सत्यमेव जयते

Toolkit for Solid Waste Management

Jawaharlal Nehru National Urban Renewal Mission

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Ministry of Urban Development

Government of India

JnNURM

Creating sustainable, equitable and economically vibrant cities

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Preface

Jawaharlal Nehru National Urban Renewal Mission (JnNURM) is a reform driven infrastructure improvement programme that aims to create economically productive, efficient, equitable and responsive cities. To bring about this urban transformation, active participation is sought from State Governments and Urban Local Bodies (ULBs) in the Mission cities to undertake infrastructure projects for improving urban utilities and a series of reforms to ensure sustainability of the infrastructure investments made under the Mission.

In the last six years of implementation of JnNURM, Indian cities have witnessed widespread infrastructure development linked to municipal services. Solid Waste Management (SWM) sector is one amongst them having developed 44 projects with an approved cost of Rs. 1,978.60 Crore. However, as a learning from project implementation under JnNURM it was felt that urban bodies face challenges in zeroing down methods of collection and transportation, treatment technology selection and disposal methods. Also, it was felt that many urban local bodies are unaware of the applicable rules and regulations in Municipal Solid Waste Management. This shortcoming also retards project progress as implementers take time to gather information from various sources to understand the sector as there is no nutshell document that provides comprehensive information about the sector.

This toolkit is an attempt by the Ministry of Urban Development to provide a simple, yet comprehensive document about the sector, applicable rules and regulations, methods of project implementation, etc., which will ease understanding of the sector and hence improve project progress. This toolkit covers areas of concern from the implementer's point of view with examples, and references.

1. Introduction

1.1 What is Municipal Solid Waste?

Municipal Solid Waste (MSW) is the trash or garbage that is discarded day to day in a human settlement. *According to MSW Rules 2000 MSW includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Waste generation encompasses activities in which materials are identified as no longer being of value (being in the present form) and are either thrown away or gathered together for disposal.* Municipal Solid Waste consists of the following kinds of waste.

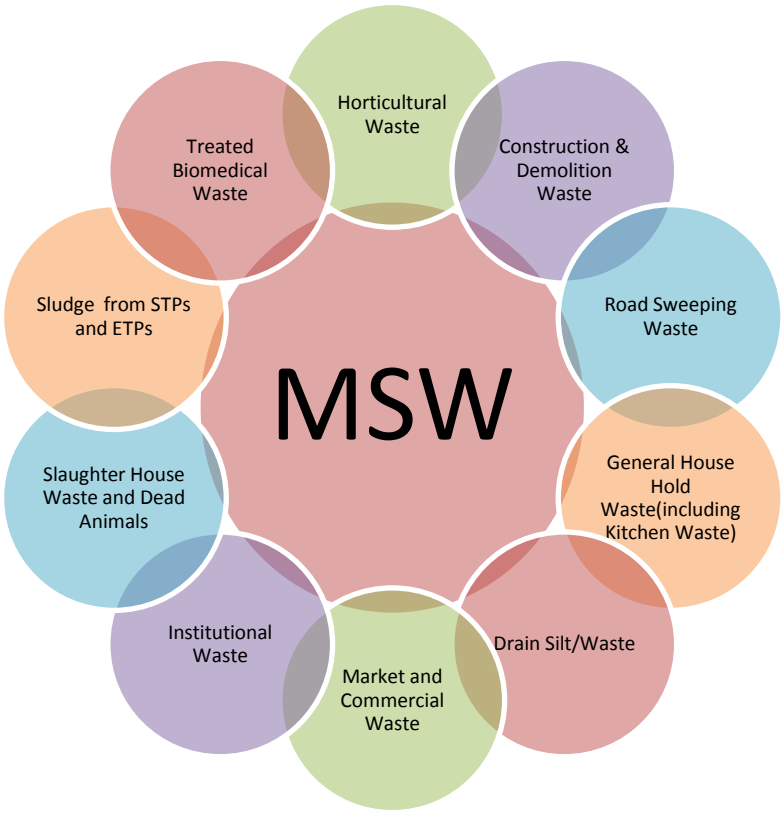


Figure 1.1: Sources of MSW Generation

The other kinds of waste found in urban settlements are;

1) Industrial or Hazardous Waste and
2) Bio-Medical or Hospital Waste and
3) E-Waste.

The Industrial hazardous waste is managed through Hazardous Waste (Management and Handling) Forth Amendments Rules 2010. Hazardous waste is typically identified with properties of *ignitability, corrosivity, reactivity and toxicity*. Hence urban local bodies must ensure that industrial waste in their command area does not get mixed with the municipal solid waste stream, failing which will result in economic losses (as hazardous waste treatment costs much more higher than

the municipal solid waste) and health & safety hazards (Contaminants like heavy metals, chromium, mercury, etc. when found in the municipal waste stream will contaminate the compost produced by the city. When farmers buy the compost it will indirectly affect the food chain.) while treating such wastes.
According to the Hazardous Waste Management Rules 2010, the onus of managing and treating hazardous waste lie with the waste generator, and the urban local body has to ensure that such waste does not contaminate municipal waste stream in their area of authority (Hospital Waste and E-Waste is dealt in sections 2.2 and 2.3).

1.2 What is Municipal Solid Waste Management

Municipal Solid Waste Management(MSWM) refers to a systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste.

1.3 Significance of MSW Management

Though Solid Waste Management (SWM) is an age old service provided by the urban local bodies (ULBs), efficient municipal solid waste management benefits in maintaining hygienic conditions leading to lesser health issues, better living environment, improved economic prosperity in the area, aesthetically cleaner surroundings with cleaner drains for storm water flow, cleaner water sources and safer neighbourhoods. Some of the key benefits of solid waste management have been discussed in the following sections.

1.3.1 Environment, Health and Safety Benefits

Effective solid waste management helps preserve environment in the project area;

- As it ***prevents waste*** to contamination of water (in drains) and soil in particular;
- ***Reduces waste*** sent to the landfill, which may have negative impacts on groundwater and air quality;
- ***Reduce emissions*** from energy consumption- as waste when recycled requires less energy than making goods from virgin materials thereby reducing the energy demand and pressure on non renewable sources (oil, fossil fuels);
- ***Contributes to Climate Change*** by reducing methane emissions from landfills. Waste prevention and recycling (including composting) divert organic wastes from landfills, reducing the methane released when these materials decompose. Thereby reducing the emission of greenhouse gases and climate change;
- Improved waste management services reduce chances of spread of diseases; and
- Efficiently designed waste management reduces multiple handling of waste avoiding potentially injurious or dangerous practices.

1.3.2 Economic Benefits

- Reduction in quantum of waste by diverting it to recycling and other processing unit reduces the landfill costs;
- Better managed waste management services indicate better value at same cost;
- An effective waste management implies reduce, reuse and recycle waste matter leading to introduction of more and more of waste matter into the value chain leading to economic benefits; and
- Waste management being a labour intensive activity, it helps in employment generation. Introduction of rag pickers into formalized waste collection and segregation process is a win win scenario for implementers.

1.4 Purpose of this toolkit

This toolkit is focussed to provide a comprehensive knowledge of solid waste management for implementers, hence it has been prepared to provide vital information that a municipal manager will require while executing a project.

