

A STUDY OF SOLID WASTE MANAGEMENT - WITH REFERENCE TO MADURAI CORPORATION

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Abstract

Basic infrastructure development is an essential element of the economic growth equation. The Government of India has proposed and provided for transferring several administrative and financial powers to Local Bodies and designating them as the nodal agency for provision of effective and sustainable urban services. Municipal Solid Waste (MSW) Management is an obligatory function per the respective Municipal Acts that govern the functions and responsibilities of Local bodies in India. It is the responsibility of the Local bodies to collect, transport, process and dispose the Municipal Solid Waste in an environmentally acceptable manner. The factors that influence the volume and composition are average level of income, population, social behavior, climate, industrial production and market for waste materials. Generation of solid waste is also reportedly in direct relation to economic wealth. Variations are also bound occur in composition of solid waste due to seasonal and location factors.

Keywords: *Municipal Solid Waste, JNNURM Scheme, Urban Infrastructure, Basic Governance, Urban Poor, City Development Plan*

Objectives of the Study

1. To identify the causes for increasing solid waste.
2. To know about the solid waste management project under JNNURM Scheme.

Methodology of the Study

Madurai District has 13 Community Development Blocks, 100 wards and 428 village. Madurai Corporation is geographically well located. Corporation of Madurai has been identified as one of the cities for infrastructure development in accordance with the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) scheme. This mission comprise of two submissions namely :

- Sub-Mission for Urban Infrastructure and Basic Governance.
- Sub-Mission for Basic Services to Urban Poor

The Main thrust of the submission is on infrastructure projects relating to Water Supply and Sanitation, Sewerage, Solid Waste Management, Road Net Work, Urban Transport, development of old city areas with a view to upgrading infrastructure. Corporation of Madurai has prepared the City Development Plan. Improvement to the existing Municipal Solid Waste Management system has been identified as one of the priority sectors in the City Development Plan for Madurai.

JNNURM Scheme

- Project Under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) Scheme.
- It is the first project of Integrated Solid waste Management Project having concession period of 20 years based of PPP Model.
- Survey, Design, Supply and construction of waste processing and disposal facility of 350 TPD and O & M of the project for the concession period of 20 years after date of Commissioning.
- Construction and Development of Sanitary Land fill Facility (SLF) and O & M of the same for the disposal of inert & processing rejects & to accommodate mixed waste in line with MSW Rules 2000.

Sources of Municipal Solid Waste

MSW is usually categorized as follows

- Domestic Origin (food, vegetable residues, Packaging Material 'Paper, Plastic, metals)
- Commercial / Institutional Origin (Hotels / Restaurants / Marriage halls)
- Market Origin (cardboard, packaging materials and related)
- Health Care Facilities (infected linen, injection vials, discarded medicines, cultures, body parts, etc)
- Industrial Waste (Scrap metals, alloys, glass, paper, plastic, packaging materials chemical residues, etc.)
- Vegetable Markets (Reject Vegetables)
- Slaughter House (Body residues)
- Worship places : (Used flowers, food waste, etc). Street sweeping (Kerb - side Waste, Soil, Silt, Paper, Plastic, etc)

Classification of MSW are biodegradable, easily Biodegradable (food, fruit and vegetable waste, garden waste, paper etc.), non Easily Biodegradable (Wood, Animal residues, etc) combustibles that is, Relatively dry with high calorific value (plastic cardboard, Wood, rubber, leather etc.), Inert (dust, cinder, grit and other debris are known as "inert materials", hazardous Items (e.g. Chemical Based Waste, Bio medical waste, etc)

The residential area covers the major portion of the land use, which reflects that the city is densely populated. The distribution of potential sources of MSW in Madurai Corporation is presented in the following Table

Table 1: Potential Sources

Sl. No.	Type of waste	No. of units
1	Residential	170094
2	Industrial	1350
3	Commercial	12551
4	Residential with commercial	7507
5	Marriage halls	285
6	Lodge	151
7	Cinema theatre	38
8	Commercial Complex	112
9	Hospital and nursing homes	546
10	Hotels	223
11	Market	24
12	Slaughter houses	2
13	Bus stand	2

As specified above, salient details of the present solid waste management system per waste sampling and testing conducted and data obtained from Corporation of Madurai officials are presented in the following Table

Table 2: Salient Features of Solid Waste Generation in Madurai Corporation

S. No.	Description	Details
1	Per Capita waste generated (Kg/day)	0.382
2	Waste generated per day - approx (MT)	450.00
3	Waste collected per day - approx (MT)	400.00
4	biodegradable waste (% of total waste)	70%
5	Non biodegradable waste	50 to 45%

Additionally, studies have also been conducted to analyze the pattern of waste generation and collection at the city-level. Although the above mentioned table indicates 450 tons per day of waste generation, the quantum of 450 tons per day has been assumed as the optimal generation of waste, though there will be increase due to 100% coverage of street sweeping and which would not have any adverse impact on waste processing activities since street sweeping contains mostly inert materials.

