

# Kolkata Municipal Corporation PROJECT MANAGEMENT UNIT KOLKATA ENVIRONMENTAL IMPROVEMENT PROJECT

## MASTER PLAN ON SOLID WASTE MANAGEMENT



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DHI WATER & ENVIRONMENT



## 1.0 INTRODUCTION

### 1.1 Project Background

The Govt. of India signed a loan agreement with the Asian Development Bank (ADB) to assist the Govt. of West Bengal (GoWB) for implementation of Kolkata Environmental Improvement Project (KEIP) at an estimated cost of US \$ 220 millions. KEIP is basically an urban infrastructure investment programme with the obvious and major thrust in improving the basic urban services in Kolkata Municipal Corporation (KMC) area, protect the environment from advance development impact and help to develop KMC as a proficient and autonomous municipal corporation. The project has six components – Stakeholder Consultative Process, Sewerage and Drainage improvement, Slum improvement, Solid Waste Management, Canal improvement, Improvement of lakes/ parks/ water bodies and Capacity building. It has been decided that the project scheduled to be implemented over a period of 5 years commencing from September 2002. Kolkata Municipal Corporation and Irrigation Department of GoWB are responsible as the executing cum implementing agencies. To assist KMC in implementing the project, Project Monitoring Consultants (PMC), Design and Supervision Consultants (DSC) for detailed Engineering and Supervision over construction, NGO Consultants and Public Relation Consultants are appointed. One of the important components covered under KEIP is Solid Waste Management (SWM). The total amount allocated for SWM is Rs. 600 Millions.

### 1.2 Scope of the Work

The purpose of this SWM master plan is to act as a guideline to improve and raise substantially the present level of collection, transportation and disposal system of Municipal Solid Waste by following the guidelines and practices recommended in “MSW Rules 2000” notified in the Gazette of Government of India by the Ministry of Environmental and Forest.

The important steps in formulation of MSW Master Plan are as under,

- Recognizing the key problems that exist
- Collecting and analysing data
- Addressing the existing situation in light of the analysed data
- Suggested action to correct the problems
- Assessing future need and evolving suitable strategy for implementation with respect to time frame
- Recommended solution and action plan
- Possibility of private sector participation in setting up, operation and management of compost Plant and Controlled/Sanitary landfill as also in sweeping, collection and transportation arrangement in certain area.
- Community participation and publicity campaign for waste segregation, house-to-house collection and waste minimization programme.

- Recommendation for institutional strengthening
- Projection of operation and maintenance cost and revenue/resource generation to sustain improved system
- Implementation schedule and performance evaluation.

### 1.3 City of Kolkata

Kolkata is one of the four metropolitan cities of India and is the capital of the state of west Bengal. The city is centered on latitude 22° 34' North and longitude 88° 24' East. Elevation ranges from 1.5 to 9.0 m above sea level. The river Hugly is the principal waterway and forms the western boundary of Kolkata, however, the natural drainage of the KMC area is away from the river, to the east and south. The region contains numerous low-lying areas, marshes, wetlands, and shallow lakes or jheels. The KMC area comprising about 187 km<sup>2</sup>, having population of 45, 80,544 as per the 2001 census and has a density of 24429 per sq.km. The day population inclusive of floating population is close to 8 million. The city is divided into 15 boroughs and 141 electoral wards. Quaternary sediments consisting of clay, silt and various grades of sand gravel and pebbles underlie the city. The climate of Kolkata is hot and humid. Average temperature ranges between 15° C and 35° C. Relative Humidity varies between 85 percent in August and 68 per cent in March. On an average, the city receives 1650-mm rainfall annually.