2. Which are the Rules and Guidelines applicable for the management of Municipal Solid Waste?

MSW Management and Handling Rules 2000	•***Rules*** delivered in the year 2000 by MoEF •Foundation stone for waste management practice in India • Designates Urban Local Bodies responsible for MSWM • weblink : http://envfor.nic.in/legis/hsm/mswmhr.html
Manual on Municipal Solid Waste Management and Handling 2000	• ***Guidelines*** published by Ministry of Urban Development through CPHEEO in the year 2000 • Provided implementation guidelines for all aspects of MSWM, including collection, transportation, treatment and disposal • weblink : http://urbanindia.nic.in/publicinfo/swm/swm_manual.htm
TAG Report on Municipal Solid Waste Management	•***Compilation Document*** based on information recieved on proven waste treatment and disposal technologies from field experience and sector experts •Published by Ministry of Urban Development in the year 2005 • weblink: http://urbanindia.nic.in/programme/uwss/tag_swm.pdf
Inter-ministerial Task force on Integrated Plant Nutrient Management	•***Report*** presented by the Interministerial Task force to understand production and marketability of compost. Study undertaken by MOUD and Minstry of Agriculture. • **The report waste published in 2005** and is an important reference document related to design and development of compost plant •weblink : http://urbanindia.nic.in/programme/uwss/imtf_pnm.pdf
National Urban Sanitation Policy(NUSP)	•***Policy*** prepared by the Minsitry of Urban Development in **2008** • Broadly covers aspects of urban sanitation, with a specific focus to eliminate open defecation in cities •Focus on re-orienting institutions for developing city-wide approach to sanitation, covering all its aspects including Solid Waste Management •weblink: *www.urbanindia.nic.in/programme/uwss/**NUSP**.pdf*
Service Level Benchmark (SLB by Ministry of Urban Development)	•***Benchmarks*** *to evaluate performance of Urban Services* •SLB: Improving services through better provision and delivery •http://urbanindia.nic.in/programme/uwss/slb/slb.htm
National Mission on Sustainabel Habitat	•The National Mission on Sustainable Habitat is a component of the National Action Plan for Climate Change. *Focus on Waste Recycling* •*http://urbanindia.nic.in/programme/uwss/NMSH.pdf* •http://urbanindia.nic.in/programme/uwss/nmsh/mswm.pdf

Figure 2.1: Rules and Guidelines in MSW Management

2.1 Salient Features of MSW Rules, 2000

Responsibility of the Urban Local Body

- The Rule designates the Urban Local Bodies as sole responsible to manage solid waste in their area and dictates that "*within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes"*
- Prohibits waste to be exposed to open atmosphere;
- Prohibits waste disposal by burning (garbage, dry leaves) in open;

Collection of MSW

- Mandates collection of waste from slums and open squatter areas, hotels/restaurants/office complexes and commercial areas;
- Avoid Manual handling of waste, and ensure that the waste is collected and removed from the municipal area daily;
- Vehicles used for transportation of wastes to be covered;
- Bio degradable waste and non bio-degradable waste must be collected in separate bins from source. Waste bins for biodegradable waste shall be painted 'Green', those for storage of recyclable wastes shall be printed 'White' and those for storage of other wastes shall be printed 'Black':
- Construction/demolition wastes/debris to be separately collected and disposed off following proper norms;
- Stray animals are to be kept out from the waste storage facilities

Processing of MSW

- Recover recyclables from the waste mass before treating for biodegradable portion of the waste;
- Treatment of organic waste through biodegradation such as vermi composting, mechanical composting by windrow method or any other suitable methods such as anaerobic digestion etc as approved by Central Pollution Control Board (CPCB) may be adopted;
- In case the municipal body is engaged in any other treatment technology, such as incineration, energy recovery from waste etc. it must be duly approved by CPCB;
- *Chlorinated plastics should not to be incinerated;*

Box 1: Bio-Medical Waste in MSW stream

Biomedical wastes and industrial wastes should not to be mixed with municipal solid wastes and such wastes are being followed by rules as specified separately by Bio Medical Waste (Management and Handling) Rules, 1998 and Hazardous Waste(Management, Handling and Trans boundary Movement) Rules 2009 respectively or whichever is the latest revision of the rules.

Disposal of MSW

- Municipal body to develop scientifically designed landfill as disposal facility for residues out of waste processing facilities, as well as pre-processing rejects or unprocessed mixed waste (applicable if the waste is not fit for any

treatment) in a scientifically designed sanitary landfill for a long term of 20 – 25 years.

- Site suitability criteria to be ensured for selection of landfill sites
- Land filling of mixed waste must be avoided, unless the waste is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms.

Monitoring of Pollution

- Municipality to take adequate pollution prevention steps for all its waste management and handling units
- Measures to reduce air pollution typically in case the unit has a waste to energy units.
- Environment Monitoring (ground and surface water, air quality) for waste handling site

Awareness Programs

- The municipality to be engaged in encouraging citizens, by organize awareness programs for segregation of waste at source and promote recycling or reuse of segregated materials through community participation programs involving representatives of local resident welfare associations, community based organizations(CBOs) and nongovernmental organizations

2.2 What is Bio-Medical Waste? What is the role of Municipal Body Towards its management?

Hospital waste/Bio-medical waste is generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities in these fields or in the production or testing of biological waste. Hospital/Bio-medical waste must be managed through "***Bio-Medical Waste (Management and Handling) Rules, 1998***". ***Weblink: http://envfor.nic.in/legis/hsm/biomed.html***

Box 2: Role of Municipal Bodies as per Bio Waste Management Rules 1998

The biomedical waste management rule directs biomedical waste incineration ash to be disposed into municipal landfills. Also, the municipal body must be a member of the '*Advisory Committee*' in the state to advice on steady implementation of biomedical waste management and handling in their area.

2.3 What is E-Waste? What is the role of Municipal Body towards its management?

E-waste or electronic waste means waste electrical and electronic equipment (EEE), whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded. The ***E-waste (Management and Handling) Rules 2011*** has been recently been published by the Ministry of Environment and Forest.

"Wondering what to do with your old desktops, wires and dated mobile handsets? Soon, you can just hand them over for hard cash to the Ahmadabad Municipal Corporation, which is starting a month-long drive for collection of e-waste through private agencies from June 5, the World Environment Day" – ***Indian Express, June 5, 2012, Ahmedabad***

3. Waste Quantification and Characterization

3.1 Waste Quantification

As waste generation is a factor of population, lifestyles and level of urbanization, the quantification process has been linked with population multiplied by the waste generation factor of the urban area. The factor of waste generation in turn has been calculated by monitoring 'total waste generation' to the population of the city at a given time (total waste generation/ population).Accordingly waste generation factor between 0.2-0.6 kg/capita/day has been recommended for Indian cities. A city wise bifurcation has been provided in table below.

Table 3.1 Quantity of Municipal Solid Waste in Indian Urban Centres

Population Range (in Millions)	Number of Urban Centres (sampled)	Total population (in Million)	Average per capita value (kg/capita/day)	quantity (tonnes/day)
< 0.1	328	68.3	0.21	14343.00
0.1 - 0.5	255	56.914	0.21	11952.00
0.5 - 2.0	31	21.729	0.25	5432.00
1.0 - 2.0	14	17.184	0.27	4640.00
2.0 - 5.0	6	20.597	0.35	7209.00
> 5. 0	3	26.306	0.50*	13153.00

* 0.6 kg/capita/day generation of MSW has been observed in metro cities

Source: Manual on MSW Management 2000

3.2 Sampling Stages of SWM

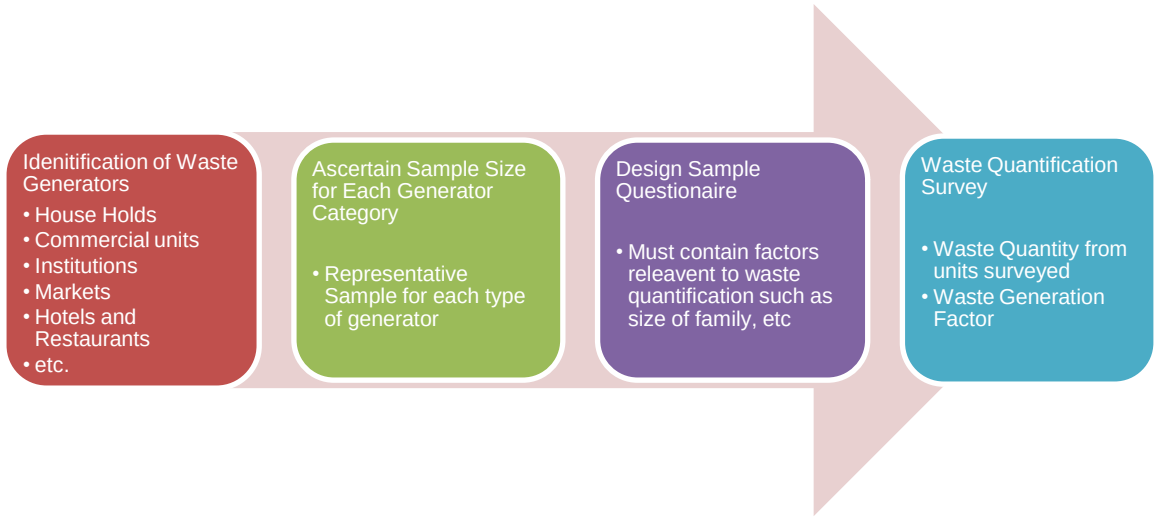


Figure 3.1: Rules and Guidelines in MSW Management

3.3 Waste Characteristics and Importance of Its Measurement

MSW characteristics depend on the type of activity from which it is produced; such as households, commercial shops, hotels & restaurants, markets and mass storage units, institutions and offices etc. Waste composition basically indicates the *Physical Characteristics* and *Chemical Characteristics* of waste.[1]

