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Machanisms and Problems of Solid Waste Management (SWM) Services in a Corporation City: A Case Study of Mangalore*

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INTRODUCTION

IN THE urban areas higher disposable income and changed pattern of life has resulted in higher rate of consumption, resulting in larger amount of solid wastes. As different economic activities use resources leading to waste generation, solid waste has increased considerably in the cities. The generation of wastes arising from human activities both solid and non-free flowing generally considered to be unwanted and discarded, can be a valuable resource by which wealth can be generated through proper management system. In India, the corporation cities are now growing under the problems of high volumes of wastes, the rising cost involved in its disposal and lack of technology available and the impact of the waste on the local environment. Average per capita generation of wastes in large cities in India is about 0.5 kg per day which means that a city of four million would generate about 2000 tonnes per day of domestic solid waste, not counting construction debris and other types of industrial commercial waste. These wastes have to be collected, transported and disposed in an environmentally sound manner. Improper disposal of these wastes leads to the spread of communicable diseases causing obnoxious conditions and spoils the environment as a whole.

Municipal solid waste management is an essential part of the urban environment management in cities of India. Management of solid waste is a discipline associated with the control of generation, storage, collection, transfer, transport, processing and disposal of solid wastes in a manner that is in accordance with best principles of public health economics, engineering conservation, aesthetics and their environmental consideration. The system should comply with the provisions of Municipal Solid Waste, i.e. Management and Handling Rules, 2000. In its scope, solid waste management includes all administrative, financial, legal planning and engineering functions involved in the whole spectrum of solutions to problems of solid wastes thrust upon the

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community by its inhabitants. The present nature of mechanisms of SWM in a growing corporation city like Mangalore is undergoing wider changes due to increase in the waste generation, nature of economic activities and consumption patterns.

Presently, effective management of urban waste is required but urban local governments in many of the Indian cities are constrained by limited finance and inadequate managerial staff. Management of Solid Waste (MSW) – more commonly known as thrash or garbage – consists of everyday items such as product packaging, gross clippings, furniture, clothing, bottles, food scraps, news papers, appliances, paint and batteries. Households often discard many common items such as paint, cleaners, oils, batteries and pesticides that contain hazardous components. Leftover portion of these products are called household hazardous waste (HHW). These products if mishandled can be dangerous to human health and the environment.

At the present situation protection of environment from different types of pollution is considered as a part of social development policies. Thus, promoting human health and trying to reduce the economic losses due to improper and ineffective management of solid waste is considered an important aspect of human resource development. Further, it also helps to manage the problem related to the disposal of infectious waste. However, although most of the Indian Urban Local Bodies are spending 30 to 50 per cent of their total budget on SWM services, they are unable to provide satisfactory services; they are faced with a few common problems like: inadequate coverage of low settlement areas, frequent waste removal, contamination of surface and ground water by leach ate, air pollution due to burning of open dumps, flooding due to clogged drains and non-availability of adequate staff vehicles and suitable dumping sites. The major components of Solid Waste Management are:

1. Type of waste generated
- 2.. Source of Segregation
3. Primary Collection
4. Secondary Storage
5. Secondary Transportation
6. Processing and Disposal

Nature and the Status of Solid Wastes in the Study Area

Keeping in view the larger increase in waste generation and the difficulties in managing the waste management services in most of the urban corporation

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cities, an attempt is made in this article to find out the nature, status and mechanisms being followed in managing the solid wastes in fast growing city corporation area. Hence, the major objectives of this study were, to review the status of the SWM services in the study area and to identify the various steps associated with these services. Finally, the article would conclude by addressing the major problems encountered in the study area along with a set of policy suggestions to minimize the various impediments experienced by the ULB, Mangalore City Corporation in the last few years. For the purpose of the study, the Mangalore City Corporation in Karnataka was selected and the available secondary data was used.

Mangalore City Corporation (MCC) Profile

In 2001 Mangalore City Corporation (MCC) was the highly denser urban area with a density of 4003 persons per sq. km. Today it is expected to be 4080 per sq. km. The city has a total of 60 wards with a population of around six lakh. Due to these features the solid waste management is a crucial problem today and will become a very crucial issue in the near future when there is a speedy growth in industrial and service activities.

The Health Department under the MCC undertakes the assignment of solid waste management. Waste, which is not collected by MCC, is illegally dumped in the streets and drains and also disposed in nearby areas to the waste generation sector.

The Mangalore Corporation area is having three dump sites for waste disposal. Among these three, Moodushedde dump site is 10 km. away from the city, all types of waste including hospital, industrial, and slaughter house etc, both hazardous and non-hazardous waste are disposed in this dumping site. Table 1 gives details of the MCC.

Nature, Status and Quantification of Wastes Generated

The area coming under the jurisdiction of Mangalore City Corporation produces on an average of 175 tonnes of waste per day including construction debris and street sweeping wastes. Out of which, Mangalore sub-division area generates an average of 146.20 tonnes per day of wastes and Surathkal sub-division area generates wastes of about 28.80 tonnes per day. An excess of five per cent of waste has been calculated to the total amount of waste generated in the corporation limits as a cushion to absorb the future fluctuations. Table 2 provides information on nature and quantification of wastes generated in the MCC area.

In 1999 there were 4, 05,426 household populations in Mangalore City

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TABLE 1: SALIENT FEATURES OF MANGALORE CITY CORPORATION

Population	4,19,306 (as per 2001 census) 4,43,122 (Projected till 2005)
Area	132.45 sq km.
No. of wards	60
No. of corporators	60
Connectivity	Air - 20 km Rail - 01 km Sea - 10 km
Tourist spots	Bengre Sandpits, Sultan bathery, St. Aloysius College Chapel, Thannir Bhavi Beach, Panambur Beach, Pilikula Nisargadhama, Rosario Church.
Fairs and festivals	Kadri Manjunatha Temple Jathra in the month of January, Gokarnanath temple, Mangaladevi temple Jathra during the month of October-November.
Rain fall	An average of 3500 mm.
Temperature	Minimum 17° C and Maximum 37° C
Climate	The town has heavy rain fall in the monsoon month and is characterized by high humidity and temperature.