## 2.0 SOLID WASTE GENERATION, PRIMARY COLLECTION and SEGREGATION of WASTE

### 2.1 Municipal Solid waste Generation

Field survey was carried out in the year 2003 under KEIP to assess the status of MSW generation in each of the 15 boroughs on the basis of waste collection from various collection points. The rate of waste generation varies from 623.97 gpcd (borough – VII) to 1235.97 gpcd (borough V) in Borough I to IX classified as Cluster – I. The rate of waste generation from borough X to XV, classified as Cluster II, is found to be varying from 262.80 gpcd (borough- XII) to 523.91 gpcd (borough – X). The average commercial waste generation is about 365-g/shop/day. The average generation of market waste is around 250g/shop/day. In borough, I to IX the average generation of waste was 2310 MT/ day (790 gpcd) in the year 2003. The household waste generation is 790 MT/day i.e. 270 gpcd, sweeping waste: 527 MT/day i.e 180 gpcd, Institutional waste: 146 MT/day i.e. 50 gpcd and commercial and market activities including floating population: 847MT/day i.e. 290 gpcd. In the year 2003, from borough X to XV average waste generation from all sources assessed as 609 MT/day i.e. 360 gpcd. It is estimated that in 2003 total waste generation within the KMC was 2920 MT/day i.e. 632 gpcd. It is further noted that waste generated by resident population, sweeping and institution activities in Cluster I is 500 gpcd. In Indian conditions this indicated that the generation of garbage has already reached a saturation level and no further increase is anticipated. In case of Cluster II, the business and commercial activities are primarily for consumption of the resident population of this Cluster and thus does not attract considerable floating population from outside the Cluster. Present average rate of generation of waste is around 360 gpcd. It has been considered that with the development of infrastructure and growth of population, an average generation rate of MSW in Cluster II would increase from 360 gpcd to 400

gpcd by 2007 and to 500 gpcd by 2017. It is calculated that projected generation of waste will be 2970 MT/day in 2005 and which would be increase to 3465 MT/day in 2035.

A weighted average shows that around 25.3% (w/w) of MSW is made up of such recyclable waste out of the total solid waste being generated in the households. Commercial establishments generate about 51.0% (w/w) of recyclable waste out of the total solid waste generated by them. In both the cases paper is the major recyclable component, followed by plastic and Polythene. Therefore, there is large potentiality of recovery of recyclable waste from the mixed municipal solid waste. Projected generation of recyclable waste (which is to be segregated) will be 636 MT/day in 2005, 899 MT/day in 2015, 924 MT/day in 2025 and 942 MT/day in 2035.

## 2.2. Existing and Proposed Primary Collection System

There are about 10,300 conservancy mazdoor (sweepers) employed to sweep major roads of about 1850 kms, to clean open drains and waste collection from houses/buildings. For SWM service each ward is divided into 7 to 10 blocks and each block is provided with 8 – 10 sweepers. Each sweeper is provided a handcart or tricycle (altogether 6750 nos presently available), a broom and a scrapper to sweep the roads, lane & bye lanes, to clean open drain, collect the waste, load it into the handcart and transfer the same to secondary collection point in form of open vat or Dumper Placer container. Containerized handcart having 4 buckets of 40 to 50 litres has been introduced in some wards to transfer the waste collected into containers (4.5 m<sup>3</sup> & 7.0 m<sup>3</sup>). Sometime the waste is directly loaded into vehicles (Direct Loading system) by handcart buckets avoiding double handling of waste.

There is some deficiency in primary collection system, which are summarized below.

- Sweeping and collection in core city area (Borough I to X) is done regularly and fairly well but sweeping and collection in added area (Borough XI to XV) is neither on daily basis nor regularly. Though sweeping and collection in core/ old city is done regularly, householders particularly in slum, low-income group and middle- income group as also the shopkeepers throw the waste on streets, roads, open space or open drain after collection hours.
- Above 60 % of primary collection and storage is in the form of open vats, which develop unhygienic condition, foul smell and odour, proliferation of flies, and other diseased vectors. A large number of bulk containers and vats with dwarf wall around are in very bad shape needing repair or replacement. In some cases wall of the vat get damaged due to operation of Pay Loader.
- Conservancy Mazdoor are not distributed to each ward and block on any fixed norm basis but on ad-hoc basis resulting in uneven distribution of work and poor average productivity.
- Sweeping and household waste are collected in the handcarts, transfer and unloaded on ground at open vats and again manually lifted the load into the vehicles resulting in loss of productivity.

- Presently containerized handcarts are not used, resulting in double handling of waste and loss of productivity. The handcarts do not have bush or ball bearing resulting in extra effort and loss of productivity

Based on Statutory Requirement specified in MSW Rules, 2000 and ADB's recommendation, the following action plan and recommendation are given below.

