collection with the help of Kudumbashree Mission- an agency for the empowerment of women. The initiative was called "Sevanasree" in Thrissur. In this scheme, the local government sought the support of Kudumbashree Mission to engage economically poor women for the door to door segregated waste collection. Nearly 10-15 economically poor women organised into a SHG to carry out the waste collection activities, and Sevanasree encompasses several of these groups. Each group had three-wheeler tipper pick-up van for waste transport to the treatment plant. Sevanasree units collected waste from different localities and carried it directly to the waste treatment plant. The group was financially supported by the households on a monthly basis as a token for waste collection. The women divided collected amount through the thrift and credit process and used for loan repayment, repair of the vehicle, and their monthly income. The waste collection services in the locality had a change in two main aspects after the introduction of technologies: 1) The service provision extended from community to household services, and 2) Introduction of informal labour for waste

collection. In Kochi, the self-help groups were engaged in waste collection in only 15 of the 71 wards. Kochi also has nearly 250 resident associations that are involved in doorstep collection. Unlike Sevanasree women in Thrissur who transport waste directly to the treatment site, in Kochi, street sweepings and primary waste collection are transferred to the secondary collection points through Hand Carts, Wheel Barrows, and Tractor Trailers'. The circle offices of the 21 sanitation circles act as the secondary collection points from where the waste is collected in open Trucks to transport to the treatment plants. Thrissur and Kochi carried municipal solid waste in a fleet of 26 and 107 vehicles to the treatment site, respectively. Vehicles include tractor trailers and trucks.

2.1.3. Waste Treatment and Disposal

In the pre-independence period, the sanitation council of King Raja Rama Verma selected Lalur as a landfill site after shifting the Royal administration to Thrissur. The *Thotti* or waste collectors, belonging to Scheduled Caste community collected vegetable waste and night soil (human excreta) from the Royal routes and transported to the village for trenching. The practice of trenching continued even after independence until the method failed due to the increase in non-biodegradable waste. Everyday waste that reaches the landfill site got accumulated, and Lalur trenching ground soon turned into an open waste dumping ground. Wastes affected the daily lives of people in the landfill sites leading to discontent and resistance. In the wake of protests, a mechanised waste treatment plant was constructed in Lalur in 2002 with a cost of 1.74 crores to address the issue. The plant was contracted out by the Corporation paying Rs.2, 81,000 per month as its operational

cost. Three Orgaver machines (figure 3) were installed at the plant each with a capacity to digest 15 MT of biodegradable waste. The orgaver machine was supported by conveyor belts and sieves. However, two Orgaver machines, the conveyor belts, and sieves were unused at the time of field survey making the actual operational capability of the plant only 15 MT of waste per day.

Table 4. Basic information on waste treatment and disposal in Thrissur and Kochi

Waste Treatment and Disposal	Thrissur	Kochi
Waste Treatment Method	Windrow Composting	Windrow composting
Area of Compost Plant in Acres	26	108
Number of Households near landfill site	480	0
Machine used for waste treatment	Orgaver (3)*	Trommel (3)
Total Number of composting machines used	3	3
Total compost produced in Metric Tonnes	15	30
Per capita compost production (Kg)	0.047	0.048
Total waste landfilled in Metric Tonnes		85210
Per capita waste landfilled (Kg)	0.26	0.342

Note: Given in parenthesis is the number of machines
Source: Health Department of Thrissur & Kochi Municipal Corporation

Similarly, waste treatment facility of Kochi Corporation is in *Brahmapuram*. Around 33.3 acres of wetland was reclaimed in Brahmapuram in the year 2008, to construct the waste treatment plant.

Figure 3 Orgaver Machine

The plant was initially contracted out to Andhra Pradesh Technology Development and Promotion Centre (ATDPC). In 2009, reports of Brahmapuram plants developing cracks came out. An expert inspection conducted by the faculty of National Institute of Technology (NIT), Calicut found that all the buildings had developed cracks with columns settling, the tie beams sloped, and parapet walls developing cracks. At this point, Corporation took the responsibility of the plant from ATDPC and in 2010 gave the contract to Centre for Environment and Development (CED) to rectify the problem and reinitiate waste processing. Newspaper in 2010 reported that the plant "turns profitable" with an increase in production of manure from the plant (The Hindu, 2010).