Generation of Solid waste in Indian cities :

As per the norms / standards prescribed in the Manual, the generation of the wastes in Indian cities with respect to the population is as follows :

Table 3: Per Capita Generation of Solid Waste in Indian Cities

Population range	Average per capita value (Grams / capita / day)
Less than one lakh	210
One lakh to five lakhs	210
Five lakhs to ten lakhs	250
Ten lakhs to twenty lakhs	270
Twenty lakhs to fifty lakhs	350
More than fifty lakhs	500

Source : CPHEEO manual on solid waste management

Madurai with a present population of approximately 9.50 Lakhs and a floating population of nearly 2 lakhs per day is expected to generate about 270 grams per capita per day. However, the present level of generation related to about 382 grams per capita per day which is higher than the prescribed norms and is however typical of large cities where the economy influences the level of waste generation.

Fund Allocated for Solid Waste Management Project

The Madurai city is one among the 63 Mission cities under the JnNURM. According to the population the Mission cities are categorized into Mega cities, Million plus cities and Heritage cities. The Madurai city comes under the category of heritage city. The Central Sanctioning & Monitoring Committee of the Ministry of Urban Development and the Ministry of Housing and Poverty Alleviation, Government of India have approved five projects under the Urban Infrastructure & Governance and three projects under the Basic Services to the Urban Poor respectively. The details are as follows :

Table 4: Fund Allocation for Urban Infrastructure (2009-10)

Sl. No	Name of the Project Cost	(Rs. in lakhs)
1	Urban Infrastructure & Governance	
(i)	Second Vaigai Water Supply Scheme	5931.00
(ii)	Construction of Check Dams	477.00
(iii)	Solid Waste Management Project	7429.00
(iv)	Storm Water Drainage	25156.00
(v)	Underground Sewage Scheme	22936.00
	Sub Total	61929.00
2	Basic Service to the Urban Poor	
	Phase I	2685.00
	Phase II	10357.82
	Phase III	17675.00
	Sub Total	30718.76
	Grand Total	92647.76

Source : Web site : Madurai District

All these wastes are collected by sanitary workers through pushcarts, tri cycles, autos and bins of various sizes. The collected wastes are transported to the dump yard through the tipper lorries and tractors. The dumping of waste in open causes pollution around the existing dump yard. The capacity of the vehicle used for the secondary collection was not sufficient. Hence this project was proposed to create sufficient infrastructure for primary & secondary collection and facilities for processing of waste in compliance with the Municipal Solid Waste (Handling and Management) Rules, 2000. Under this project, it is proposed to ensure the segregation of waste at source by providing household bins and daily clearance of waste by procuring sufficient bins and vehicles. The establishment of 350 TPD waste processing unit is underway. The construction of sanitary landfills for the accumulated waste and the present and the future non - recyclable waste has been completed. The organic waste will be converted into bio manure and the recycled waste will be sent for reuse.

The Ministry of Urban Development, Government of India has sanctioned the Solid Waste Management Project on 02.02.2007 at a cost of Rs.74.29 crore. The Government of Tamil Nadu has accorded the Administrative Sanction for this project on 17.04.2007. This project has been divided into VIII packages.

Working of a Project

This project was divided into seven packages.

Package - I : The estimated cost of this package was Rs.168.77 lakh. This package provided for the procurement of household bins (522645 nos) to collect the garbage at the source level, tricycle bins (10272 nos.) to collect the garbage from door to door, the compactor bins (96 nos.) to collect the garbage from the roadsides and the tricycles.

Package - II: The estimated cost of this package was Rs. 65.09 lakh. This package comprised of the procurement of Safety Equipments such as face masks (2827 nos.), gloves (2827 nos.), cap (2827 nos.) and handling equipments (2900 nos.) for the sanitary workers.

Package - III : The estimated cost of this package was Rs. 275.86 lakh. This package was meant for the procurement of mobile compactors (4 nos.), mini loaders (4 nos.) and tipper lorries (4 nos.) for scrapping, collecting & conveying the garbage to the waste treatment plant.

Package - IV : The estimated cost of this package was Rs. 279.30 lakh. This package provided for the procurement of Stainless Steel Dumper Bins (570 nos.) to store the garbage collected through the tricycles.