- Stakeholder awareness, segregation of waste at source and door to door collection
- Replacement of open vat and optimization of collection points and shifting of collection point from congested area based on the field study and detailed consultation with SWM officers and municipal councilors
- Replacement of existing handcart by containerized handcart to avoid double handling and less manpower/ productivity
- Open vats to be converted into closed body containers or direct loading. Where open vats can not be totally eliminated, the same shall be kept clean after waste collection by providing screen wall and gate and posting vat attendant
- KMC shall notify waste collection time to avoid littering of waste
- To introduce penal charges for throwing waste on roads, street, or in open drain
- Bio-medical and Industrial waste not allowed to be mixed with MSW and KMC to take stringent action against the defaulters
- Debris, silt and construction/ demolition waste to be stacked separately and transferred to landfill site and use as cover material
- Introduce Mechanical Sweeper for sweeping VIP areas to begin with and increasing gradually in the area suitable for mechanical sweeping
- To fix sweeping norms for different type of area according to population, commercial activity, type and length of road and reallocate the staff in each block and ward as per revised norms developed. The surplus staff resulted on account of reallocation of staff as per norms developed, introduction of house to house collection through NGOs and mechanical sweeping as also due to introduction of containerized handcart and Dumper Placer (reduction of loader Mazdoors), should be transferred to other boroughs where Conservancy Mazdoor strength is low and sweeping & collection services are poor (mainly the added areas)
- To introduce superimposed inspection and monitoring system. Inspection and Monitoring Forms to be filled up for Sub-overseer, Overseers and Conservancy Supervisors to assess performance of sweepers and supervisors and to take corrective action by Assistant Director to improve overall performance of sweepers

The primary collection models as developed and considered are given below:

- i. Collection of mixed bio-degradable and recyclable waste into containerized handcart by KMC sweepers and transferred to collection points. Debris and silts to be stacked separately and loaded directly to vehicles.
- ii. Collection of mixed waste from residential area (households) in a containerized handcart by municipal sweeper and transferring to bulk container, open vat or directly loaded to vehicle. Hotel, restaurant and market waste to be collected separately from the source into vehicles and transported to compost plant site. Commercial waste to be collected by NGOs by their own handcart/ tricycle, carried to their godown for sorting and selling for recycling. Debris and silt to be stacked separately on road and collected by KMC vehicles transported to landfill.
- iii. To introduce segregation of waste at sources. Segregated bio-degradable waste from households, hotels and restaurants to be collected by KMC from house to house, transferred to community bins in a containerized handcart and transporting onward to compost plant. Segregated recyclable waste from residential and commercial areas as also from institutions to be collected by NGOs from house to house twice in a week for sorting and transporting onward to bulk trader or industry directly. Debris, silt etc. to be stacked separately on roads by the citizen and collected directly into vehicles by KMC.

Model (c) is recommended to be implemented in a phased manner within 5 years. Till such time model (c) is fully implemented, model (b) is recommended to be adapted for borough I to X and model (a) for added areas (borough XI to XV).

As per proposed collection model projected requirement of primary collection equipment like containerized handcart and tricycle, litter bins have been worked out. It is noted that as per waste generation the requirement of handcarts, tricycle and litterbins will be 9357 nos., 580 nos. and 15134 nos respectively. After implementation of recyclable waste segregation programme requirement of handcart and tricycles will be less. The detailed survey shows that total service road and streets within KMC area is approx. 3275 km. Based on density of population, service road length and command area of collection point realistic requirement of sweeper will be 11121 instead of 10300. Ward wise proper distribution of sweeper and other manpower is recommended. The estimated cost for procurement of about 70% of the total requirement of primary collection equipment (under KEIP) is Rs 48.15 million.

### 3.0 ASSESSMENT of MUNICIPAL SOLID WASTE QUALITY

Physical and chemical analysis of household waste, market waste, commercial and hotel and restaurant waste have been carried out. Domestic municipal solid waste samples contain 45.1% fruit and vegetable waste part

followed by 8.8% paper. Average density of solid waste is around 400 kg/m<sup>3</sup>. Waste from market contains 32.4% leaves, hay and straws, followed by 25.7% fruits and vegetable waste. Waste from the commercial area contains about 51% recyclable waste. Recyclable waste percentage in domestic waste comes out to around 25%. Chemical properties of the waste indicate that C/N ratio is the maximum (22.0) in market waste and minimum (9.3) in hotel waste. Average moisture level in city waste is around 60 %. Average Calorific value from all source of waste is 1832 K Cal/kg. Heavy metals like lead, chromium, zinc, copper and nickel are present in solid waste sample.