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

and it generated 225 tonnes of solid waste per day. In 2008 there was 5, 97,112 population in the city, and per day it generated 590 tones of solid waste. In the year of 1999 there was 16,698 slum population in the city which generated 18 tonnes of solid waste per day. In the year of 2008 there were 20,837 slum population in the city generated 22 tonnes of solid waste per day. In 1999 there were 51 hospitals (including nursing homes) which generated seven tonnes of solid waste per day and in 2008 there were 72 estimated hospitals in the Mangalore City area generated approximately 19 tonnes of solid waste per day. In 1999 there were 198 industrial units which generated 15 tonnes of solid waste per day and in 2008 there were 329 industrial

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TABLE 2: ESTIMATION OF WASTES GENERATED PER DAY IN THE CITY
(IN TONNES)

Types	Numbers	Quantity of Wastes generated (kg/day)	Total waste generated
Medium & High income Households (5 Members per household)	55419	1.00	55.419
Low-income Households (5 Members per household)	28192	1.00	28.192
Slum Households (5 Members per household)	4104	1.00	4.104
Shops (Small)	11689	0.30	3.5067
Shops (Large)	5623	0.50	2.812
Garages	711	2.00	1.422
Hostels	116	10.00	1.160
Boarding and Lodging	90	5.00	0.450
Commercial Complexes (Medium & Big)	121	12.00	1.452
Commercial Complexes (small)	121	04.00	0.484
Major Choultries and Temples	61	150.00	9.150
Small Choultries and Temples	30	40.00	1.200
Major institutions	151	5.00	0.755
Hotels(Big)	15	20.00	0.300
Hotels (Medium)	276	10.00	2.760
Hotels (Small)	530	03.00	1.590
Markets (Big)	01	6000.00	6.00
Markets (Medium)	04	2000.00	8.00
Markets (Small)	10	400.00	4.00
Slaughter houses	02	900.00	1.800
Meat shops	139	2.00	0.2750
Construction debris	—	—	1.00
Street Sweeping Waste	—	—	27.266
Total	—	—	163.0977
Additional 5 per cent	—	—	8.155
Total Quantity (in tonnes)	—	—	171.25 - 175.00

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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units in the city generated 35 tonnes of solid waste per day. Table 3 provides clear picture of solid waste generation in the Mangalore City Corporation Area.

TABLE 3: ESTIMATES OF WASTE GENERATION

Year	Population	Waste in tonnes per day
2001	398745	140
2005	440247	162
2010	486068	189
2015	536658	219

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

The Supreme Court committee suggests a per capita waste generation of 220 grams for cities of population less than 0.5 million and 350 grams for cities of population between 0.5 to one million.

- Although the present population of Mangalore is less than 0.5 million, the high education levels and the forward looking lifestyle observed in the city suggests a higher waste generation rate and 350 grams per capita is taken. The waste generation rate for Mangalore based on this is 140 tonnes per day.
- An independent assessment based on the per capita waste generation for different waste estimates taken from the City Corporation has been done. The sum of the products of per capita waste generation and the number of such units for different waste generators gives the total waste generation. This estimate comes out to be 120 tonnes per day.
- The final assessment is based on the actual quantity being collected and transported to the dumpsite. A field assessment for three consecutive days was done and the number of trucks arriving at the dumpsite was counted. The quantity of waste transported for a sample of trucks of different varieties were taken and used for estimating the waste transported. The output of the study was the quantity of wastes transported per day was 115 tonnes in about 31 trucks. The density of the garbage was about 400 kgs per cubic meter.
- Waste like debris removed from the water drains is used in landfills.

From the above four assessments the estimates in b and d are obvious reasonable estimates hence the estimate of 140 tonnes per day is taken as

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generation rate for all further calculations.

From the above assessment of the waste generation the following data on basic design quantities is presented. This has been used for all further design.

- a) Quantity of wastes to be collected and transported for a given year is taken as quantity of waste to be handled with a density assumption of waste to calculate volume requirement of 400 kgs per cubic meter. A 25 per cent additional capacity is provided to accommodate daily and seasonal charges.
- b) Quantity of waste, which has to be composted in the mixed waste system as of 2001, is 140 tonnes the present collection by the MCC. In future as the segregation improves this would be adequate till 2016. In future either improved technology to reduce the days for composting or operating the plant over two or three shifts should take care of the additional load.
- c) Quantity of waste, which would have to landfill at present, would be 50 tonnes per day or about 40 per cent of total waste generation. As the segregation improves and about 50 per cent of the recyclable wastes are actually recycled the waste to landfill would be about 34 tonnes or 25 per cent of the waste generated

Mechanisms of Solid Waste Management Services in the Study Area

Different methods have been involved in the process of the solid waste management services in the city under study. The major steps are as discussed below:

For the collection of waste from street sweeping 1084 bottomless RCC bins have been provided in the city, which are cleaned once a day in the busy commercial areas and in other places once in two days. Pourakarmikas brings the street sweeping in more than 110 handcarts to deposit it in the RCC bins. The waste from the household and other premises brought by the users and deposited in the bins. The hospital waste from 64 hospitals and nursing homes covering about 4000 beds are also deposited in the dustbins.

For the transportation of waste 14 lorries have been deployed each carrying about 3.5 tonnes. The vehicle makes usually two trips per day to the disposal sites. In addition to that three dumper placers are engaged for carrying 51 metal containers to the dumping site. Further some of the hotels and factories transport their wastes directly to the disposal site in their own vehicles. The loading and unloading is done manually.

The solid waste finally disposed off at the dumping site, which is 15 kms away from the city and located at Moodshede. There is walled protection

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for the dumping site only from the main road side, but for this, the site does not have a protection wall all round. Because of this, there is encroachment of site by the locals. Further the Government has allotted some area for the beggar home and a school for dumb and deaf etc. As a result in initial land holding about 900 acres, it has come down to 50 acres. Infectious hospital waste is also disposed off at the same site. The rag pickers also come to the dumping site and collect paper, metal, plastic, glass etc. The vermiculture process of composting of organic waste by a private agency is already functioning at the dumping site for a few years.

There is no house-to-house collection and segregation of waste except in Gandhi Nagar and an endeavour is made for house-to-house collection in Mallikatta area and it is also proposed to extend to other areas depending upon the peoples' participation through the involvement of elected representatives. There is low output and indiscipline among the Paurakarmikas, the Government policies also do not favour to increase the manpower. Thus it would be appropriate to consider doing additional work of collection of waste by contracting out these services.

Primary Collection

- As per MSW Rules 2000, the waste should be collected from door-to-door in residential areas. Waste from bulk generators should be collected separately. In accordance with the State Policy on ISWM, primary collection of solid wastes from the residents are proposed by ensuring the following steps: Both the drain cleaning and street sweeping activity are treated as a single component. Biomedical wastes should not get mixed with the municipal wastes, processing and disposal of bio-medical wastes should be done as per Bio Medical Waste (Management and Handling) Rules, 1998.

Street Sweeping

- For street sweeping Mangalore is divided into three zones:
 - Zone 1:** This zone consists of highly populated areas, traffic areas, commercial and industrial areas, slums and tourist places. This zone is proposed to be swept seven days in a week.
 - Zone 2:** This zone comprises of residential areas having very low commercial activities and traffic. This zone is proposed to be swept twice a week.
 - Zone 3:** This zone is delineated of sparsely populated areas with very less number of households. This zone is proposed to be swept once a week.