Package - V : The estimated cost of this package was Rs. 116.17 lakh. This package was for the procurement of tricycles (920 nos.) for collecting the garbage at the door step.

Package - VI : The estimated cost of this package was Rs.400 lakh. This package was for the procurement of dumper placer vehicles (47 nos.) to collect the dumber bins located in each wards and then the bins are conveyed to the waste processing unit.

Package - VII: The estimated cost of this package was Rs. 5730.43 lakh. This package consisted of the construction of Landfill & Waste processing Unit.

Outcome of the Project

- The regulations under the Municipal Solid Waste (Handling and Management) Rules 2000 and the State Pollution Control Board viz. source segregation, door to door collection, reducing multiple handling of garbage are being strictly followed.
- The wayside littering of garbage has been reduced. The fly menace has been controlled and stench has come down.
- One kilometer radius around the internationally renowned Arulmigu Meenakshi Amman Temple has been declared as a litter free zone.
- With the new infrastructure in place, 100% garbage clearance is undertaken in each ward every day.
- The health and hygiene of the sanitary workers have improved.
- User charges are being levied on the generators of the solid waste. This will reduce the financial burden of Madurai Corporation.
- The citizens will be benefitted after the implementation of the scheme, and may not show reluctance in paying the user charges.

Disposal of Solid Waste in Madurai Corporation

Solid wastes collected from various locations in the city is disposed of by open dumping at the Vellakkal site, located south of Madurai in Avaniyapuram Municipality over an extent of approximately 110 acres including a sewage farm that receives sewage/partially treated effluent from the predominantly deficient sewage treatment plant. The existing dumping ground has been reportedly used by Madurai Corporation for over 15 years. A weigh bridge is available at the entry to the dump site which essentially records the vehicle details and weight of the incoming waste and source. Recently, the MC has reviewed its agreement with the IMA to ensure that Bio-Medical Waste generated from Government and Corporation Hospitals will be properly segregated from MSW for treatment and disposal through common facility. Pursuant to implementation of the disposal system through common facility for biomedical (contaminated) wastes, such wastes would not reach the Vellakkal site. At present, Madurai Corporation do not have waste processing facility at the disposal site.

Process of disposal of solid waste in Madurai Corporation

The following are the methods of disposing solid waste in Madurai Corporation:

Street sweeping : Street sweeping and drain cleaning are regular function of the Corporation and the supervisory mechanism is a critical area identified for improvement in

order to achieve the 100% coverage. The major sources of street wastes in Corporation included:

- Natural waste comprising dust blown from unpaved areas, decaying vegetation like fallen leaves, blossoms and seeds originated from trees and plants,
- Road traffic waste like oil, rubber, accidental spillage of load of vehicles in addition to the construction wastes and animal droppings of related vehicles.
- Behavioral wastes include litter thrown by pedestrians, households, establishments and tourists along with human spittle and excrement of domestic pets.
- Storm Water Drains/Sewer Cleaning wastes.

From the observations made on-site, the natural wastes and road & traffic wastes are unavoidable and to be cleaned by street sweeping process. However, the behavioral wastes are largely avoidable provided an efficient refuse collection service if in operation for the use of pedestrians. It is very common to see solid waste in various places of the city especially in commercial areas. The reasons are:

- Behavioral pattern of the local inhabitants and floating population,
- Solid waste thrown by the shop keepers,
- Organic wastes from domestic and stray animals spread mainly in commercial areas,
- Wastes produced by the street hawkers and road side vegetable vendors and
- Wastes generated from various small eateries.

But it was evident from the observation during the field visit that the success was requiring a continuing program of public education and awareness backed by legislation and efficiently operating enforcement measures.

Collection Bins for Secondary Transportation

Corporation has provided three types of temporary waste storage points within its jurisdiction; viz. (i) MS Waste Containers, (ii) MS Dumper Bins and (iii) Stainless Steel Dumper Bins. These storage points are not only facilitating the residents to deposit the wastes in these storage points but also enabled the municipal Sanitary Workers to carry and deposit the wastes swept by them.

Waste Transportation to Dumping Sites

The main objective of transportation is to clear waste from the city and dispose it off at the disposal site. It is the responsibility of the local body to ensure the city is maintained in a hygienic manner by transporting the wastes from the collection and temporary storage points to the waste processing and disposal facility with the help of transportation fleet. The movement of wastes from the households, street sweepings, etc. to the temporary storage collection points is the collective responsibility of the Sanitary

Workers and the citizens of the city. Transportation of waste involves the following activities:

- Movement of vehicles to the various temporary storage points;
- Manual loading of wastes using baskets and other lifting tools;
- Lifting of wastes from the open yards on the way to the disposal site; and
- Transportation of waste to the disposal site.