Typical physical and chemical characterization waste for Indian Cities has been found as follows;

Table 3.2: Physical and Chemical Characteristics of MSW in Indian Cities

Population Range (in millions) ⟶	0.1 to 0.5	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	> 5
Physical Characteristics					
Paper (as %)	2.91	2.95	4.71	3.18	6.43
Rubber Leather And Synthetics (as %)	0.78	0.73	0.71	0.48	0.28
Glass (as %)	0.56	0.35	0.46	0.48	0.94
Metals (as %)	0.33	0.32	0.49	0.59	0.8
Total compostable matter (as %)	44.57	40.04	38.95	56.67	30.84
Inert (as %)	43.59	48.38	44.73	49.07	53.9
Chemical Characteristics					
Moisture (as %)	25.81	19.52	26.98	21.03	38.72
Organic matter (as %)	37.09	25.14	26.89	25.6	39.07
Nitrogen as Total Nitrogen (as %)	0.71	0.66	0.64	0.56	0.56
Phosphorous as P2O5(as %)	0.63	0.56	0.82	0.69	0.52
Potassium as K2O(as %)	0.83	0.69	0.72	0.78	0.52
C/N Ration	30.94	21.13	23.68	22.45	30.11
Calorific value* in Kcal/kg	1009.89	900.61	980.05	907.18	800.7

Source: Manual on Municipal Solid Waste Management 2000- CPHEEO
**Calorific Value on dry weight basis*

3.4 Methods of Waste Characterization

Physical Characteristics of waste must be ascertained through '*quarter coning method*', as the data of waste composition is essential for evaluating feasible techniques for treatment. Following procedure/steps are to be followed for collection samples through this method:-

- Identify major waste sample collection sites covering the whole city population.

[1] Definitions of Physical and Chemical Characteristics can be referred from the Manual on Municipal Solid Waste Management 2000- CPHEEO.

- The sample collection sites should be so selected that all the type of area such as residential, commercial, industrial, markets (vegetable market, meat market, slaughter house, grain market etc.) and slums etc. are covered.
- Sampling points should be further identified on the classification based on economic status of the area such as high, middle and low income group localities.
- From the identified spots, take about 10 kg of municipal solid waste from outside and inside of the solid waste heap.
- All the samples collected with the above method will be heaped at one place and mixed thoroughly (refer to Figure 3.2: Sampling Procedure through Quartering Method).
- One quarter of this thoroughly mixed heap will be taken out and this quarter portion will be again thorough mixed and quarter portion of it will be taken out.
- Samples collected for physical and chemical analysis are double bagged in plastic bags, sealed and sent to the laboratory for analysis, each sample being in the range 10 to 12 kg.
- *This sample is first subjected to physical analysis for determination of physical characteristics (as in* **Table 3.2: Physical and Chemical Characteristics of MSW in Indian Cities***) and moisture content. Then the chemical analysis of the sample is done in the laboratory.*
- Collection of sample and getting a representative sample can be performed in other methods also. But the fundamental idea is to get a real picture of the composition of MSW so as to recommend the technology to be adopted for the waste treatment.

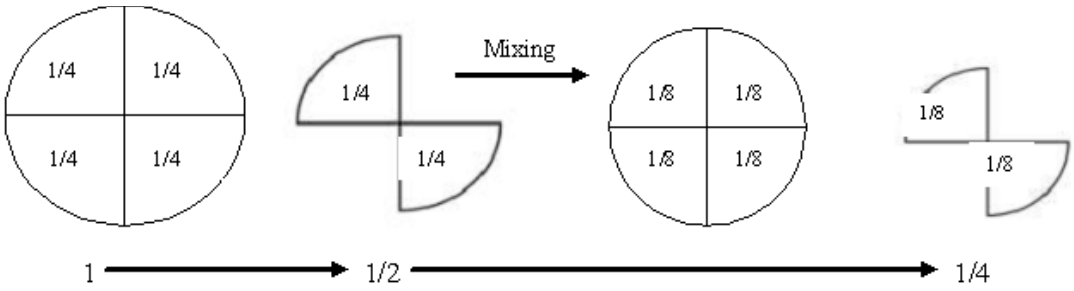
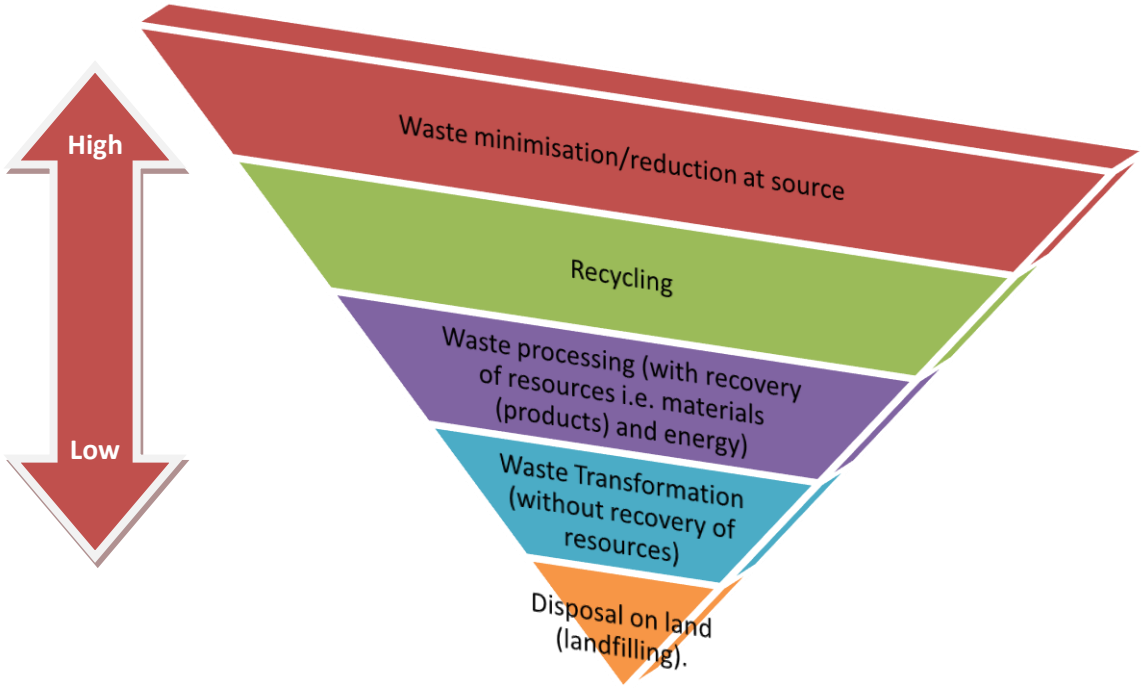


Figure 3.2: Sampling Procedure through Quartering Method

3.5 Approaches to Sustainable Solid Waste Management

The recommended approach to effective waste management prioritizes waste minimization and recycling against other techniques. The hierarchy usually adopted is as described;

Figure 3.3: Preference of Solid Waste Management



It is important to note that the hierarchy of waste management is only a guideline. Waste management systems must be designed based on actual field conditions and after due considerations of the feasibility of project.