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TABLE 4: CLASSIFICATION OF WASTE GENERATORS AND MODE OF PRIMARY COLLECTION

Sl No.	Waste generator	Primary waste collection
1	Residential house holds	
	High income non-slum households	Proposed SHGs/RWAs to collect the waste, the boundaries are demarcated.
	Low income house holds	Total 67 auto tippers, 39 Tricycles and 74 pushcarts are required.
	Slum households	Collections by ULB workers - 30 workers are deployed.
2	Small waste generators	
	Shops, institutions and small hotels	Collection through SHGs.
3	Bulk generators	
	a) Choultries, Hotels and Restaurants b) Markets and Slaughter Houses	a) Collection by the SHGs excluding the wastes from markets, slaughter houses and construction debris. b) Wastes from Markets and Slaughter Houses will be managed by ULB.
4	Road side waste generators	
	Street sweeping, drain cleaning and open area cleaning	670 Km road length is proposed to be outsourced. 36 Km road length will be managed by ULB
	Dead animals	Managed by ULB through task-force team
5	Waste generators (waste not collected by the ULB)	
	Hospitals	Some hospitals are using incinerators for bio medical waste disposal and for some hospitals the wastes are collected by M/s Medicare Incinerators Pvt Ltd, KADBI industrial area, Mulky wherein the wastes are treated in common biomedical waste treatment facility.

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

The scope of work involved in street sweeping is as follows:

- Street sweeping
- Road side drain cleaning
- Cleaning of road Medians
- Removal of road side and drain side vegetation
- Cleaning of silt from drains and roads
- Clearance of litter bins

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TABLE 5: ZONE WISE STREET SWEEPING AND ROADSIDE DRAIN CLEANING FREQUENCY AS PER THE STATE POLICY

Zones	Street Sweeping frequency	Sun	Mon	Tue	Days Wed	Thu	Fri	Sat
1	Daily sweeping	✓	✓	✓	✓	✓	✓	✓
2	Weekly twice sweeping		✓			✓		
3	Weekly Once sweeping		✓					

SOURCE: Office of the City Corporation, Mangalore.

- Open area cleaning
- Transportation of the swept wastes to the landfill site

Door-to-Door Collection

TABLE 6: DOOR-TO-DOOR WASTE COLLECTION FROM HOUSEHOLDS

Zones	Number of households
Zone 1 (Non-slum areas where door-to-door waste collection can be done through auto tipper)	62172
Zone 2 (Non-slum areas where door-to-door waste collection can be done through pushcart and tri cycles)	21439
Zone 3 (slum area using pushcarts)	4104
Total	87,715

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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Non-slum Households Waste Management

a) Auto Tippers

The door-to-door waste collection of segregated waste from residents is proposed in the following way. Auto tipper is proposed for door-to-door collection. One Auto tipper can serve 750 to 1,000 households. Auto tipper is designed in such a way that it can mechanically tip the waste directly into the secondary storage container. The specifications for the vehicles are as per the manual prepared by DMA & KUIDFC, GOK.

Number of households to be served by auto tippers : 83,611 x 0.75
: 62,708.25 ~ 62,709
Number of auto tippers required: 62709/1000 : 62.71 ~ 63* No's.

b) Tricycles

One Tricycle can serve 240 households per day. A tricycle can cover 80 households per trip. One worker is proposed per tricycle.

Number of non-slum house to be served by tricycles : 9,274
Number of tricycles: 9274/240 : 38.64 ~ 39 No's.

c) Pushcart

Pushcart is preferred in the areas where roads are very narrow, congested and highly undulated. One pushcart has four buckets of 40 kg carrying capacity, which can serve 160 households per day. Pushcarts can cover 40 households per trip. One worker is proposed for each pushcart.

Number of households to be served by pushcarts : 12,165
Number of pushcarts: 12165/160 : 76.03 ~ 76 No's.

Vehicles requirements for primary collection:

Auto tipper : 67

Tricycle : 39

Pushcart : 74

Note: 1. ULB will manage the primary collection at slum areas having a household of 4,104 No's. using Pourakarmikas.

Slum Households Waste Management:

Number of households to be served under door-to-door collection system is 4,104.

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TABLE 7: WASTE COLLECTION GROUPS FOR SLUM AREAS

Sl No.	Ward No.	Name of the slum	House holds	No. of Pushcarts Required	No. of Workers Required	Place of Deliverance to Secondary Containers*
1	4	Idya	314	2	2	660L and 1100L (No.5)
2	14	Krishnanagara	207	2	2	C12
3	18	Sujikal	191	1	1	C13
4	18	Anandanagar	186	1	1	C9, C13
5	18	Mullakadu	130	1	1	C13, C17
6	21	Sanjayanagara	286	2	2	C23, C33
7	21	Shakthinagara	303	2	2	C33, C34
8	21	Ashrya Colony	212	2	2	C34
9	21	Yeyadi Gundalike	229	2	2	C33
10	22	Gandakadu	319	2	2	C23
11	24	Nekkilagudda	208	2	2	C20
12	26	Sunkadakatte	192	1	1	C19
13	26	Bapujinagara	198	1	1	C19
14	26	Adarshanagara	209	2	2	C27, C29
15	29	Vivekanagar	232	2	2	C37, C38
16	31	Kadri Darkasgudde	286	2	2	C40
17	57	Jeppu Arakarebailu	189	1	1	C69
18	59	Jeppu bappal	213	2	2	C57, C72
		Total	4104	30	30	

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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Management Plan

Waste collection from the slum households will be carried out by the City Corporation workers using door-to-door collection in slum areas by 30 pourakarmikas.

TABLE 7: DOOR-TO-DOOR WASTE COLLECTION PLAN FOR RESIDENTIAL HOUSES

Sl. no. Details of collection activity in residential areas in morning time for 6 hours	Auto tipper	Tricycle	Pushcart
1 Total time available per day including one hour break, i.e. 6 hrs	360 Min	360 min	360 min
2 Number of houses to be covered in a day	1000	240	160
3 Carrying capacity of the collection vehicle per trip	500-600kgs	80-100 kgs	40-50 kgs
4 Number of houses that can be covered per trip	500 houses	80 houses	40 houses
5 Number of trips per day per vehicle	2 trips	3 trips	4 trips
6 Time required per trip for up and down of collection vehicle to transfer the waste	15 min	20 min	25 min
7 Total time needed for transferring the waste in a day	30 min	60 min	100 min
8 Time required for door-to-door collection in a day	300 min	270 min	230 min
9 Time required for collection of waste from each household	3 minutes for 10 households	9 minutes for 10 households	14 minutes for 10 households
10 Time required for each trip including up and down to the secondary storage container	2 hr 45 min	1 hr 35 min	1 hour
11 Workers required per vehicle	1 worker	1 worker	1 worker

Self Help Groups will collect wet waste from 8.00 am to 2.00 pm daily and dry waste from 12.00 pm to 2.00 pm from residential areas weekly once using door-to-door collection.

Afternoon from 1.00 pm to 6.00 pm, SHGs will collect the waste from the bulk generators excluding markets and slaughter houses.

Source: Office of the City Corporation, Mangalore, Karnataka.

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Thirty pushearts will be provided to each worker at the distinguished areas, so that they will be able to collect the waste from the source. The waste thus collected from the slum will be delivered by the pourakarmikas to the secondary containers as mentioned in Table 7.

Collection Plan

Wet waste will be collected daily from the residential areas in the morning hours, as they are prone to decay. The wet waste generated by the bulk generators will be collected by the primary collection vehicles only in the afternoon hours. On the other, dry waste is proposed to be collected once in a week in the residential area by the respective SHGs between 12.00 pm to 2.00 pm. Each day the collection vehicle will collect dry waste from one area on an alternate basis, thereby covering the whole command area. Retrievers will segregate recyclables out of dry waste after its collection.