## 4.0 SECONDARY COLLECTION & TRANSPORTATION SYSTEM

### 4.1 Existing Situation

Presently mixed waste (bio-degradable and recyclable) are collected from residential, commercial and market area and brought to secondary collection points which are in form of 4.5 m<sup>3</sup> and 7.0 m<sup>3</sup> capacity bulk containers or open vats. There are about 664 such collection points of which about 388 i.e. 58 % are open vats and the rest (42%) are in form of bulk containers or direct loading. About 55 % (i.e. about 1450 MT/day) of the total collected waste (amounting to about 2700 MT per day) is transported from collection point by Private agency. They make about 260 trips carrying on an average about 5.5 MT/ trip. The remaining 45 % of the collected waste, i.e. about 1250 MT is transported by municipal vehicles, making about 330 trips carrying on an average about 3.5- 4 MT / trips. The vehicles used by KMC are tipper trucks of 6 – 8 m<sup>3</sup> and 10 – 12 m<sup>3</sup> capacity (manually and mechanically loaded) and Dumper Placer of 4.5 m<sup>3</sup> and 7.0 m<sup>3</sup> capacities. Around 40% (550 MT) of the total waste collected by KMC is transported by Dumper Placer and the rest by tipper trucks. About 70 % of the municipal vehicles are more than 8 years old. Cost of transportation by Private agency is about Rs 150/ MT for manual loading from open vat, whereas the cost of direct loading is Rs 750/ trip carrying 3 to 4 MT, which works out about Rs 215 / MT. As regards transport by Municipal vehicles, the average cost of transport is about Rs 300/ MT. The operating cost per ton waste is found to be low/ economical in case of 10 m<sup>3</sup> tipper truck with mechanical loading and 7.5 m<sup>3</sup> dumper placers whereas cost of transportation by 5 m<sup>3</sup> tipper trucks manually loaded and 4.5 m<sup>3</sup> dumper placers are higher, rather non economical. There are 11 garages and workshop deploying about 450 staff for servicing, repairs and maintenance of about 400 vehicles including jeep, breakdown van, water tanker, bulldozer etc. Total numbers of conservancy vehicles transporting/ helping in collection of Municipal Solid Waste such as trucks, tipper trucks, dumper placer vehicles, tractor trailer, refuse collector, pay loader etc. are about 245, of which about 180 are in working condition. Out of these 180 vehicles in working condition, on an average 120 – 130 vehicles are presently operated daily.

### 4.2 Deficiencies in the Present Collection and Transportation System

- About 58 - 60% of collection points are in the form of open vat and the waste is lifted daily. In case of Dumper Placer container points, all containers are not cleared on day-to-day basis. More than 30% of the containers are lifted twice in a week to once in a week creating there by unhygienic condition and inviting public complaints. This is partly due to shortage of Dumper Placer vehicles. Moreover, 70% of KMC

vehicles are more than 8 years old. Out of about 245 conservancy vehicles about 180 nos. are in working condition, and of which 120 to 130 vehicles are operated daily. The operational efficiency is less than 50%.

- Total numbers of loader mazdoors deployed are above 1000. Considering the fact that about 50% waste is transported by private contractors with their mazdoors, about 25 % of the waste is transported by Dumper placer (which needs only one mazdoor) and bigger tippers are loaded with front-end loaders, the strength of loaders mazdoors engaged by KMC is more than twice the requirement. Also average O&M cost (excluding depreciation and interest on capital) of KMC vehicle is about Rs. 300/- per ton as against Rs. 150/- per ton by private vehicles. The cost of transportation by manual loading and house-to-house collection is Rs. 450/- per ton and Rs. 1300/- per ton which is too high.