3.6 Approaches to 3R to Different Waste Types

S.No	Waste Type	3 R Solution to Waste Type
1.	General House Hold Waste(Including Kitchen/Food Waste)	• Waste which includes paper, plastics, wood, ceramics etc. in mixed form and Kitchen Waste which is primarily food and vegetable peel waste. • Towards reduction of kitchen/food waste public awareness towards reduction of food waste, segregation for easy composting is required. Also decentralized composting initiatives must be propagated. • Kitchen gardens to be propagated by authorities. • As a reduction measure for '*General House Hold Waste'*, public awareness towards waste reduction through recycling of their house hold waste must be imparted. • Waste recycling for paper, cardboards, plastics etc are informal activities under MSW management. Such activities needed to be formalized under the urban local body or mobilizing Non Governmental Organization (NGO). • Some household waste have hazardous characteristics (such as dry paints, pesticide bottles etc.) which must

S.No	Waste Type	3 R Solution to Waste Type
		be separated out from the main MSW stream. Disposal of such waste must be done as per Hazardous Waste Management Rules. • Waste Batteries must be disposed as per ***Batteries Rules 2001***. Other house hold hazardous waste must be sorted at source and disposed according to Hazardous Waste Management Rules.
2.	Road Sweeping Waste	• Waste contains dirt and silt along with recoverable such as paper and plastics etc. • Efforts to be made to avoid waste disposal on roads and streets as public awareness measure which will also improve civic sense vis-a-vis aesthetics of the city. • Recoverable material such as paper, plastics, cardboards etc to be collected and recycled during treatment.
3.	Construction Waste	• As building demolition is the main component of this waste type, waste recycling, by screening out useful material 'fit for reuse' must be propagated. • The waste can be used as an inert fill material for low-lying areas and landscaping, processed C&D waste can be used for road and embankment construction, finer grade can be moulded into blocks and slabs with appropriate binder, the finer grade can also be used as daily cover for SLF/ closure of SLF • Delhi has pioneered in C&D recycling through its plant in Burari.
4.	Drain Silt/Waste	• The cause to drain silt is mostly inefficiently designed storm water systems and 'negligence' in people while disposing garbage. As a reduction strategy these two shortcomings must be targeted. • Drain silt having some portions of organic matter is best disposed into a sanitary landfill.
5.	Market and Commercial Waste	• The waste category mostly forms paper, plastics, cardboards, packing material, rubber etc. As a measure to reduce, the implementing agencies must ***discourage use of plastic products*** as they only aggravate sanitation situation (being not easily decomposing). • Further initiatives to recycle waste by proper segregation of these materials must be propagated. Formalizing waste recycling at Material Recovery Units(MRF, as found in many towns in India, such as Kadappa town in A.P state) must be adopted as a waste

S.No	Waste Type	3 R Solution to Waste Type
		management measure
6.	Institutional Waste	• Institutional waste includes organic waste (small quantities), large amounts of paper, plastics and rejected E waste and also hazardous house hold waste is typically found. • Initiatives such as printing paper on both sides, use of reused paper, and propagating minimum use of plastics must be taken up. • Institutions can play in a major role in managing E-waste, by following Extended Producers Responsibility (EPR) principle, which refers to management of waste by the producers. Hence institutions must create arrangements with their equipment providers to help manage their E-waste, such as computers, printer cartridge, etc.
7.	Sludge from STPs and ETPs	• Sewage Treatment plants generate sludge as solid waste. • Sludge mixed with other MSW helps sped up composting process. • Sludge must be dried before disposal.
8.	Horticultural Waste	• This waste type forms excellent compost after bio decomposition. Hence such waste type must be used for composting rather indiscriminate disposal.
9.	Waste from Slaughter Houses and Dead Animals	• Dead animals[2] should be incinerated in a scientific manner. The Manual on MSW management and handling provides guidelines towards management of such waste. • Slaughter house waste is a combination of following types of waste which included manure from stork yards, blood and hair from killing floors, paunch manure and liquor flesh, grease blood, etc. • The waste water from slaughter house is highly polluted and, should not be allowed to flow into the municipal drain system without pre-treatment meeting sewage standards as per the Bureau of Indian Standards(BIS) • The Manual on MSW Management and Handling proposes that these types of waste are required to be disposed by adopting methods like rendering/controlled incineration/burial/composting/anaerobic digestion etc.

[2] Term applicable for animals which die naturally or are accidentally killed

S.No	Waste Type	3 R Solution to Waste Type
		• Slaughter house waste could also be explored for power generation due to high organic content in this waste, which help faster decomposition, leading to biogas generation. • ***Central Pollution Control Board (CPCB) has brought out "Draft Guidelines for Sanitation in Slaughter Houses" during August, 1998*** • Plant in Vijayawada, with 150 KW capacity using vegetable market & slaughter house waste. The plant used 16 TPD of segregated MSW and 4 TPD of slaughter house waste for electricity generation using 'biomethnation process'

Box 3: C&D waste handling plant in Delhi

C&D waste recycling unit have been made functional in Delhi through Public Private Partnership between Municipal Corporation of Delhi (MCD) and Infrastructure Leasing and Financial Services Ltd (IL&FS) at Burari, with an installed capacity of 500 TPD of C&D waste. The plant produces Kerb Stones, pavement blocks from C&D waste through a series of screening process. The waste material after screening is also used for road construction in sub base preparation which has been certified by Central Road Research Institute (CRRI).

- IL&FS Waste Management and Urban Services Ltd Presentation on PPP in Waste Management in India.

4. Which are the Primary Elements of Municipal Solid Waste Management?

Though, waste management systems adopts varied options depending upon resource availability and ease of operations; presented is a schematic diagram to illustrate waste management systems in general, which is representative of the Indian scenario. The stages involved in a typical SWM system are; Storage and segregation of waste at source, Primary Collection, Secondary Collection and Transportation, Intermittent storage during transportation(in transfer stations), Waste Treatment, and Waste Disposal.