Waste Collection from Bulk Generators

Waste collection from bulk generators will be done by SHG's at their particular SWM area allotted to them, excluding markets and slaughter houses. The user charges as approved through council resolution for the bulk generators will be collected by the SHG's. The bulk generators viz., markets and slaughter houses will be managed by the ULB.

Disposal of Construction Debris and Dead Animals

The collection and transportation of the dead animals will be carried out by ULB. One vehicle will be allotted by ULB for this purpose. The owner of the building constructed/demolished will be held responsible for clearance of construction debris generated.

Secondary Storage

In the secondary collection action plan waste is stored at two levels, i.e. (i) Source level (ii) Community level.

Storage at Source

At source level, individuals are expected to maintain two dustbins—one for wet and another for dry waste. The hazardous waste can be stored in cover. It should be given to the collection vehicle. It is the responsibility of every individual to store the waste generated by them separately and deliver the same to the collection vehicles.

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Storage at Community Level

At community level, it is proposed to have container system, which can be carried off to disposal site with the help of secondary transportation vehicles. Secondary storage points can be classified based on the type of area. Each storage location will have one container for wet waste. These containers are placed on a P.C.C platform with proper drainage facility, to avoid any leachate seepages. PCC slab and containers are designed as per the standard specifications provided by DMA. Collection vehicle will tip the waste into respective containers placed in that area.

TABLE 8: ESTIMATION OF WET WASTE GENERATED

Sl. No	Type of wet waste generator	Number	Unit quantity of wet waste generated (kg per day)	Total wet waste generated in a day (kg per day)
1	* Non-slum households	83,611	1.0	83,611.00
2	Slum households	4,104	1.0	4,104
3	Shops(big)	5,623	0.10	562.3
4	Hotels (big)	15	20.00	300.00
	Hotels (medium)	276	10.00	2,760.00
	Hotels (small)	530	03.00	1,590.00
5	Hostels	116	10.00	1,160.00
6	Major Choultries and Temples	61	150.00	9,150.00
7	Small Choultries and Temples	30	40.00	1,200.00
8	Markets (big)	1	6000.00	6,000.00
	Markets(medium)	4	2000.00	8,000.00
	Markets(small)	10	400.00	4,000.00
	Slaughter houses	02	900.00	1,800.00
	Meat shops	139	2.00	278.00
	Lodging and boarding	90	5.00	450.00
	Institutions	151	5.00	755.00
Total wet waste generated in a day				1,25,720.3 kg / 125.723 tonnes

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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Secondary Containers Requirement

(a) Mangalore sub-division:

Total wastes generated : 96.37 TPD*
 No. of bins required : $96.37 \times 1.25 / 1.5 = 80.3$
 3 m³ containers : $80.3/2 = 40.1 \sim 40$ No's.
 4.5 m³ containers : $80.3/2 = 40.1 \sim 40$ No's.

For festival occasions

3 m³ containers : 3 No's.
 4.5 m³ containers : 3 No's.

Number of Twin container dumper placers (with each carrying 3 m³ and 4.5 m³

Containers) required with each vehicle making five trips, say, 8 no's.
 Therefore number of replacement containers required:

3 m³ containers : 8 No's.
 4.5 m³ containers : 8 No's.

Total number of containers required

3 m³ containers : 51 No's.
 4.5 m³ containers : 51 No's.

(b) Surathkal sub-division:

Total waste generated : 19.00 TPD

No. of bins required 1100 L (400kg capacity) : 30 No's x 400kg = 12.0 TPD

No. of bins required 660 L (240 kg capacity) : 20 No's x 240kg = 4.8 TPD

Total number of bins of 1100 L : 30 No's.

Total number of bins of 660 L : 20 No's.

Additional containers required for tourist spots and airport

1100 L: 02 No's

660 L: 16 No's

Total containers required for Surathkal Area:

1100 L : 38 No's.

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660 L : 36 No's.

Existing bins with ULB under KUDCEMP plan:

1100 L : 50 No's

660 L : 60 No's.

Note: Bins in excess (660 L: 24 No's. and 1100 L: 12 No's.)

The 40 containers of 3 m³ capacity and 40 of 4.5m³ can cover only the area of Mangalore sub-division. A total of 20 containers of 660 L and 36 of 1100 L containers are required at Surathkal sub-division. About 16 containers of 660 L and two 1100 L containers are required at the tourist spots, therefore a total of 36 containers of 660 L and 38 of 1100 L capacity containers are required. The details regarding the placement of containers and the respective locations are shown in the Map.

Placement of Litter Bins

The tilting and carrying types of litter bins are proposed and would be located in and around the temple area, market area, commercial areas, bus stop areas, busy streets and public places. Litter bins will be located at an appropriate distance depending upon the field conditions. The 100 L capacity litter bins would be located at a distance of 25 to 500 m as per normative standard. 200 litter bins are required and as on the regular basis the litter bins will be cleared during street sweeping. The clearance of the litter bins should be done at the time of street sweeping.

Collection Methods

House-to-house collection is done in about 30 areas under the control of Nirmalya Samiti. One ward is fully covered for door-to-door collection with auto tripper and start up costs provided by the KUDCEMP project, about 1000 houses are covered. All the other waste generators transfer the waste directly to the bins. The waste from the generator, house-to-house collection and street sweeping gets disposed off to the community bins. About 1600 RCC bins of 8 m³ capacity, 64 bins of 780 litre plastic containers, 54,1190 litre metal containers and 62 containers of 4.5 m³ capacity are there. The dumper placer containers are also used for primary collection of wastes. The total volume of storage is about 1960 m³. The storage volume is about four times the estimate of total volume of waste generated per day in Mangalore.

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TABLE 9: DETAILS OF LOCATION AND QUANTITY OF LITTER BINS

Locations	No. of Litter bins of 100 litre Capacity	Clearance Method	Distance between the Litter bins
Temples, Churches and Mosques	20	During Street Sweeping	Litter bins will be located at an appropriate distance depending upon the field conditions.
Shopping Complexes	35	During Street Sweeping	
Commercial or busy streets	45	During Street Sweeping	
Tourist places	30	During Street Sweeping	
Bus stops	20	During Street Sweeping	
Schools, Colleges and Government Institutions	18	During Street Sweeping	
Markets, Public places	32	During Street Sweeping	
Total	200		

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

Sweeping Pattern

- Sweeping of roads is also done in about 450 km road in residential, markets and commercial areas. The sweeping is done in a single shift from 7 a.m. to 2 p.m. out of this 50 per cent is in the central business district, which is covered by the contract system. The staff absenteeism among the sweepers is about 10 per cent. The standards for sweeping and collection are 0.5 km for high-density roads and one km for low-density roads. The drain cleaning, clearing of vegetation from open areas is also the responsibility of the sweeping staff but this activity is not done daily. It is done before the rainy season or on receipt of complaints. Cleaning of the drainage system is handled by a separate set of contract workers.