### 4.3 Strategy and Action Plan for Improvement of Secondary Transportation System

With a view to suggest improvements in collection and transportation system fulfilling the requirements laid down under MSW Rules, 2000, the existing system and available data (secondary) were reviewed and required primary data generated and action plan has been developed. A detailed survey of about 664 collection points is made to assess waste generation and collection of waste at each point, feasibility of converting open vats into closed body containers and feasibility of providing direct loading of collected waste into vehicle (without providing open vat or close container) wherever it is not possible to locate vat/container due to space restriction or traffic problem and optimizing the number of collection points. A further survey in consultation with conservancy staff and local councilors is also carried out to shift or provide new collection points. Based on this detailed survey, detailed interaction and consultation with the Municipal Councilors and SWM officers, the number of collection points, and waste generation borough wise are finalized. As per the proposed plan overall increase of container point and direct loading point will be from 35% to 57% and 7 % to 31% respectively, while decrease in open vat will be from 58 % to 12%. In order to assess more accurately the waste generation at collection point and development of selection criteria for conversion of present collection system to proposed system ward wise land use map has been prepared and studied in detail. For optimization of vehicle utilization and transport cost, route planning from each collection point to waste disposal site is developed.

Based on projected waste generation, implementation of segregation plan, considering 25% standby vehicles vehicle requirements are worked out upto year 2035. As per the proposed plan in the year 2005 requirement of DP will be 143 nos, Tipper truck 29 nos. and private vehicles 297 nos. In case of 60 % privatization for collection and transportation of Solid Waste (including silt and debris) the requirement of private vehicle will be 369 nos. and KMC vehicles 136 nos. Number of vehicles increased for Option- II (60% privatization) due to increase in number of Direct Loading vehicles operated by private agency. Manpower requirements for secondary collection and transportation of Municipal Solid waste is worked out. For 45-50% private collection requirement of loader mazdoor and driver will be 409 and 321 respectively. For Option- II (more privatization and use of modernized vehicles and equipment) of transportation about 65 drivers and 135-loader mazdoor become excess in compare to 45-50% privatization in transportation. Presently KMC is having 450 repair staff plus 56 administrative staff and 22 Senior



Supervisory/ Managerial Staff i.e. 528 nos. Based on 60 % privatization and introduction of some modern vehicles like compactor and mechanical sweeper in present fleet of vehicles is assessed. With 60% privatization, about 920 staff associated with waste transport operation would become surplus.

#### 4.4 Costing – Secondary Collection and Transportation

As decided, under Package I procurement of KEIP, the vehicles like Dumper Placer with container, Wheel type Payloader with EURO II standard are being purchased. The cost of the vehicles is Rupees 115.78 Million. Based on the type and locations of secondary collection points and the collection plan for all the boroughs approved by KMC, considering vehicles procured under Package I procurement plan of KEIP and assuming vehicles <7 years old to be retained, the requirement of vehicles for the 5<sup>th</sup> year of planning horizon i.e. upto the year 2010 are works out for procurement under the Package II procurement. The cost of vehicle to be procured under Package - II procurement plan of KEIP is worked out to Rs. 115.1 Million. In case of Option - II transportation plan (60 % privatization) estimated cost of vehicles to be purchased under KEIP Package – II would be 96.5 Million. O & M cost of the proposed secondary collection and transportation system is worked out to be Rs 258.9 Million. O & M cost of the proposed secondary collection for Option – II (60 % privatization in transportation) worked out to be Rs 262.33 Million. To monitor the overall performance of the secondary collection and transportation system, reporting and review system is proposed.

### 5.0 SOLID WASTE TREATMENT and DISPOSAL SYSTEM

#### 5.1 Present Status

More than 95% of total waste generated in KMC area is disposed at Dhapa landfill site and the rest at Garden Reach dumping ground. It can be seen from the survey that about 21.5 Ha of land under zone – III is developed upto 17 m height (13 m above road level) and very small area is now available for waste disposal. Remaining areas are occupied by shallow water bodies or man made channels (used for cultivation and pisciculture), vegetable cultivation, composting, slum clusters etc. The present method of waste disposal can not be called as sanitary or controlled landfilling because neither the waste is placed systematically nor covered with earth and compacted in thin layers of 200 to 400 mm. There is no control on entry of rag pickers who carries out rag picking in haphazard and hazardous way. The leachate generated is also neither collected properly nor treated before being discharged into Water bodies. Recent analysis carried out on samples of aged/old waste collected from Dhapa site shows the presence of heavy metals namely lead, cadmium, chromium, copper, zinc and nickel. Garden Reach site is having an area of about 8 Ha. Presently Borough XV disposes of 10 – 15 MT of waste per day. Apart from MSW, dead animal and slaughter house waste is also dumped. The approach road is very bad and needs to be widened and reconstructed. The plot is also encroached by unauthorized huts & cattle sheds.