Figure 4 Trommel in Brahmapuram

At the time of field visit, the treatment plant had two separate roofed structures. One of them designed for windrow composting with two

functional trommels (Figure 4) for churning solid waste and the other one designed for storage and disposal of non-biodegradable wastes equipped with unused Refuse Dervived Fuel (RDF) pelletizer. In addition to Trommels and RDF Pelletizer, the plant had vehicles for leachate suction. Excess wastes were landfilled in the marshland (Figure 5) adjacent to river Kadamprayar increasing the risk of leachate percolation and pollution of the water source. The floor of the facility was broke and sunk, columns tilted and the tie beams not in alignment (Figure 6).

Figure 5 land filling waste in the marshy land

According to the plant in-charge, *"the wetland was reclaimed to build the plant. Flooring should be at least 12 meters in such cases. But here it is just 2 meters which are the main reason for breakage"*. The impact of breakage of the infrastructure is that the moisture is retained making it unsuitable for windrow composting. The Health Inspector in charge of the plant reiterated that *"the infrastructure cannot support windrow composting since moisture remains in the waste. Mechanised composting requires*

Figure 6 Tilted columns in Brahmapuram

dried waste. Now we can process only up to 30 MT of fertiliser out of the total waste. Rest of the waste requires landfilling and capping". These observations point to the negligence in the technical planning and execution of waste treatment plant in Brahmapuram. Out of the 240 MT of waste reaching the landfill site, nearly 210 MT waste is land filled in Brahmapuram currently. Due to lack of leachate treatment facility, proximity to the river Kadamprayar and the area being a reclaimed wetland, the environmental impact of Brahmapuram plant is massive.

Summing up, when the amount of waste increased the local government sought to minimise the waste using mechanisation as it was the available market strategy to cope with the increasing waste. The hope with the mechanised waste process was that piling up of waste due to increased production and consumption could be controlled using a series of technologies. Technologies are not value-neutral. Technologies can create alienation of labour (Marx, 1890), build order in the society, and also create and maintain a particular set of social condition either for the perpetuation of the system or develop a technology compatible with the system (Winner, 2009). Applying this to the solid waste management, we can see that large technologies are designed to treat the waste without altering the system that produces a huge quantity of waste. Mechanised Composting was preferred in Kerala because of the increased moisture content in the waste stream. Lack of citizen's compliance to source segregation and increased practice of street discard, however, led to the collection and accumulation of mixed waste. Mechanised composting fails in such condition. In addition to this, inadequate operational capacity in Lalur and the infrastructural

breakdown at Brahmapuram affected the efficiency of mechanised composting leading to large-scale environmental degradation. Environmental degradation intensified the social and economic issues faced by the residents of the landfill sites which increased the discontent among them. Subsequent environmental movements and government interventions determined the future of waste management in both the cases.

Section III
Socio-economic Impact of Landfills and the Emergence of Social Movements

Discontent against waste dumping has led to the emergence of movements against waste management. A movement is an unstable and vacillating phenomenon with intermittent and erratic actions, and lull period (Oommen, 1977) Thrissur experienced a movement against waste management for over a period of three decades with intermittent protests and lull period. The disturbance in Kochi cannot be considered a movement as it died out soon in the hands of state intervention. Understanding the reasons for discontent, and course of struggles against waste management will reveal the transformations initiated by the social movements in waste governance in Kerala.

3.1 Households near the landfill Sites

Table 5. Proximity to the landfill Sites (%)

Households near landfills – Distance (Km)	Lalur (Thrissur)	Brahmapuram(Kochi)*
<0.3	82.5	Nil
0.3-0.6	17.5	Nil

Note: The column for Brahmapuram, is 'Nil' because residents of the village have been evacuated.

Source: Primary Survey

Proximity to the landfill sites determines the intensity of social, economic, health and environmental issues suffered by the people. Lalur had a population of 20,000 persons (480 families) living near the waste disposal facility. Nearly 82% of the surveyed households inhabited in less than three hundred metre from the landfill site(Table 5). In Brahmapuram, the government reached a settlement agreement with the residents to evacuate the area for developmental purpose. After the intervention of the political elites like the then opposition leader and chief minister, the state government provided Rs.85 crore to the Municipal Corporation of Kochi for reaching a settlement with the residents. Subsequently, the people acquired land elsewhere and moved out of their village (Chellippadam where the waste treatment plant was located). When resettled, the people from different religious and caste communities chose to remain closer to their community. That is, the displacement in a way affected the secular fabric of the village community.