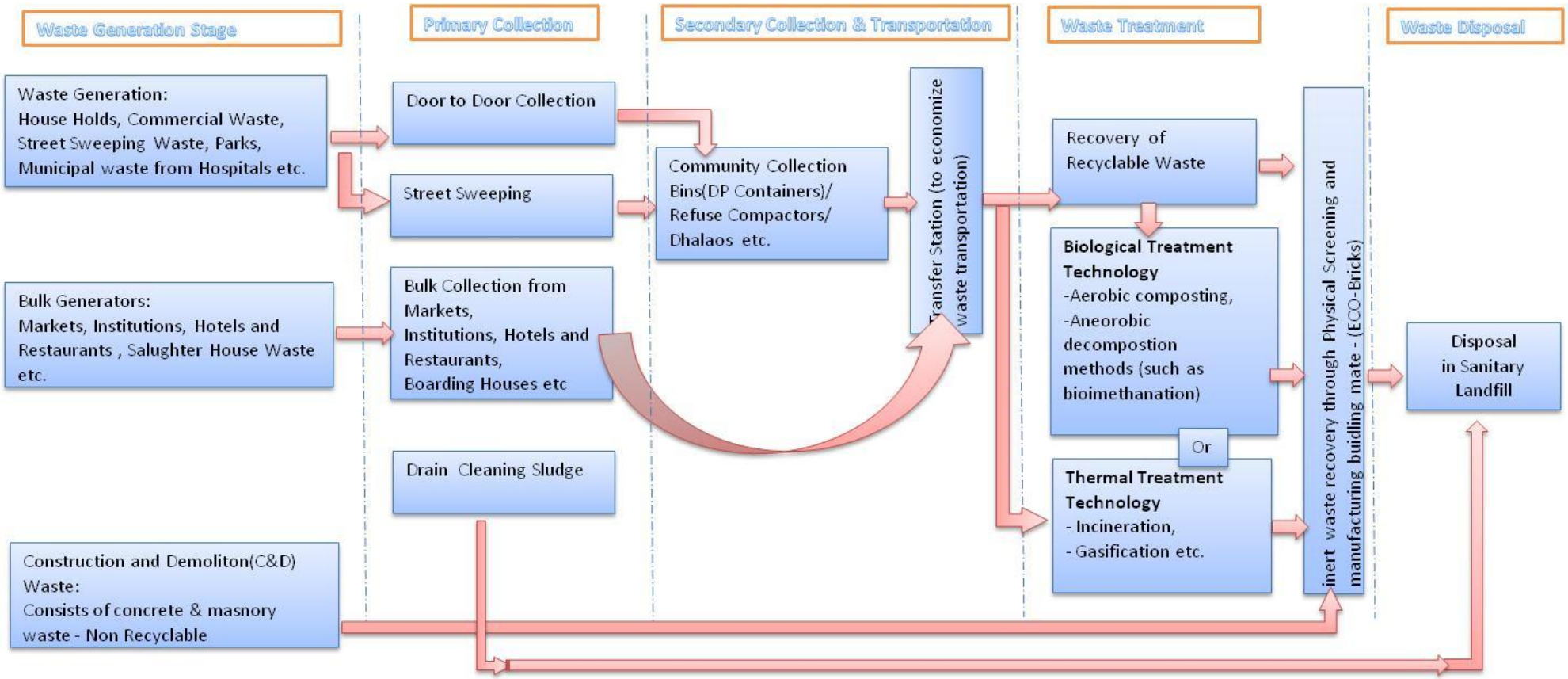


Figure 4.1: Schematic Flow of SWM systems

4.1 Waste Storage and Segregation at Source

Practice of waste to be stored at source of waste generation till collected (for its treatment and disposal) is essential as it helps enable waste to be collected at a pre decided time before it is indiscriminately thrown on streets causing pollution.

4.2 Primary Collection and Segregation at Source

Primary collection is the practice of waste collection from its very source of generation. Primary collection includes 'house to house' or 'door to door' collection, collection of waste from commercial units like shops, hotels and restaurants.

Cycle Rickshaws equipped with bins to collect segregated waste

Push carts equipped with bins to collect segregated waste

Rickshaws for collection of segregated waste

Collection vehicles with two bin system in place- Bengaluru

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4.3 Secondary Collection and transportation

Secondary waste collection and transportation are stages to optimize waste transportation cost. It consists of lifting of waste after it is collected at the primary level into a community bins/ dhalaos[3] and transportation of the same for treatment and disposal. This stage is mostly mechanized involve equipments such as auto tippers, tipper trucks, Dumper Bins with Placers, Compactor Trucks and Bins etc. Efficiency in this stage could be achieved by;

- Channelize collection and transportation of domestic, commercial and Institutional waste etc.*(as shown in* ***Figure 4.1: Schematic Flow of SWM systems****.)*.;
- Better designed waste storage points;
- Different size of waste containers to meet different requirement;
- Routing of transportation vehicles in such a fashion that traffic free portions of the city is used for their movement;
- Use of Vehicles in Two Shifts to improve their utilization;
- Use of closed/covered vehicles
- Bio-Medical Waste from Hospitals/Nursing Homes/Health Care Establishments etc. to be collected separately and not mixed with the municipal waste.
- Construction Waste and Debris to be transported separately.
- ***Transportation of Waste from Narrow Lanes***: Local bodies should provide facility of direct loading of waste in small vehicles in the congested areas.

Box 4: GPS & GIS Systems

GPS and GIS enabled vehicle tracking system has improved waste collection and transportation of SWM systems by;

- Eliminating human errors
- improving surveillance system for monitoring the movement of the vehicle using GPS/GIS and GSM mobile communication technologies
- Real time monitoring of vehicle
- Monitoring status of bin lifting
- Management Information System(MIS)for effective planning of resources
- Municipalities such as Pimpri Chinchwad Municipal Corporation, Hyderabad Municipal Corporation, and Municipal Corporation of Delhi has benefitted from this system.

[3] Dhalaos are kerbside waste collection bins found in Indian Cities

Secondary Waste Collection points with two bin(1.5 cum each) system in place

A typical unmanaged Secondary Collection point

Closed transportation of waste in Varanasi

GIS based Vehicle Tracking system for PCMC[4]

Photo showing how compatible equipments reduce manual handling of waste in Guwahati

[4] Pimpri Chinchwad Municipal Corporation

Box 5: Collection and Transportation in Amritsar

Amritsar metropolitan town was having the population of 10.11 Lakhs in 2001.

Prior to the Project

There was no door-to-door collection of waste and heaps of garbage was seen in most of the localities. The sanitary conditions were very poor due to lack of unorganized system of collection and transportation. Unhygienic and dirty environment in the streets, localities, markets and open areas.

Project Area:

The Sanitation Zones of 4, 5, 6 and 7 were selected for collection and transportation of waste. The job was awarded to a private party in 2008 for O & M of the project facility.

Project Activity:

The major activities under the project included:

- Provision of adequate machinery, equipments and staff for the project upgrading door to door services and SWM infrastructure.
- Vehicles have alarm system for house to house collection.
- Primary and secondary storage in bins.
- Prohibition of waste littering and arbitrary disposal of waste.
- Public awareness for better sanitation/ waste management.
- Provision of mobile covered bins and synchronized transportation mechanism, has removed dhalaos and kuda ghars.
- Uniforms for the safai sewaks, drivers and supervisors etc.
- Transportation of waste through high capacity, covered vehicles.
- Provision of centralized complaint redressal system by the Contractor.
- Arrangement for processing facility with multiple product recovery (work is in progress through private participation)

Project Achievements:

- Improved door to door collection and Efficient, hygienically safe transportation of waste to the landfill site.
- Improvement in the environmental conditions in the selected zones.
- Negligible littering in the streets due to awareness of the citizens, adequate bins, timely and effective collection of waste from the source and its regular transportation.
- Replacement of old dhalaos/kuda ghars with colourful collection points, improving aesthetics of the area.
- Reduced manual handling of waste in collection and transportation.
- Greater awareness among citizens about cleanliness/ waste management.
- Reduction in expenditure on improving the waste collection/ transportation under SWM Rules.

Municipal Corporation of Amritsar (MCA) pays an amount of Rs 500/- tonnes per day of waste transported using the project facilities provided in the city to the contractor.

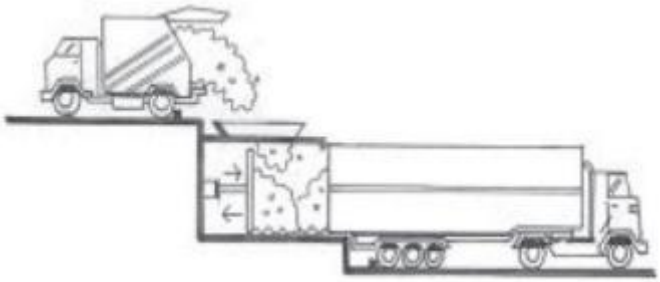
– Source – PEARL Report

4.4 Transfer Stations

A transfer station is a place in the waste collection stream where waste is transferred into a 'larger vehicle' / 'vehicle driven container' from many smaller collection vehicles (used for primary and secondary collection) in order to transport it for a longer distance. In this way, the transfer station provides economies of scale while transporting waste by using a large vehicle having greater capacity to travel for longer distance instead of many vehicles having smaller capacities.

Figure 4.2: Schematic Diagram showing types of Transfer Station

Direct Transfer Station(simple type)



Mechanised refuse transfer station

Detailed guidelines about transfer stations are available in ***section 13.5 of Manual on Municipal Solid Waste Management 2000.***

It may also be noted that in case of urban local bodies having issues of suitable land for a permanent transfer station, mobile compactor trucks compatible with primary collection vehicles such as auto tippers or suitably sized collection bins can be used to improve transportation efficiency of the system. Such systems have been effectively used in Surat and Kanpur as temporary arrangements till permanent transfer stations are built for these cities.