700 TPD compost plant is set up by M/S. Eastern Organic Fertilizer Ltd. with technical back up of Excel Industry, Mumbai. Plant was set up and commissioned in the year 2000 and operated at 200 – 250 TPD capacity till 2003.

Since 2003 Eastern Organic Fertilizer has stopped operating the plant because they are unable to sell the compost with reasonable profit margin and failed to meet their commitments towards KMC.

## 5.2 Deficiencies in the Present Disposal System

- Maximum balanced life of Dhapa is less than a year if the land presently used by cultivators is not taken over and developed for Engineering Landfill (ELF). Garden Reach site has balanced life about 15 years if the site used to develop for disposal of waste generated in borough XIV and XV. The waste disposal is presently done in a crude, haphazard and most unhygienic fashion and the site needs to be developed & operated following the guidelines provided under MSW Rules, 2000 issued by GOI, MoEF
- The method of operation of Dhapa waste disposal site is also uncontrolled without providing earth cover, liner and leachate collection and treatment.
- Mechanized compost plant of 700 TPD capacity set up by Excel Industry is not operated since 2003 due to the problem of marketing of the compost and non-viability of economic operation of the plant.
- Rag picking carried out at Dhapa site for recycling and reuse of recyclable waste is most unorganized, hazardous and unhygienic way, affecting seriously the health and safety of rag pickers.

## 5.3 Processing and Treatment Options for Disposal of Solid waste

Treatability for the processing of solid waste depends on the Physico-chemical characteristics of the waste. Due to nutrient value of organic matter, percentage of biodegradable component in MSW is the most important factor influencing the treatability. Municipal Solid Waste collected from household, market and commercial areas is analyzed recently and the results show that that the waste contains large quantity (48.6%) of biodegradable components and hence is suitable for composting. Further it also contains large quantity of inert matters and sizeable quantity recyclable matter. If silt and debris are not mixed with household and market waste and segregation of recyclable and biodegradable waste at source is adopted, the composting can be carried out efficiently and economically and the waste going to landfill can be reduced by 25 to 30% and life of the landfill site at Dhapa can be extended saving there by a huge investment on land acquisition.

The biodegradable waste can be processed by aerobic composting, vermi -composting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. It should not be sent directly for disposal. Regarding municipal solid waste to energy, it should be either thermally treated or biologically treated. The other options are Pyrolysis and Plazma technology which are not cost effective. A short description of methods of treatment like aerobic composting, incineration, pelletization, bio-methanation , Pyrolysis and plazma and processing technologies with their merits and demerits, overall review of technologies adopted in India and feedback on their performance are discussed in Chapter 6. In view of the above scenario, we are left with the following two technologies which are more suitable for treatment and disposal of MSW generated in KMC area.

1. Aerobic composting (manual vemicomposting at decentralized level or mechanized at centralized level)

2. Sanitary (Engineered) landfill at decentralized or centralized location

Both these technologies are the least cost and economically viable if segregation of waste into biodegradable and recyclable components at source is adopted and inert matters like silt, debris and sweepings are not mixed with household and market waste.