Observation

- The per capita generation of waste in the city is 22 percent higher than the quantity prescribed in the CPHEEO Manual and is about 330 grams (Standards 270 grams for the cities with a population between 10 to 20 lakhs).
- Wastes are consisting of food waste and other discarded waste materials such as paper, plastic, glass, metal, rags, packaging materials, etc. The household industries (brassware) are contributing wastes in the form of ash.
- Households, shops and commercial establishments in Madurai City are yet to start the practice of segregation of recyclable waste at source. Such waste on the streets or in the municipal bins are found going to disposal sites un-segregated.
- The habit of storage at the source of waste generation for the effective door-door collection is not practiced in all the area.
- In the absence of the system of storage of waste at source, the waste is thrown on the streets, treating streets as receptacle of waste.
- The people are found throwing the wastes on the streets and expecting the Sanitary Workers of the Local Body to clean leading to an ugly and unhygienic atmosphere prevailing in the city.
- There is a need to educate people to change their habit so as to store waste at source, dispose of the wastes as per the directions of the Local Body and effectively participate in the activities of the Local Body to keep Madurai City clean.
- In few areas, the bins in use are without lids and found unsuitable for storage of food wastes for 24 hours or more especially in households, restaurants, hotels and eateries as wastes start stinking due to putrefaction.
- Since Madurai Corporation is having 615Km length of roads needs to be swept every day, major roads of width more than 7.5m requires mechanical sweeping machines in order to save time and manpower.
- Inadequate supply of essential tools like wheelbarrows/baskets to the Sanitary Workers, often found forcing the Sanitary Workers to make a heap in undesignated open yards.
- All roads and streets are not being swept on daily basis. Certain important roads and markets are swept daily, some are swept on alternate days or twice a week, some are swept occasionally or not at all.

- Sweeping in commercial areas are found beginning in the morning around 7.30 am, but shops open after 9.00 am and found start throwing their sweepings on the streets soon thereafter, nullifying the work just done by the Sanitary Workers.
- In many places, the MS containers without lid are found to be either damaged or toppled to horizontal positions and thereby not facilitating for the use.
- Tractor-Trolleys are of 35 years old and have exhausted their economic life, requiring immediate replacements to economize the operations. The hydraulic Tractor-Trolley is procured about 6 years back, left with 2 years of economic life. Animal carts need to be discontinued as they are not complying to norms/standards.
- Waste handling is partially mechanized and the waste is handled multiple times leading to potential health hazards for the workers as all types of wastes including hospital wastes are disposed off in the same storage points. The Sanitary Workers are not given proper protective clothing.

Key Issues

Some problems are faced by Madurai Corporation while disposing the solid waste.

They are as follows:

- Segregation of the collected waste from households at source is not being practiced leading to mixing of waste and entrainment of recyclable waste being dumped without proper and full recovery.
- Door-to-Door collection is not practiced in a complete manner resulting in haphazard disposal of waste by households on streets and adjacent to waste bins rendering the general environment unaesthetic.
- It is felt that in absence of adequate manpower, regulated transportation, narrow streets and financial constraints are some of the reasons that are deterring door to door collection.
- As specified above, recyclable waste is not being removed from the general waste at the source of subsequent pre-disposal points. This is leading to rag pickers disturbing the waste dump and posing a significant public health risk.
- Separation of waste that is bio-medical in nature at the household level is also not performed which could entail some quantity of bio-medical waste reaching the disposal site although a common treatment and disposal facility has been reportedly made available at Madurai.
- Waste is not covered with earth to prevent ingress of vector, pigs, dogs etc. A large number of stray animals are found during site visits to the disposal site. Waste from slaughter houses are observed to be disposed along public areas resulting in public health and pollution problems.

Conclusion

To conclude that the present system of MSW collection is vested with the Health Department and performed by Sanitary Workers who are in turn supervised by Sanitary Inspectors. Transportation and maintenance of vehicles, however, is being performed by the Engineering Department. It was noted that this existing system of dual (two-fold) responsibility results in inefficient collection leading to complaints and inadequate redressal/corrective mechanism. The institutional strength and capacity of Madurai Corporation needs to be revamped to ensure effective management of the system.

References

1. CPHEEO manual on solid waste.
2. Hand Book of Madurai District.

Abbreviation

1. MS - Municipal Solid
2. MSW - Municipal Solid Waste
3. JnNURM - Jawaharlal Nehru National Urban Renewal Mission
4. CPHEEO - Central Public Health and Environmental Engineering Organisation
5. MT - Million Tonne
6. Nos - Numbers