Photo showing waste tipped into a compactor truck from a collection bin in Kanpur

Photo showing waste tipped into a compactor truck from an auto tipper in Kanpur

4.5 Waste Treatment

4.5.1 Treatment Technologies

There are various technologies available for treatment and processing of waste in an environmentally sound manner. However, a technology suitable for one may not be appropriate for others.

A detailed report on Technology Selection has been prepared and uploaded on the JnNURM website at: http://jnnurm.nic.in/wp-content/uploads/2011/01/MSWM%20Brochure%20(Bleed%205%20mm).pdf
Also the Ministry of Urban Development has uploaded toolkit named "Improving Delivery of MSWM Services In India Through Public Private Partnership (PPP)", also available at the following http://jnnurm.nic.in/wp-content/uploads/2011/01/Model%20PPP%20Framework%20(Bleed%205%20mm).pdf

4.5.2 Comparison of different treatment technologies

The section is an attempt to provide a one page reckoner to compare different waste management technologies discussed.

Table 4.1: One Page Reckoner for Treatment Technologies

Element	Composting	Refuse derived fuel	Biomethanation	Gasification/ Pyrolysis	Incineration
Technically and economically feasible size of operation per day fresh waste	50 TPD and above	100 TPD and above	1 TPD at small scale and above 50 TPD at larger scales of pure organic waste	500 TPD and above. Due to high moisture in our waste, suitable only for segregated dry waste.	500 TPD and above due to high moisture in our waste. Suitable only for segregated waste. However sizes as small as 10 – 50 TPD of waste are available for commercial sale but not advisable due to high running costs.
Adopted Capacity for study	500 TPD	500 TPD	500 TPD	500 TPD plant	500 TPD
Land	6 Ha	3 Ha	4 Ha	10 Ha	4 Ha

Element	Composting	Refuse derived fuel	Biomethanation	Gasification/ Pyrolysis	Incineration
required for adopted capacities					
Waste Characteristics	Moisture Content>50 % Organic Matter>40% C/N Ratio between 25-30	Moisture<45% Volatile Matter>40 %	Moisture Content>50% Organic Matter>40 % C/N Ratio between 25-30	Moisture Content <45% Net Calorific Value>1200 KCal/kg	Moisture Content <45% Net Calorific Value>1200 KCal/kg
Waste Suitability	Suitable for MSW Characteristics of India	Not Suitable for MSW characteristics in India but Workable with use of Auxiliary Fuel	Suitable for MSW Characteristics of organic waste in India	Not Suitable for MSW characteristics in India but Workable with use of Auxiliary Fuel	Not suitable. due to high moisture in our waste
Typical Investment for assumed capacities(excluding cost of land)	INR. 17 – 20 Cr for a 500 TPD plant	INR. 17 – 20 Cr for a 500 TPD plant	Approximately INR 75 - 80 Cr for a 500 TPD plant	INR 80-90 Cr for 500 TPD plant	NA

Element	Composting	Refuse derived fuel	Biomethanation	Gasification/ Pyrolysis	Incineration
Recurring cost	INR. 300 per ton of input waste	INR. 290 per ton of input waste	INR 100 per ton input waste	NA	-
Recoveries	250 Kgs of compost per ton of waste	200 Kgs pellets per ton of waste	80 cum of bio gas/ ton of waste plus 200 Kgs of manure / ton	NA	-
Volume reduction	45-55 %	55-65 %	55-65 %	>80 %	>80 %
Environmental issues	Impurities in compost due to mixed waste, traces of heavy metals, leachate runoff	Problems in burning exhaust	Problems if mixed feedstock	Ash handling and Air Pollution	Ash handling and Air pollution (emission of particulate matter, chlorinated compounds dioxins/ furans)
Technology Reliability	Running successfully in India	Running successfully in integrated facilities	Small scale organic treatment plant operational but mixed waste large scale plants failed in India	Insufficient operational experience for MSW	Only Plant in India failed due to mismatch in waste quality. MSW 2000 has recommended for incineration of waste only after doing a waste suitability analysis, and providing adequate flue gas management

Element	Composting	Refuse derived fuel	Biomethanation	Gasification/ Pyrolysis	Incineration
					methods.
Limitation	Large Land Requirement, Non acceptance of compost as soil enrichener in some areas of the Country Process depends highly on factors such as waste quality, & climatic conditions.	Fluff/ Pellets can be used as fuel in large industries, e.g. in cement kilns with necessary permissions from the PCBs and required pollution control measures	The technology requires pre-segregated homogenous biodegradable waste as mixed waste retards efficiency of the process. Hence applicability is limited to highly organic and homogenous waste streams like Market wastes	Requires waste with high calorific value. Expensive flue gas remediation methods to attain achievable outputs.	Expensive Technology, waste criteria must have low moisture content and high calorific value, which is not found in Indian Waste. Costly flue gas remediation methods to attain achievable outputs.

4.6 Disposal of waste

Waste after treatment must be disposed in a manner such that it does not create any instance of environmental pollution and public nuisance. The MSW Rule 2000 defines waste disposal as an activity which involves "*final disposal of municipal solid wastes in terms of the specified measures to prevent contamination of ground-water, surface water and ambient air quality*".

Landfills can be designed both above and below ground level which has been illustrated below.

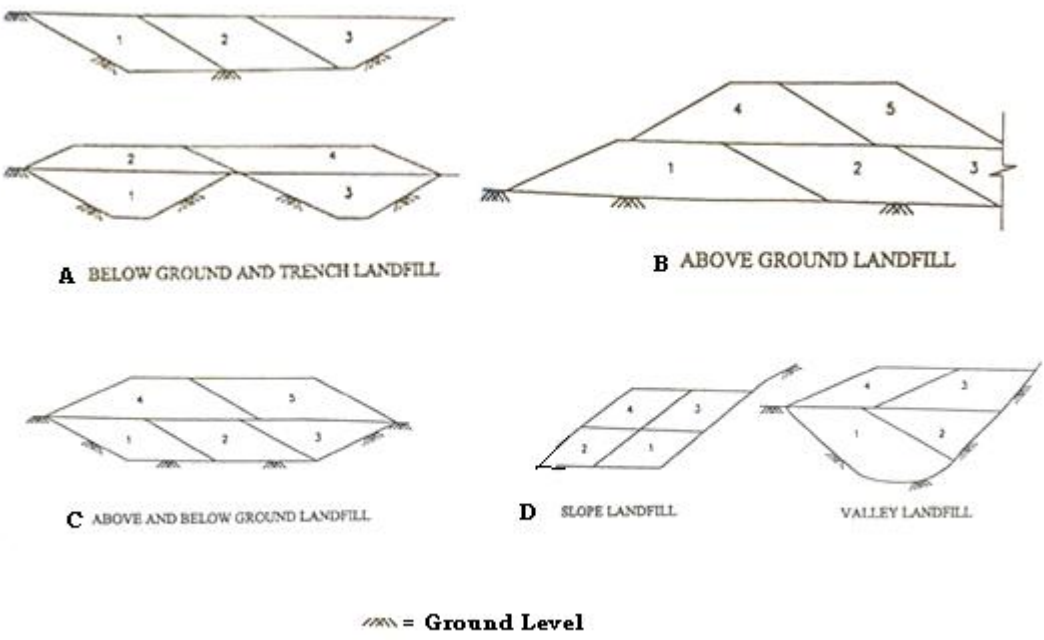


Figure 4.3: Landfill Methods

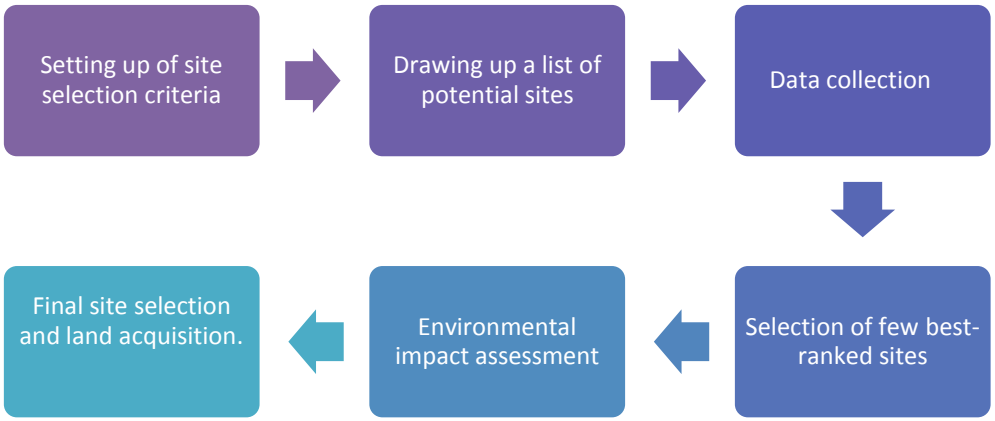
Illustration of different forms of landfills; a) Below the Ground Level, b) Above Ground Level, c) Above and Below Ground Levels d) Landfills on Slope and Valley Sections. Number 1,2,3,4 in each figure indicates the preferred sequence of stacking waste.