Table 6. Duration of stay near the landfill sites (%)

Duration of Stay near the landfillsites in Years	Lalur	Brahmapuram
<10	15.0	0
10-20	27.5	0
20-30	32.5	11.1
30-40	17.5	22.2
40-50	2.5	27.8
50>	5.0	38.9

Source: Primary survey

The duration of stay in the landfill sites determines the economic vulnerability of a population. In Lalur nearly 77.5% of the population resides for over 30 years (Table 6). It means that the people bought the land in an area knowing the presence of landfill site. The rehabilitated residents of Brahmapuram mentioned that they had stayed there for more than 20-30 years before moving out. Nelson & Genereux, (1996) say that,

> "Given a choice between two sites offered at the same price and identical in every respect except that one is located closer to a landfill, home buyers will choose the site that is farther away. Only when closer site is offered for less money will families consider the closer site a suitable alternative".

A field survey in Lalur reveals that booming property market dissuades poor from purchasing land for house construction in better localities.

Nearly 57.2% of the sample households purchased land in Lalur attracted by the low cost. About 22.8% of the population inhabit because the property was inherited(Table 7). Low selling price and lack of buyers are also reasons for continued stay in the landfill site. Unlike Municipal Corporation of Kochi, the Corporation of Thrissur was unable to reach a financial settlement with the residents of Lalur, leading to continuous exposure of the households to a degraded environment. That is, the lower economic status of the population and state apathy towards the sufferings of the people sustained the exposure of people of Lalur to a degraded environment.

Table 7. Reasons for purchasing land near a landfill Site (%)

Reasons for buying the land	Lalur	Brahmapuram
Land was cheap	57.2	Nil
Inherited	22.8	Nil
Convenience	20.0	Nil
Reasons for the continued stay		
Land price is low	46.5	Nil
No buyers	12.5	Nil
Impossible to move out for personal reasons	36.0	Nil
Other	5.0	Nil

Note: Government has taken over the land in Brahmapuram and no private ownership possible at the time of field work

Source: Primary Survey

3.2 . Environmental Pollution and Its Impacts

Unequal exposure of people to the landfill sites have health impacts (Vrijheid, 2000). Residents of Lalur reported problems of Asthma/allergy and other diseases like diarrhoea. Moved residents from Brahmapuram stated that while staying near the landfill site, they developed health issues like Asthma/Allergy.

Table 8. Reported illness due to presence of landfill site (%)

Health Issues	Lalur	Brahmapuram
Asthma/ Allergy	52.5	27.8
Other (diarrhoea)	60.0	16.7

Note: Respondents mentioned either one or both of the illnesses. Therefore, the figure for 1 more than hundred and only few mentioned illness in Brahmapuram

Source: Primary Survey

Apart from the health and economic marginalisation, residents also reported deeper social issues emerging from the environmental contamination. Problems were often weather dependent and therefore the intensity of problems across the season varied.

The stench emanating from the malodorous gaseous emissions from the landfills is a mixture of complex materials. There are two primary sources of odour in a treatment/landfill site: (i) The aerobic decomposition of the freshly arrived wastes, and (ii) the generation of landfill gas due to the anaerobic decomposition of wastes stored for longer periods.(Stretch, Guy, Lindsay, & Margot, 2001) Respondents of both Lalur and Brahmapuram reported an intensification of the stench during winter (December-January) with experience of loss of appetite, sleeplessness, nausea and headache during this season. The foul smell spread across a distance of about one Kilometre and the residents of the

site confined indoors closing the windows and ventilators of the houses. (Menon, 1989) Socialisation of the community living near the landfill site was found to be affected due to confinement to the living space. Children were the most affected because they were restricted from playing outside the house.

Insects and flies are considered to be an indicator of unhygienic environment because they are carriers of pathogens that cause illnesses. Standing idle near the waste treatment plant was impossible because flies cover up the body (Pasha, 2009).Vector control measures of the urban local bodies met with failure in landfill sites due to the economic cost of such activity on a daily basis. Residents of Lalur reported that children were affected mostly as the flies sit on the served food and at times it entered the mouth through food. Women being the housekeeper in a patriarchal society with strict division of labour, the responsibility of cleaning living space falls on women, and they were forced to put extra effort and time in wading away the vectors.

During summer, the waste dump catches fire either due to spontaneous combustion as part of chemical reactions and methane production, or the carelessness of people. Fire in the waste dump exposes inhabitants to the smoke and toxic gases that emanated from substance burning (Aderemi & Adebayo, 2012). Burning of waste dump can emit a noxious odour, which may lead to the congestion of the respiratory tract. One of the residents from Brahmapuram reported that

> *"Major factor that made us take the decision to move out of Brahmapuram was the landfill fire that lasted for a week.Smoke clouded the entire area making us unable to breathe, eat or sleep. Children suffered the most with congested lung and continuous cough. We were terrified to live in that place anymore*".