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Role of SHGs in SW services in the Study Area

Involving Self Help Groups

Solid waste management is a local issue demanding involvement of community for its effective implementation. As per the State Policy, SHGs should be given the first priority for door-to-door waste collection in residential and commercial areas. Fifty per cent of the amount for purchasing a primary collection vehicle will be provided as subsidy by the City Corporation and the rest of 50 per cent has to be borne by the SHGs, for which SHGs have to raise a bank loan at subsidized rates. The group will enter into an agreement with the City Corporation. Eighty SHGs are required for the primary collection activity for areas coming under jurisdiction of Mangalore City Corporation.

Functions of SHGs

The functions of the SHGs are given below:

- Everyday, door-to-door waste collection from the residential and commercial areas should be done without fail as per the collection route given by the City Corporation.
- Periodic collection of dry waste from the households, i.e. once in a week.
- Transferring the collected wet waste into the secondary storage containers.
- The driver should not mix the wet and dry waste.
- Park the primary collection vehicle in the safe premises as per the City Corporation instructions.
- Prepare the list of defaulters while collecting the user charges and submit the same to the City Corporation for further actions.
- The recyclables should be separated from the dry waste and sold to an identified shop. The amount gained is shared among the group members.
- All the group members should attend awareness programmes conducted by the City Corporation in association with the KUDCEMP and should also motivate others to attend.
- The workers should wear all the protective gear.
- Prepare a list of defaulters who do not segregate waste.

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Conducting Awareness Programme

Regular awareness programmes are essential for effective implementation of the proposed action plan and topics on which awareness campaigns are to be conducted are:

Sl. No	Target groups	Subject
1.	Residents, PKs / Workers Institutions and bulk generators	Awareness on segregation of waste into wet and dry.
2.	SHGs	Proper handling of waste during primary collection
3.	General community	Waste minimization, reduction, reuses and recycle concept.
4.	Residents and waste retrievers	SWM system adopted in the City Corporation.

SOURCE: Office of the Mangalore City Corporation.

Segregation of Waste

The waste has to be segregated into two types:

Wet wastes : Food waste, Paper, & other decomposable / Organic wastes
Dry wastes: Plastics, metal and other non-decomposable / Inorganic waste.
 Households hazardous wastes will be collected separately while collecting dry wastes and dumped safely in the area allotted in the land-fill site.

Segregation of wastes acts as the base for the whole SWM action plan, most of the SWM system fails at this step only. As per MSW Rules 2000, waste should be segregated into organic and inorganic including recyclables. SHGs will be responsible for collection of segregated wastes in their command areas. RWAs should motivate the residents to segregate their waste into wet waste (i.e. organic - mainly kitchen and other decomposable wastes), and dry waste including recyclables (i.e. *metal*, plastic covers, dust from sweeping etc) and household hazardous waste (used battery, paint bottles, used medical and chemical wastes. etc.).

Waste reduction can be done effectively by implementing 3R's principle i.e. REDUCE, REUSE and RECYCLE. City Corporation involving SHGs and NGOs should educate residents about waste minimization using 3R's principle. SHG's/RWA's will be responsible to enforce segregation in their command areas. They should hand over the waste to the collection vehicle, in separate bins storing organic waste, inorganic waste and recyclables.

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Regular awareness programmes should be conducted for the residents educating them of the importance of scientific solid waste management and reminding them of their roles in it (like segregation, willing to pay service charges, etc). As segregation was not in practice earlier, it requires great efforts to change the attitude of the citizens, which is a slow and gradual process. The retrievers will segregate dry waste into recyclables, which will be sold in the market. The remaining refuse will be transported for landfill. The segregation of wastes should be carried-out in a phase-wise manner.

Step wise programmes to attain segregation of waste:

Step 1: Conducting awareness campaigns every month for general public, commercial establishments, institutes, schools and colleges. Awareness should be created regarding the effects of hazardous waste and its proper handling.

- Familiarizing people about the solid waste management system adopted in their ULB. Educating people to be careful while purchasing the goods and other products.
- Training programme for retrievers regarding segregation, proper handling of waste and its hazards due to improper handling.

Step 2:

- The waste collector should inform the supervisor in case, if any household personnels are not following the process of waste segregation. The retriever should inform the residents to hand over the wastes in segregated form only.
- The committee members should approach such residents explaining them of the importance of waste segregation and should encourage them to segregate and deliver it to retrievers only.

Step 3:

- Levy fine on defaulters who do not follow the process of waste segregation.
- Household shall be fined for throwing the waste/litter in open area.

Processing of Waste

Wastes are segregated into organic, recyclable and refuse. As per MSW Rules 2000, waste has to be inertized before disposing it. The processing of the segregated waste is explained below.

Organic Waste / Wet Waste

The best way of processing organic waste is by composting. Composting is a biological process of decomposition carried out under

controlled conditions of ventilation, temperature, moisture with the help of micro-organisms in the waste that converts wastes into humus-like material by acting on the organic portion of the solid waste. Vermi-compost is another type of composting where earthworms are used. The castings of the earthworms are the final product i.e., vermi-compost, which are rich in micronutrients, enzymes, etc. A common site has been identified near Pachanady for compost unit and landfill, located at an average distance of 12 km from MCC.

Inorganic Waste / Dry Waste including recyclables

The inorganic wastes will be transported to scientific landfill site identified at Pachanady located at about an average distance of 12 km from MCC. The waste collector will deposit the recyclables at the identified spots from where the contractor will pick up the useful material. Only the refuse will be transported to the landfill site under the present clearance of the street sweeping system.

TABLE 10: VARIOUS TYPES OF RECYCLABLES

Glass	Unbroken bottles
Metals	Iron, ferrous and non-ferrous components
Plastics	Plastic sheet, piping and plastic bags, cans and bottles
Paper/cardboard	Newspapers and packaging covers like milk covers and cardboard
Rubber /leathers	Old tyres and shoes
Wood	Wooden logs, woody waste from garden

SOURCE: Office of the City Corporation, Mangalore, Karnataka

Management Plan

Treatment of wet waste is done by composting method. A compost plant is developed under ADB assisted KUDCEM project.

Disposal

Disposal of Wastes

As per MSW Rules 2000, guidelines and specifications for development and operation of landfill site are clearly mentioned. Only inert wastes are proposed for disposal in the landfill site near Pachanady.

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Disposal Ways

Wet Waste : Pachanady Sanitary landfill Site - (to & fro 24 km distance from MCC).

Dry Waste : Pachanady Sanitary landfill site
(to & fro 24 km distance from MCC).

Waste from Street-Sweeping: Pachanady landfill site (to & fro 24 km distance from MCC).

Desilted Waste : Low lying areas

Construction debris/waste : Low lying areas and if required to the Pachanady landfill site as cover material.

Transportation of the Solid Waste

The transportation is done by a combination of vehicles of different types and capacities. The waste is being dumped at the landfill site at Vamanjur.