The landfill so designed should be aimed to minimize the following:

- The ingress of water into the landfill
- The production of leachate, its subsequent outflow and uncontrolled dispersions into surrounding aquatic environment
- The accumulation, migration and uncontrolled release of landfill gas into the atmosphere.

4.6.1 Landfill Site Selection

The Manual on Municipal Solid Waste Management 2000 provides guidelines for Selection of a landfill site. The site selection usually comprises of the following steps:



The MSW Rules 2000 identifies and mandates the following criteria for Landfill Site Selection:

- ✓ In the jurisdiction of the development authority.
- ✓ Landfill is a part of integrated treatment and disposal facility. Landfill sites shall be selected to make use of nearby wastes processing facility. Otherwise, wastes processing facility shall be planned as an integral part of the landfill site
- ✓ Landfill is away from airports. Landfill developed within 20 Km from an airport including airbase needs permission from the airport authorities.
- ✓ The landfill site shall be away from habitation clusters, forest areas, water bodies, monuments, National Parks, Wetlands and places of important cultural, historical or religious interest.
- ✓ ***The site should be so selected that there must be a gap of a minimum of 2 meters between the base of the landfill and the highest water table available on the site.***

4.6.2 Reclaiming Existing Dump Sites through Landfill Capping

Site reclamation is a process of reintroducing an existing waste disposal site (or a dump site) into useful land resource through restructuring, stabilizing and covering of the openly disposed waste through engineered land capping techniques.

Pictures showing land reclamation through engineered capping methods in Deonar, Mumbai

Box 6: Dump Site Rehabilitation

- Waste disposal sites at Perungudi, and Kodungaiyur in Chennai Municipal Corporation were rehabilitated. Waste lying over 200 acres of land in Perungudi was rehabilitated into only 30 acres of land, relieving almost 85% of the land under waste disposal. The total savings in solid waste disposal due to the project is in tune of INR 2 Crore per annum.
- Similarly for Kodungaiyur site only 100 acres have been earmarked for waste disposal out of the 269 acres presently in use for waste disposal. The waste in these sites has been sieved for recoverable material (for other use) and valuable land retrieved for other uses.
- The project has helped increase the life of landfill for about 20 years
- Cost savings to the tune of about Rs.1.5 cores per annum

4.7 Landfill Gas Extraction

The waste deposited in a landfill gets subjected, over a period of time, to anaerobic conditions[5] . This leads to landfill gas production containing about 45-55% methane. This methane can be recovered through a network of pipes and utilised as a source of energy. Landfill gas extraction systems adds to Climate Change initiatives as it helps reduce Green House Gas emissions through avoidance of landfill gas(mainly comprising of methane) into the atmosphere.

4.8 Special provisions for hilly areas

- Cities and towns located on hills shall have location-specific methods evolved for final disposal of solid wastes by the municipal authority with the approval of the concerned State Board or the Committee.
- The municipal authority shall set up processing facilities for utilization of biodegradable organic wastes.
- The inert and non-biodegradable waste shall be used for building roads or filling-up of appropriate areas on hills.
- Because of constraints in finding adequate land in hilly areas, wastes not suitable for road-laying or filling up shall be disposed of in specially designed landfills.

[5] Organic Compounds are transformed into methane (CH4), CO2, and Water in an atmosphere devoid of oxygen.

4.9 Regional MSW Development Approach

A 'Regional MSW Facility' means a waste management facility or system of any kind (*whether in relation to collection, transportation, treatment or disposal of MSW or a combination of any or all of them*), which collects, manages or receives or disposes (as the case may be) MSW from more than one Authority (eg. 2 or more urban local body).

The Government of India has published a document - ***A Guidance Note 'Municipal Solid Waste Management on Regional Basis'*** to provide better understanding of such approaches.

Box 7: Regional Landfills

- The first attempt at developing a regional facility in India was by Ahmadabad Urban Development Authority (AUDA), in 2007, to address the SWM requirements of 11 towns in its (then) jurisdiction. The project facility integrated composting facilities for approximately 150 TPD and a scientific landfill site of 50 TPD capacities. The overall strategy included the development of three transfer stations.
- Project developed in Asansol Urban Agglomeration (AUA) area includes 5 Ulbs. The project developed through JnNURM funding has three treatment plants using composting technology (500, 300, and 200 TPD capacity) and a regional landfill at Mangalpur to accommodate 400,000 MT waste.

4.10 Safety and precautions in SWM

The following instructions need to be notified and strictly adhered to:

- Clear Safety Measures in the form of a notice(in Hindi and English) to be displayed in all concerned areas;
- Issuance of all protective clothes such as, gloves, aprons, masks, shoes etc. without fail on a biannual basis or earlier if required;
- Provision of disinfectant, soap etc with proper sanitation facilities at waste management facilities;
- Regular medical check-up (half-early) for sanitary workers involved in direct handling of waste.
- Insurance of the sanitary workers or some funds allocated to be used at any unforeseen incident
- Regular trainings and capacity building of the workers and supervisors for appropriate procedures and safety measures.

4.11 Complaint Readressal

It is necessary that a SWM system must have a complaint readressal cell whose responsibility would be to provide services against complaints made by the public. The system must be linked with the field staff to take immediate actions. Online/ web based system of complaint redressal may also be developed to ensure proper monitoring of complaints.

5. How to Organize SWM in Your City?

Organizing a project starts with identifying 'need of the project' followed by a '*set of planning procedure' and organizing a team*, who will lead in project implementation. A solid waste management project too has few basic stages which include the following;

Figure 5.1: MSW Planning Stages

It is important that a proper Contract Monitoring Mechanism for evaluation of the project be evolved such that the Urban Local Body can keep a regular

track of the project; its performance milestones against the financial implications.

Guidance documents are available related to preparation of DPRs on the following: http://jnnurm.nic.in/wp-content/uploads/2011/01/9.GuidlinceFinance.pdf

5.1 Coordination in MSW Project Implementation

Waste management projects are land intensive, have potential for environmental degradation from leaching of waste water, manpower intensive and hence require lot of coordination between various departments. Amongst them, the State and Central Pollution Control Boards, Airport Authority(in case project is within 20 Km range of airport), ground water department, electricity boards, and traffic management department are most critical. Environmental Impact Assessment is also needed for MSW projects.