Combustion of the waste dump can be either due to the chemical reaction or due to negligence. Staff of Thrissur Municipal Corporation stated that

> "*The waste dump catches fire in summer due to the carelessness of workers employed in the yard. In summer, a spark of fire is more than enough to flare up, and it is a catalyst for combusting the methane gas*"

The presence of dust in the air is common in the dry season. The roads between the trenching yard and treatment plant become dry and dusty. The passage of vehicles through the road also created an enormous amount of dust, which obstructs visibility (Pasha, 2009).

Similarly, Monsoons create havoc in the area. Heavy incessant downpour for many days at a stretch is the characteristic of monsoon in Kerala which leads to water logging. Respondents from Lalur were concerned about flooding in the area. In 2009, due to heavy downpour, the compound wall of the Lalur dump yard broke, flooding the area with water and rotten garbage. Kerala Pollution control Board had to seal at least 54 drinking water wells in the area after this incident(The Hindu, 2012). An inhabitant of the area remembered the incident as,

> *"During the 2009 monsoon, runoff from the waste yard got collected in a pit near my house. As the water level increased, my home drenched in water. We had to live with crawling worms and floating wastes".*

Respondents from Lalur also complained of the reluctance of three-wheeled auto-rikshaw drivers' in transporting passengers to the village during monsoon. One of the respondents narrated an incident as,

> *"Once we hired an auto, and the driver left us on the way saying that he cannot carry us to our home through the filthy roads. He said that he was afraid of losing other passengers because the auto rickshaw might stink after the ride"*

In short, throughout the year, the inhabitants of the landfill site deal with environmental pollution which creates social exclusion and environmental injustice. The issues thus faced by the residents of landfill sites are often beyond any quantifiable measure. Lalur faced greater issues due to the prolonged existence of landfill site. Forced to buy the land in Lalur due to economic vulnerability, and neglect of the local government to the plight of the people, the residents, organised themselves demanding justice in Lalur. In Brahmapuram people organised against the state directed forceful waste dumping.

3.3. Resistance Against Waste Management

Resistance in Lalur evolved eventually due to the negligence of the urban local government and failure of trenching as a landfilling method. In Brahmapuram (Kochi) however, the resistance erupted abruptly after a High Court order to dump the wastes from the city in the proposed site. The end result of the resistance movements is also different. Therefore, emergence and the nature of resistance in both the areas need specific attention.

Lalur: Struggles against waste dumping in the Lalur started around 1988. During that period, Kerala did not have a proper medical waste management facility. Discarded bio-medical wastes including human body parts entered the waste stream of Thrissur Municipal Corporation reaching Lalur. Openly dumped Bio-medical wastes attracted stray dogs in the area affecting the health of residents. In 1988, an indefinite struggle against waste dumping was inaugurated by late writer and activist Sukumar Azhikode and led by late political activist AV Aryan in front of the Ayyanthole Panchayat under the jurisdiction of which the disposal

site situated. From 1988 to 1992 frequent protest movements rocked the administration against waste dumping in Lalur. In response to a case filed in the High Court of Kerala, an enquiry was conducted in 1989. In 1992, the High Court of Kerala ordered the Municipality to find a better way to handle solid waste. In the same year in a high-level meeting (where the District Collector, Corporation Officials, Member of Legislative Assembly and representatives of the victimsparticipated) the decision to construct a waste treatment plant, was taken. However, uncontrolled waste dumping continued while implementation of the plan delayed. In 1997, the death of three young men due to methane gas inhalation while cleaning the drinking water well re-ignited resistance struggles. The Rural Development Officer (RDO) ordered to stop dumping waste in Lalur. However, High Court stayed the RDO order based on a complaint received from the Municipality. In the year 2000, when the municipality upgraded to Corporation, wastes from more Panchayats' were transported to Lalur leading to further resistance from the people. Later in 2002, a waste processing plant was installed. In short, mechanisation of waste management in Thrissur was a result of continuous resistance from the community. However, mechanisation did not improve the condition of people living in the landfill site, and more waste found its way to the landfill site. The influx of mixed wastes seriously impaired the operational efficiency of the waste grinding machine. Further, the government proposed a World Bank project for sanitary landfill. However, this project did not take off as the site failed to pass the hydrological test. The collapse of the compound wall of trenching ground in monsoon season of the year 2009 was a catalyst for

another biggest struggle in Lalur against waste dumping. Examination of water samples from the nearby areas of the trenching ground showed high-level contamination making it non-potable. The protesters including men, women, and children stopped the corporation vehicles that carry waste to the area. This protest created havoc in the city as the waste collection from the city came to a halt.