#### 5.4 Recommendations for Treatment and Disposal of MSW Collected by KMC

- Vigorous campaign for public awareness, segregation of waste and placing biodegradable waste into community bin. Segregation of waste into recyclable and biodegradable waste at source to be introduced particularly in major markets, hotels, restaurants & catering houses, marriage/ceremony halls, housing colonies/ complexes and high income group areas to begin with and extending to other areas and to entire KMC area in next 3 to 4 years.
- Initiate dialogue with M/S Eastern Organic Fertilizer, the BOT operator of compost plant at Dhapa to restart the plant and increase uptake upto 700 MT within a year time.
- Silt, debris and sweeping not to be mixed with household and market waste and to be stacked, collected and transported separately to the disposal site for using as cover material.
- To develop about 113 Ha of land covered under zone I to II belonging to KMC but presently used for vegetable cultivation by initiating discussion with the cultivators for Engineered landfilling following the guidelines incorporated in Municipal Solid Waste (Handling and Management) Rules, 2000 issued by MoEF, G.O.I. To provide leachate treatment facility in form of waste stabilization pond. Active landfill will be developed in 58 ha area and upto the height of 16 m with 1(V): 7.5 (H) slope and would have life of 20 years. The proposed landfill of Dhapa may be further increased by 6 m i.e. upto 22 m giving benching at every 2 m and life of landfill increased by about 4 years but would involve skilled operation and further higher cost. Preliminary Cost Estimate for Development of the Proposed ELF at Dhapa is Rs 360 Million approx.
- Till such time segregation of waste at source is implemented and the existing compost plant is revived, mixed (unsegregated waste) should be brought to sanitary landfill site at Dhapa.
- To upgrade the present waste disposal site at Garden Reach following MSW Rules, 2000 and develop into Engineering landfill (ELF) for disposal of waste generated in borough XI V and XV

#### 5.5 Strategy for Future Planning

### Plan for the first 10 yrs of the project horizon (i.e. upto 2015)

- To set up Engineered Landfill Facility 113 ha plot of land at Dhapa. Waste Disposal site, which is in possession of KMC but presently utilized by vegetable cultivators. This waste disposal facility would last for about 20 years i.e. upto 2027.
- Existing 350 TPD compost plant set up by private entrepreneur but presently closed down should be revived and operated by new plant operator and its operating capacity increased to 700 TPD by the year 2008.
- Segregation of waste at source to be introduced immediately and implemented in next 2 to 3 years. This would reduce the waste quantity brought to landfill site considerably
- To set up 200 TPD capacity “waste to energy” waste treatment facility on pilot basis at one of locations/sites discussed in this report latest by 2010.
- To set up 4 to 5 vermi-composting plant at decentralized locations in borough XI to XV as demonstration project preferably on BOT or BOOT basis through NGO or Pvt. entrepreneur latest by 2010.

### Waste Treatment and Disposal Plan for the Project Horizon – 2015 to 2030

- To set up 2<sup>nd</sup> Engineered Landfill (ELF) having capacity of 1200 TPD at Dhapa closed to the proposed landfill site by taking possession of another 50 ha of land used for vegetable cultivation
- If East Kolkata Wetland Authority does not permit development of ELF as proposed above 2<sup>nd</sup> ELF be set up at one of the probable sites discussed in this report.
- The capacity of existing compost plant set at Dhapa should be increased to 1200 TPD.
- Based on the feed back of waste to energy plant of 200 TPD set up as proposed, 2<sup>nd</sup> such plant of 500 TPD capacity be set up at one of the sites discussed in this report.
  
- Based on the feed back and successful operation of decentralized vermi –compost plants proposed to be set up by 2010 , more such decentralized plants be set up in each borough.

## 6.0 ECONOMIC ANALYSIS and MEASURES to GENERATE ADDITIONAL REVENUE

The purpose of the economic analysis is to test justification of the project by assessing whether the anticipated benefit of the project exceeds or falls short of the cost. The Economic Internal Rate of Return (EIRR) is used as a measure to assess the extent to which the project exceeds or falls short of the required performance measures of the opportunity cost of capital. Economic analysis has been performed on SWM programme proposed in the Master Plan and calculation and results furnished in Annexure Table 7.7 of Chapter 7.

Financial projection of revenue and recurrent expenditure of KMC's SWM services have been carried out. The assumptions of revenue projection have been discussed in section 7.4 of Chapter 7 of the Master Plan Report.

To augment the revenue to meet the rising cost of SWM services as also to meet the repayment of loan and interest, the following measures have been proposed.