TABLE 11: ACTIVITY CHART FOR SWM IN A DAY

Activities	7.00 to 8.00	8.00 to 8.30	8.30 to 9.00	9.00 to 10.00	10.00 to 11.00	11.00 to 12.00	12.00 to 1.00	1.00 to 2.00	2.00 to 3.00	3.00 to 4.00	4.00 to 5.00	5.00 to 6.00
Street Sweeping												
Door-to-Door Collection (wet waste)												
Door-to-Door Collection (dry waste)												
Collection from bulk generators												
Transportation of wet waste												
Processing and disposal												

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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Institutional Arrangement

TABLE 12: EXISTING STAFF REDEPLOYMENT PLAN FOR ULB'S MANPOWER AS PER PROPOSED SWM PLAN

Sl. No.	Cadre	Total Number deployed	Number of personnel	Deployment
1	Pourakarmikas	Permanent:28 4 +(95 Posts Vacant)	12	Absentees (04 per cent)
			30	Slum work (door to door waste collection)
			06	Works allocated: a. Emergency work b. Open area cleaning c. Removal of encroachments d. Attending complaints e. SWM Task force workers (3 No's)
			13	Cleaners for vehicles
			26	On task works
			173	Malaria works (spraying and canalizing of the drains)
			24	For street sweeping in 2nd division
2	Sanitary Masteries	4 +(10 Posts Vacant)	2	For managing slum household collection
			3	Malaria work and other works
			2	Managing of sweeping, etc.
			2	Secondary transportation
			1	Bulk generators waste collection
			3	Door-to-Door collection
			1	Landfill site and Compost site
3	Drivers	13	02	Dumper placers
			01	Task force vehicles
			01	Compactor
			02	Side Packers
			01	Hitachi Expo - 70
			01	JCB
			05	Market waste collection vehicles along with task force (2 No's of Tipper + 2 No's of Trucks+1 No's of Mini Lorry)

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4	Health Inspector	12	12	Managing the solid waste management system in their concerned wards and reporting the progress of SWM to AHO's
5	Asst. Health officer	3	3	Managing 20 Wards each and reporting the progress of SWM to Environmental Engineers
6	Environmental Engineer	2	2	Managing 30 wards each for overall Solid Waste Management and reporting the progress of SWM to Health Officer Managing Landfill site and Compost Plant.
7	Health officer	1	1	Managing the overall system

SOURCE: Office of the City Corporation, Mangalore, Karnataka

There are five trucks, two trippers, three dumper placer, one compactor and two side packers owned by the municipality. In addition eight trucks are hired on contract and the completely contracted out area has 16 trucks. The total Number of vehicles in use are 34 trucks, three dumper placer, one compactor and three side packers. The dumper placer transfers the waste to large trucks trippers at the Alake transfer station. Typically about 36 trips are made to the disposal site. Each truck making one trip a day. The market wastes are transported in the night. A driver and six loaders, officially, man the vehicles. The C.M.C does not have a workshop and all its vehicles are maintained at private workshops. Table 13 depicts the transportation plan for MCC vehicles.

Outer Service Contracts

The daily sweeping, collection from bins and transportation to the dumpsite at Vamanjur for 37 wards including the market areas is undertaken. The 37 wards are divided among 10 contracts. The total cost of contracting is Rs eight lakh per annum for the city and contracts are renewed every year. The contract is expected to deploy 290 sweeping staff and 16 lorries. The quantity of waste collected and transported by the contractors per day is estimated at 70 tonne. The cost per tonne of the service provided is Rs 534 per tonne of waste. In addition eight lorries with loading staff are taken on contract at a price of Rs 1600 per day for use in areas where the Mangalore Municipality staff does the sweeping.

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TABLE 13: TRANSPORTATION PLAN FOR MCC SWM VEHICLES

Type of Vehicles	Type of Waste carried	No. of containers	No. of Trips / Day	Place of work allocation	Requirement of Workers In Existing System	Requirement of Workers In Proposed System
Twin container Dumper placer						
Dumper Placer A	Wet waste	10 No's.	5		2	2
Dumper Placer B	Wet waste	10 No's.	5		2	2
Dumper Placer C	Wet waste	10 No's.	5		2	2
Dumper Placer D	Wet waste	10 No's.	5		2	2
Dumper Placer E	Wet waste	10 No's.	5		2	2
Dumper Placer F	Wet waste	10 No's.	5		2	2
Dumper Placer G	Wet waste	10 No's.	5		2	2
Dumper Placer H	Wet waste	10 No's.	5		2	2
Existing Vehicles deployment						
Dumper Placer(KA 19 M 9770)	-	-	-	Standby	-	-
Dumper Placer(KA 19 M 9771)	-	-	-	Standby	-	-
Dumper Placer(KA 19 M 9472)	-	-	-	Standby	-	-
Tripper (CNG 4830)	-	-	-	Stand-by	2	2
Tripper (CNG 4728)	Market waste collection	-	-	Mangalore	2	2
Truck(MYG-8479)	Market waste collection	-	-	-	2	2

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Table 13 Contd.

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Truck (NG-4952)	Market waste collection	-	-	Mangalore	2	2
Mini Lorry (KA 19 A 2501)	Street sweeping waste collection	-	-		2	2
Mini Lorry (KA 19 A 1034)	Task Force Work				-	2
Compactor (KA 19 B 62)	Collection of waste from 660 L and 1100 L containers	20 No's.	3	Surathkal sub-division	1	2
Side Packer (KA 19 B 821)	Collection of waste from 660 and 1100 L bins	18 No's.	2	Surathkal sub-division	1	2
Side Packer (KA 19 B 834)	Collection of waste from 660 and 1100 L bins	18 No's.	2	Surathkal sub-division	1	2
Huachi EXPO - 70	Used for leveling at the landfill site, for drain cleaning and for other suitable operations	-	-	Pachanady Landfill site	2	2
JCB	Used at the landfill site, drain cleaning and other operation			Pachanady Landfill site	2	2
Total number of drivers required : 19						
Total number of cleaners required : 19						
Total number of drivers present at ULB : 13						
Total number of cleaners present at ULB : 13						
Source : Office of the City Corporation, Mangalore, Karnataka.						

Disposal System

At present, the dumping site at Vamanjur is used for dumping all the Municipal waste and debris. The Vamanjur dumping site is on top of a hill top and in use for over 30 years. The dumping site has an extent of 15 Ha. The site is being upgraded and compost plant and new landfill sites are also proposed. Two efforts at centrally processing wastes were initiated in Mangalore by M/s Canara Biotech and M/s Blossom bio-cultural. Canara biotech is having a small operation where they are doing a combination of landfill mining and vermin composting operation. Blossom bio-culture has closed down. There are two decentralized composting units operational. All together about 0.5 to one per cent waste is being processed.

Major Problems Confronting the Mechanisms of SWM Services

In recent years in India, most of the ULBs have been experiencing huge expenditure on solid waste disposal with very poor efficiency, pollution due to the burning of waste, unorganized and poorly co-ordinated transportation resulting in excessive fuel usage and pollution generation, loss of reusable/recyclable material due to unsegregated collection, unhygienic conditions leading to public health problems and spread of disease to local as well as global air pollution due to the uncollected and poorly disposed waste, dirty streets and cities failing to attract foreign investments and markets, etc. In the light of these problems, the mechanisms and managing the urban solid waste is gaining importance; and various methods at different stages have been tried in recent years. However, the development of infrastructure facilities and disposal methods have not kept pace with the rate of waste generation, leading to increased pollution and environmental impacts. The increase in the growth of the solid wastes and failure to manage it sustainably, worsened and acts as a major bottleneck for development in particular in a growing densely populated city like Mangalore.