The protesters also targeted the SHGs. Though initially the Sevanasree programme was received by the society as a novel idea, the protesters targeted Sevanasree believing that waste reaching the village has increased after the introduction of Sevanasree. The distrust was that Sevanasree women transformed the waste removal habit of city dwellers. One of the active participants in the protest movements mentioned during the field survey that "*after the introduction of* Sevanasree, *even the households which treated wastes at their backyard began to remove kitchen wastes through these women. It is a convenient way for them to get rid of waste. But we have to bear the burden"*. Protesters blocked the Sevanasree vehicles from entering the village. The ruckus by the protestors finally led to the abolition of the Sevanasree waste collection programme leaving the women jobless. From the case, it can be seen that introduction of composting technologies demanded change in the waste behaviour of the households. Segregation of waste became significant for effective use of composting technology. Introduction of new labour for waste collection from the households was to ensure the change in household behavior towards source segregation. In these cases, a new form of formalisation of labour in waste management was introduced. Sevanasree women were part of

the waste management system but outside the formal command of Municipal Health Officer. They were not entitled to any social and occupational protection in comparison to the municipal employees. However, protesters targeted Sevanasree women claiming an increase in waste in the landfill by changing waste removal habits of city dwellers. Without employing a critical analysis of the claims, soon after the protests, the government scuttled the Sevanasree programme leaving the women jobless. This act leaves out underlying reasons for increased waste production which include market influence on increased waste production and lack of environmental awareness that lead to the environmental unfriendly waste removal habit of the people. When waste management is under scrutiny, the influence of capitalist marketing strategies like planned obsolescence and the role of the packaging industry in increasing the consumption and wastage are seldom discussed. Also, when the authorities abide by the claims of the protesters targeting the informal labour without a critical reflection of the ground realities, the onus of waste production in the city falls on the informal labour. In such a situation the inherent power relations rooted in the neoliberal economic agenda with profit motive tend to be overlooked, and the state becomes the facilitator for sustaining the economic projects. The introduction of informal labour can also be considered as the neoliberal experiments of creative intervention in the urban space.

The then Chief Minister of the State, V S Achudananthan convened high-level meetings to address the issue of local resistance against waste management in Lalur. The decision for a new decentralised waste treatment project by Dr. Pathiyoor Gopinath of Kerala Agricultural

University (Lalur Model Project for Solid Waste Management (LAMPS)) was approved in the meetings. Thus, for the first time, the concept of decentralised waste management was introduced in Kerala. However, this project met with challenges due to the NIMBY movements erupted in the proposed areas in the city which ensured that decentralised waste treatment sites are not located in the middle-class areas. Landfill in Lalur was closed down in 2014 as per the High Court order, and decentralised waste management has been accepted as an alternative model by Thrissur Municipal Corporation.

Brahmapuram: Unlike Thrissur Municipal Corporation, Kochi faced local resistance from three areas. During 1990s wastes from Kochi Corporation found its way to a village called *Cheranallur.* Local resistance from the local community forced the Corporation officials to find another space for waste disposal. The Corporation then entered into an agreement with the naval base of Kochi for disposing waste in Wellingdon Island. Residents protested against the waste dumping in Wellingdon Island. In 2002, Navy was alert against the bird flying in the area. On October 2006, a Dornier aircraft of the Coastguard suffered a bird hit near INS Garuda, the naval air station. Though a major disaster was averted, Navy decided to withdraw the permission for waste disposal in Wellingdon Island. It was at this time of crisis that the government proposed a compost plant in Chellippadam village of Brahmapuram in the Puthen Cruz Panchayat. However, due to an imminent crisis in the city due to the non-removal of waste, the High Court ordered for disposal of the rotten waste in the proposed site even before construction of the plant. The local people of Brahmapuram launched an indefinite agitation

against waste dumping. The open dumping continued, and the Puthen Cruz Panchayat decided not to renew the No Objection Certificate (NOC) which was given to the Corporation for waste treatment in 2007. However, with the support of the Judiciary and Police, the piled up wastes in hundreds of vehicles was transported to the site. One of the major economic activities of the residents of Brahmapuram was cattle rearing. Brahmapuram was an important milk producing centre. As the convoy of garbage, vehicles passed the village, the milk stored in barrels nearby a milk co-operative society could not be taken out that day ruining the milk. The residents spilt the milk in protest in front of the police station next day. In the wake of continuing protests, in 2008, with the help of the state government, the local government purchased land from the Chellipadam residents in Brahmapuram and expanded the area to about 100 acres for developmental activities. Acquisition of land from the residents has put a stop to the local resistance in the area. At the time of the field visit wastes remained accumulated in the treatment plant emanating noxious odour. Landfilling of the wastes was also in progress.The involvement of state government was a major determinant for subsiding local resistance in Brahmapuram.