- (a) An annual growth rate of property has been considered as 15% for the initial 5 years period, which gradually reduced to 10%. An amount equivalent to 15% of the property tax is proposed to be allocated to SWM services
- (b) A conservancy charge of Rs 15 to Rs 20 per month per household is proposed which will be gradually increased to Rs 30 to Rs 40 by 2022. No SWM charges are proposed for stakeholders below poverty line and very low income group
- (c) SWM will get its share of DA subvention received from the State Govt. at least to the extent of 20% of SWM staff salary
- (d) The present receipt from miscellaneous conservancy receipt will grow at least by 10% per annum

## **7.0 SOLID WASTE MANAGEMENT – INSTITUTIONAL ASPECTS and CAPACITY BUILDING INCLUDING TRAINING**

In order to improve the solid waste management services it is essential to adopt modern methods of waste management and to have a proper choice of technology, which can work in the given area successfully. Simultaneously, measures must be taken for institutional strengthening and internal capacity building so that the investment and efforts made to improve the services can be sustained over a period and the system put in place can be well managed. Institutional strengthening can be done by adequately decentralizing the administration, delegating adequate powers at the decentralized level, inducting professional into the administration and providing adequate training to the existing staff. It is also necessary to fix norms for the work force as well as for supervisory staff to improve the manpower and productivity/optimum output expected from the vehicles and machinery utilized. NGO/private sector participation also needs to be encouraged to make the service competitive and efficient. In order to make SWM services efficient and to assess and monitor efficiency and performance of the workforce and machineries as per the norms fixed as also to control and monitor O & M cost of the entire SWM system. It is, therefore, necessary that Kolkata Municipal Corporation (KMC) adopt the above measures for Institutional Strengthening. Existing and proposed ward, borough and city level organizational set up and responsibility, norms for conservancy work, human resource development, delegation of power and training modules are elaborated in Chapter 8.

## **8.0 SOLID WASTE MANAGEMENT – MANAGEMENT INFORMATION SYSTEM (MIS)**

Good management requires collection of critical information, which is not just for keeping the records upto-date but used effectively for taking corrective measures as well as proper planning for future. Some information is, therefore, required to be collected to have an overall idea of the prevalent situation, deficiency in the system. With the advancement of information Technology, Geographic Information System (GIS) could be introduced in large cities and MIS may be integrated in this system. Similarly, there is a need for a citizen interface to seek comments, suggestions, utility services etc.

Presently, there is no system of submitting formal report (daily, weekly and monthly) in specified formats. Even complaint register is not maintained at each ward office nor any periodical report submitted by Conservancy Overseer. Similarly, there is no formal reporting on daily, weekly or monthly basis by Conservancy Overseer regarding non-sweeping and non-cleaning of drain, no. of collection points not cleared, shortfall in number of vehicles received from KMC garage and action taken or proposed to be taken to tackle these problems.

Introduction of MIS particularly for upgradation of information time to time, general information on SWM, monitoring of SWM services, daily and weekly report requirement, vehicle log book etc. are elaborated in Chapter 9, which would improve the performance of SWM department of KMC and help CME (MV and Conservancy) to monitor performance of the department.

## 9.0 PRIVATE SECTOR PARTICIPATION in SOLID WASTE MANAGEMENT

### 9.1 Present Scenario

Private sector has so far not been attracted in this important area of municipal service. However, private sector participation is being attempted by a few local bodies in the country for the last two decades, which has remained restricted in the area of awarding contract for transportation of waste from waste storage depots/dust bins. KMC may move the State Governments to get exemption from engaging contractors for providing SWM services or even privatizing those services.

### 9.2 Area Where Privatization can be attempted- Recommendations

Private Sector participation in Solid Waste Management is recommended for KMC in the following areas:

- Door to door collection of segregated recyclable and biodegradable waste from large colonies/ complexes, commercial areas, markets, hotels and restaurants on cost recovery basis
- Setting up and operation of compost plant with suitable financial model
- Transportation of waste by direct loading into private vehicle eliminating there by providing of community collection points i.e. open vat or containers. The contract rate should be on weight basis
- Operation and maintenance of KMC owned vehicles particularly garbage collectors and compactors for collection and transportation of waste from commercial and market areas. Alternatively, to award the

collection and transportation of waste from specified residential, commercial and market areas on cost recovery basis by pvt. agency with their full investment on equipment and labour.

- Operation of waste disposal/ engineered landfill facility by private entrepreneur using KMC machinery and their own labour force
- Periodical maintenance and painting of Dumper Placer containers by pvt. agency.