Waste generated by households, commercial establishments and the industry is discharged into street bins and only a few households have door-to-door collection service through the informal or formal sector. In fact, the garbage in bins usually ends up scattered over pavements and roads. Although municipal trucks collect the garbage and finally drop it at disposal sites, large number of rag pickers sort out the garbage. Sometimes items are cleaned and then sold to waste dealers or wholesalers who later supply it to other industries leading to generation of incomes to the people involved.

Although the formal sector in SWM does not recycle or retrieve materials from waste; it is the unorganized sector such as ragpickers in the informal sector who collect waste from house-to-house in certain suburbs and from all public areas in the city. They retrieve valuable materials from street waste

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even before the formal sector begins the work and reduce garbage to organize waste. But this places lesser burden on the formal sector and also brings down the volume of uncontrolled waste, extending the life of landfills. Rag pickers receive only half the price of which the wholesalers sell the materials for in the market or to all-scale industries that in turn benefit monetarily from such intermediary role. Thus, this also points out the amount that the wholesalers acquire for materials and the material composition of the waste, the economic value embodied in what is otherwise referred to as waste benefits. The experiences in the study area show that there is a large difference between urban and rural levels of waste generation, which reflects the economic extremes existing within Indian society. Perhaps, this may be due to the fact that, the larger cities are centres of major economic activity, which are, fostering consumerism among the residents together with increased waste.

Let us briefly place the various problems associated with the mechanisms of SWM services followed in the corporation cities.

(1) Lack of adequate financial support and increasing expenditure on SWM

An important issue in the municipal solid waste management is increasing expenditure on solid waste management. The total cost of the SWM is not expected to change but there would be reduction in contract costs for the Corporation and the savings would be used for the management of the disposal. The door-to-door collection would be incremental but would be collected from the users and consequently does not find mention in the corroboration cost of waste management. It is evident from the following tables (No.14, 15 and 16) the financial burden of MCC in managing the solid waste services. Further, these also indicate the rising trends in the growth of expenditure, which will continue to grow even now.

(2) Low level of segregation of wastes at the doorsteps

There is a lack of door-to-door segregation of wastes at the household level in the study area. This leads to the problem of collection of household waste generated everyday and under the prevailing centralized mechanism naturally households are compelled to throw their household wastes nearby available dumping sites or open throwaway practices causing more health hazards and losing the value of public roads, properties etc..

(3) Lack of sufficient transport mode and manpower

Though both in source and outsource transport facilities are required to dispose the solid waste, in the study area the problem is in both, i.e. inadequate

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TABLE 14: ANNUAL EXPENDITURE OF THE ULB FOR THE PAST THREE YEARS TOWARDS SOLID WASTE MANAGEMENT

Sl. No.	Particulars	Expenditure		
		2002-03	2003-04	2004-05
	Salaries			
	1. Pourakarmikas	20561753.00	17613545.00	19363401.00
	2. Sanitary	1422854.00	1469306.00	2131662.00
	3. Lorry Driver	929450.00	993621.00	934227.00
1.	4. Lorry Cleaners	165787.00	184243.00	187924.00
	5. Sanitary Inspectors	1686327.00	1813491.00	1954333.00
	6. Asst. Health Officer	446147.00	696502.00	370989.00
	7. Environmental Engineer		70000.00	187500.00
	8. Health Officer	292563.00	195437.00	185826.00
2.	Uniform, Gum Boots, Towels, Soaps, Raincoats	498846.00	518392.00	542327.00
3	Spade, pick axes, brooms, baskets etc.,	145580.00	159630.00	142906.00
4	Repairs of existing vehicles	468650.00	531884.00	660840.00
5	Fuel cost	2355000.00	2672750.00	3320760.00
6	Purchase of Dustbins	310908.00	362726.00	259090.00
7	Bleaching powder, Phenyl, insecticides	224080.00	218434.00	189426.00
8	AHO's vehicles expenditure	432000.00	432000.00	432000.00
9	Health Officers vehicles expenditure	162000.00	162000.00	162000.00
10	SWM contractors payments	18852548.00	23152916.00	31497600.00
	Total	4,89,54,493.00	5,12,46,877.00	6,25,24,811.00

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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TABLE 15. ESTIMATED CAPITAL COST FOR THE PROPOSED SWM ACTION PLAN

Sl. No.	Particulars	Qty.	Rate	Amount (Rs.)
A1 Primary Collection				
1	Auto Tipper to SHG's	67	1,25,000.00 (subsidy rate)	83,75,000.00
2	Pushcarts to SHG's	74	3,250.00 (subsidy rate)	2,40,500.00
3	Tri cycles to SHG's	39	7,715.00 (subsidy rate)	3,00,885.00
4	Pushcarts - Slums (ULB)	30	6,500.00	1,95,000.00
5	Litterbins of 100 litres	200	3,320.00	6,64,000.00
Sub-total 1				97,75,385.00
A2 Street sweeping				
	Pushcarts (ULB – 2 nd Division)	24	6,500.00	1,56,000.00
Sub-total 2				1,56,000.00
B Secondary Storage				
1	Container of 3 m ³	51	52,000.00	26,52,000.00
2	Containers of 4.5 m ³	51	60,000.00	30,60,000.00
3	660 litres container bins	60	8,164.00	4,89,840.00
4	1100 litres container bins	50	19,000.00	9,50,000.00
5	Construction of PCC Platforms for placing containers	80	15,000.00	12,00,000.00
Sub-total 3				83,51,840.00
C Secondary Transportation				
1	Twin Container Dumper placers	8	10,50,000.00	84,00,000.00
2	Side Packers	2	13,50,000.00	27,00,000.00
3	Compactor	1	19,82,000.00	19,82,000.00
Sub-total				41,30,82,000.00
D1 Treatment and Landfill				
1	Cost of Sanitary Landfill		9,24,57,397.00	9,24,57,397.00
2	Cost of the Compost Plant		5,28,60,567.00	5,28,60,567.00
Sub-total 5				14,53,17,964.00
D2 Landfill and Compost Plant				
3	Truck	1	6,00,000.00	6,00,000.00
4	Chain Dozers-Hitachi	1	15,00,000.00	15,00,000.00
5	JCB	1	13,34,000.00	13,34,000.00
Sub-total 6				34,34,000.00
Grand Total				18,01,17,189.00

SOURCE: Office of the City Corporation, Mangalore, Karnataka.