3.4. Respondent's Perception of the Solution

The emergence and growth of movement against waste management show that more than the economic issue the highlights of the protests were the immediate social and environmental issues. In this context, people's observations on the solution to the crisis become important. Nearly 53% of the population near the landfill sites believed that proper management strategies and the introduction of better

technology could solve the issue. People's suggestions towards better waste management, in general, include appropriate technological interventions and decentralised waste treatment (Table 10).

Table 9. People's response to whether technology could resolve the issue (%)

Responses	Lalur	Brahmapuram
Yes	52.5	55.6
No	10.0	22.2
Don't Know	37.5	22.2

Source: Primary survey

Table 10. People's suggestions for better waste management

People's suggestions	Lalur	Brahmapuram
Stop Dumping of waste	42.5	27.8
Use proper Technology	12.5	22.2
Decentralisation of Waste Treatment	25.0	16.7
Use all the above with equal importance	7.5	5.6

Note: The figures in the table do not total to hundred as some of the respondents did not reply

Source: Primary Survey

Movements against waste landfilling can be considered as a fight for 'social justice and sustainability'. At the micro level, the economic and social exclusion were the key drivers for people's resistance against waste land filling. Continuous exposure to waste reduced the land value, on the one hand, forcing them to stay put and destroyed the environment that finally led to social exclusion on the other hand. Social exclusion is manifested in the form of no visitors to the households, restricted outdoor activity for children, extra work for women and lack of marriage prospects for young men. Environmental sustainability is threatened due to the destruction of drinking water

sources and polluted environment. The movement is also counter-hegemonic in nature because it questions the market induced centralised technology driven waste management system and ensure reforms to improve the effectiveness of the system. Initial expectation of people on mechanisation was that large technologies would reduce the problem of waste accumulation. The people of Lalur opted for decentralised waste management and questioned the efficiency of large technologies to solve the problem. In the case of Brahmapuram, protesters focused on the act of forceful dumping of waste by authorities even before installing technologies. The officials financially settled the issue by evacuating the residents and continued with centralised waste management

Conclusion

Landfilling of solid waste is not suitable for Kerala due to the lack of land area and increased population density. Therefore, to minimise solid waste reaching the landfill sites, the local governments introduced mechanised composting. However, mechanised composting did not ensure reduction of waste for land filling either due to non-compliance of citizens or technological fatigue as in the case of Lalur, and infrastructural defects as in the case of Brahmapuram. Subsequent continuous resistance by the residents of Lalur village in Thrissur forced the closure of landfill site and then the government was forced to find alternatives to centralised waste management system. Thrissur Municipal Corporation thus introduced decentralised waste management. However, implementation and monitoring of the alternative decentralised model

has not been successfully developed. In Kochi, the Local Government could defy people's resistance with the support of the state government and acquire the entire village for its activities. Because of the fragile resistance and availability of land, the local government continued with the centralised waste management system. That is, local government chooses a system of waste management based on prevailing local conditions and continuity of people's resistance. The study concludes that centralised waste management practices can be detrimental to environment and public health of people in Kerala. Current alternative policy to this is the decentralized waste management system. However, this study shows that Local Self Governments are reluctant to shift to decentralised waste management when protests are fragile and practical knowledge of implementation are not clear.

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Notes

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[ii] Trenching is a landfilling method where collected biodegradable waste is buried and retrieved after some time to use the compost as manure for agriculture.

[iii] Consolidated data of waste generation is available with Suchitwa Mission for the year 2001 and 2006. Since then the population of the state has gone up and urbanization level has increased which has led to increase in waste production. Therefore, using these two data, compound growth rate of solid waste generation is calculated. The formula used for compound growth rate calculation is R= (t1/t0-) ^ (1/y1-y0)-1 [R= Rate of growth, t_1=End year, t_0=Beginning year]. The growth rate is then extrapolated to get the per day quantity of waste generated and annual waste generation in metric tons.

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