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TABLE 16. ESTIMATED ANNUAL RECURRING COST TOWARDS SWM

Sl. No.	Particulars	Total amount (in Rs)
Part A – O and M cost for collection and transportation of waste		
I Salaries of the SWM staff		
A	Pourakarmikas/workers	2,15,36,040.00
B	Drivers and cleaners	14,10,972.00
C	Supervisors/Sanitary Mastries (14 Mastries)	13,08,936.00
D	Sanitary Inspectors (12 Inspectors)	18,94,188.00
E	Assistant Health Officers (3 AHOs)	5,54,004.00
F	Environmental Engineers (2 Engineers)	2,57,040.00
G	Health Officer	2,14,656.00
Sub-Total 1		2,71,75,836.00
2	Maintenance cost of official vehicles of ULB	9,06,000.00
3	Maintenance cost of vehicles of SWM	
A	O & M of Existing vehicles ¹	18,30,640.00
B	Pushcarts @ 10 per cent of the cost of equipment (30 + 24)	35,100.00
C	O & M of Secondary Transportation ²	
a)	Twin Container Dumper Placers (8 No's.)	89,27,328.00
b)	Side Packers (2 No's.)	9,67,140.00
c)	Compactor (1 No.)	7,46,330.04
Sub-Total 2 & 3		1,34,12,538.04
4	Contracts	
A	Street Sweeping ³	1,30,04,961.90
5	Purchase, bleaching powder etc.	2,15,000.00
6	Purchase of uniforms for pourakarmikas (apart from street sweepers)	2,60,000.00
Sub Total 4, 5 & 6		1,34,79,961.90
Part B – O & M cost for Processing and Disposal site		
7	Tipping cost of the Sanitary Landfill @ Rs. 250.00 per Tonne's ⁴	1,57,50,000.00
Sub Total 7		1,57,50,000.00

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Part C – Purchase of tools and equipments

8 Equipments required for Street Sweeping in 2 nd Division (ULB managed 36 Km)	
A Long handled Broom	15,840.00
B Metal Scraper	2,400.00
C Metal Tray	7,200.00
D Ghamela	7,200.00
E Hand Gloves	1,200.00
F Rain Coats	8,400.00
G Gum Boots	7,200.00
H Uniforms	24,000.00
I Face Masks	2,400.00
J Spades	2,400.00
k Pick Axe	2,880.00
Sub Total 8	81,120.00
Grand Total	6,98,99,455.94

Source: Office of the City Corporation, Mangalore, Karnataka.

vehicles and labour. This is because, the city growth in the study area is not properly planned which finds it very difficult to exactly arrange the transport as well required waste clearing equipment due to lack of technology development in this regard. Similarly, since the wages paid to the labourers are very low and lack of skills to process waste separation etc. there is delay in waste disposing process daily.

(4) Pricing and Cost recovery towards the SWMs

There is a lack of efficient methods of recycling of sewage water which flows from commercial /industrial units of the city. Obviously, the ULB's administration finds it difficult to deliver the black water (contaminated dirty water) released from big commercial and industrial establishments. On the other hand the question still emerges whether the polluter has to pay or not and whether they have to pay the cess or fees to clean the solid waste generated and thrown open to the streets by the households. Further the effect of the diseases like plague, malaria etc. also calls for the need to spend a sizable amount of money on health care maintenance schemes including anti-malaria mosquito controlling devices. Thus in this regard, is the Municipality or city

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administrators are required to take care of such health hazards then the local governments has to generate or has to get sufficient capital even from the state governments to overcome the diseases like diarrhoea, plague etc which are likely to spread due to water contamination or polluted water used for drinking purposes. Thus on the whole, the pricing of the solid waste services and the recovery of the investment parts remain to be a practical investment burden for the urban city administration in most of capital deficient municipalities.

(5) Absence of proper laws on plastics uses

There should be a legal support for recycling of solid and liquid form of waste generated by the households, commercial units, industrial units, and hospitals. If wastes are thrown open to the street it results in spreading of viral diseases, causing the households to spend more on health maintenances. The Mangalore City Corporation needs efforts to make aware among the households the adverse impact of throwing of plastics and other plastic products into the open road space and also public places. Most often the wastes are mixed with different types of non-digestible components of wastes (plastics, bottles, needles etc) and because of this nature of raw waste, it also will be difficult to convert such wastes into the compost manure. Hospitals located in Mangalore City Corporation are not responsible enough when they are disposing the sewerage and solid waste of hospitals. The waste generated by the hospitals are mixed with disposable needles, plastics, bottles, plasters, wrappers, waste cotton etc. Further, some of them are also not digestible in the soil and without separating such raw waste it is not possible to extract its economic value of use; which calls for the need to create awareness among the waste generators. Hence, there is a need of implementing proper technology to separate different types of solid waste and liquid waste from raw waste and make it fit for use as compost manure. But there is a complex engineering work and technological skill lie behind this process of making waste into compost manure. Mangalore City Corporation is lacking such technological skill and equipments and therefore there is a need to put effort in such directions. There is also a high possibility of it effecting negatively to the productivity of agriculture sector. The liquid waste generated by the commercial/industrial units and hospitals, mixed with the fresh water results in water borne diseases. Irresponsible delivery of liquid waste by the commercial/industrial units and hospitals is responsible for environmental hazards and serious negative impact on health. Thus, from the point of view of this there is a need to build environmental awareness among the people of Mangalore City Corporation to minimize the environmental hazards.

Written by Administrator

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CONCLUSION

The present study has examined a few problems and the mechanisms of the solid waste management services in the Indian growing corporation city area like Mangalore. The study has pointed out that due to increase in waste generation in various sectors, the MCC officials find it very difficult to manage it efficiently at various stages in particular at the disposal sites. Interestingly, the waste generated in the city area shifted to a far away rural residential place leading to wide protests by the local residents. Importantly, the management of hospital wastes still remains as a recent factor in the hands of MCC officials. Thus, though a sincere effort has been made to interact with MCC officials, NGOs, local resident associations the environmentalist's organizations in the region and above all the rural based local residents who are affected by the open-waste dumping.

As this study points out there is no question that waste management in cities needs to radically change from current practices, but it has to be addressed with proper capital supply and manpower. The new rules signify a movement in the right direction; however, the implementation and enforcement of these rules will determine their success. The collection of municipal solid waste needs to ensure that piles of garbage do not litter the cities and towns in Indian cities. Waste reduction is a worthy goal, and several cities in India are attempting to reduce the amount of non biodegradable waste by banning plastic bags. However, in the absence of any fees for garbage collection, there are few monetary incentives for waste reduction. The absence of tipping fees at landfills further exacerbates the problem. There are concerns that tipping fees would encourage improper disposal with waste haulers dumping at locations other than the landfills. Penalties in the form of fines may discourage such practices.

Further, the plans for increased recycling have to include the rag pickers in the informal sector. While the rules dictate that working conditions have to be improved for workers recycling material, they also state that rag pickers may not be allowed into the new landfills. Household recycling may take many years to take place, and facilities must be developed close to the landfill for sorting before disposal to ensure that millions of rag pickers do not lose their livelihood and that recyclables are not disposed off in landfills. Thus, an efficient solid waste management mechanism should integrate the dimensions like stakeholders, NGOs, the private sector agents and the factors and system elements for effective results in management of solid waste in urban cities in particular, the highly growing cities.

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