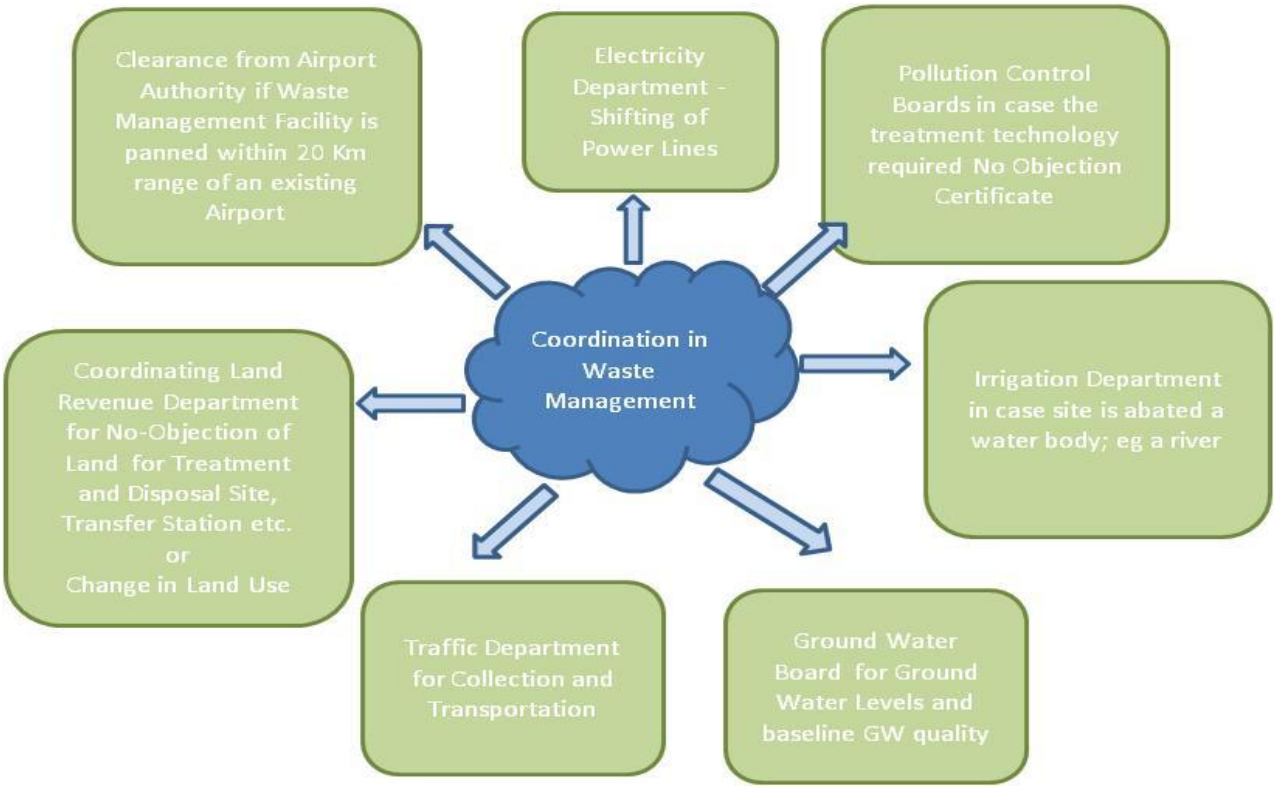


Figure 5.2: Coordination between agencies in MSW Planning

Box 8: Environment Clearance Requirement for SWM projects

During execution, Common Municipal Solid Waste Management Facility (including landfills) requires an environmental clearance under the ***Environmental Impact Assessment (EIA) Notification 2006*** where such facilities with landfill and Effluent Treatment Plant for leachate treatment falls under Scheduled Category B, wherein all projects have to obtain environmental clearance from the respective **State Environment Impact Assessment Authority (SEIAA).** Accordingly, the implementing agency needs to conduct an EIA and get it approved by the SEIAA before embarking on construction activities at the proposed landfill site. Project with ***Incineration facilities*** has been considered under **Category A**, where the projects will require prior EC from the Central Government in the Ministry of Environment and Forest on recommendation of Environment Appraisal Committee (EAC)

5.2 Quality Assurance and Quality Control

Quality Assurance and Quality Control (QA/QC) activities include General Quality of Construction for collection, transportation, treatment (e.g. Aerobic Composting unit, Refused Derived Fuel; RDF unit) and disposal facilities.

- All items of building works shall conform to standards given in the National Building Code (NBC) / Central and State Public Works Department (CPWD) and PWD specifications for Class 1 building works;
- Bureau of Indian Standards (BIS);
- Any other standards specified by Project Engineer;
- Suitable specification/standard devised by the Project Engineer;
- Any other standard as approved by the Project Engineer;
- MSW Rules.

The Contractor for this work shall be required to work in co-operation and co-ordination with other agencies on site and give them all reasonable assistance and help for the execution of the work in an efficient manner as directed.

6. Project Financing

SWM projects require a large dose of capital investment and continuously increasing operation and maintenance costs over time. SWM must be treated as a specific and exclusive project which requires large capital investment as well as large operation and maintenance cost.

Box 9: Requirement for Developing Bankable Projects

There is **a dire need to develop bankable and sustainable projects** in Solid Waste Management sector. There is considerable O&M cost involved to run SWM projects; hence cities must focus on developing projects which can sustain from the revenues generated from the SWM services

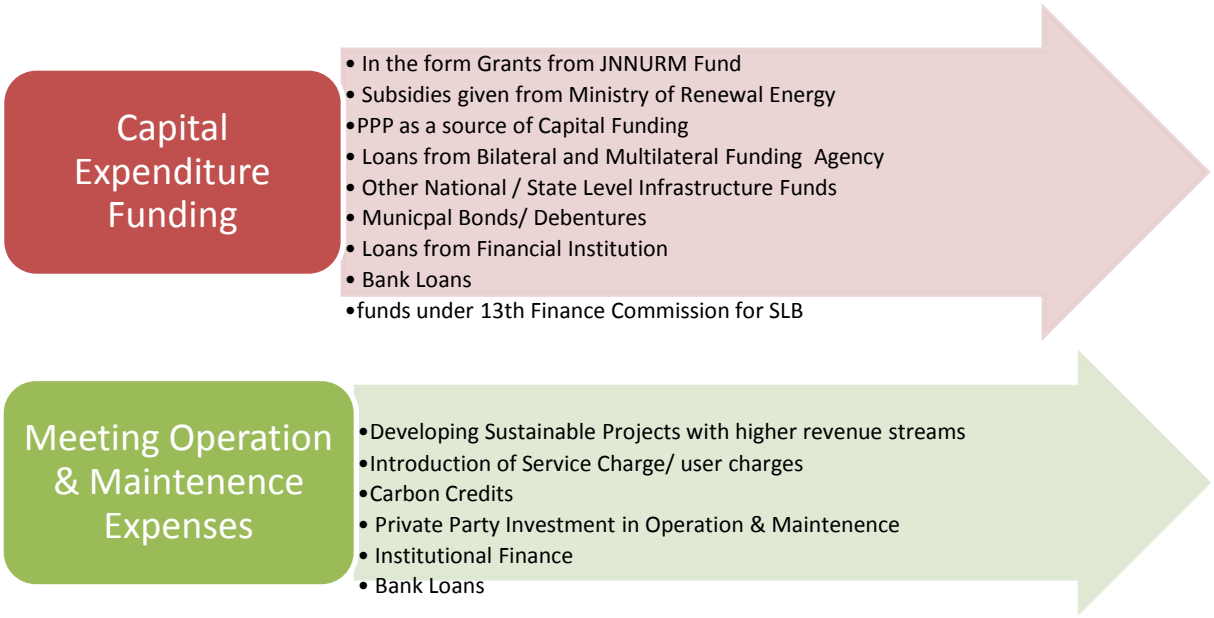


Figure 6.1: Meeting Capital and O&M Expenses in MSW projects

6.1 JNNURM Grants

The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) was launched by the Government of India on 3rd December 2005, envisaging an investment of more than Rs.1,00,000 Crore during a period of 7 years from 2005-06 to 2011-12 with a committed Central Government share of Rs. 66,000 Crore. JnNURM is a reform driven, fast track programme to ensure planned development of identified cities with focus on efficiency in urban infrastructure/service delivery mechanisms, and through community participation and enhanced accountability of ULBs/parastatal agencies towards citizens. Further information about availing funds from JnNURM are available on the following: http://jnnurm.nic.in/wp-content/uploads/2011/01/English1_Toolkit1.pdf

6.2 PPP as a source of Funding

Public Private Partnerships (PPP) are innovative methods used by the public sector to contract with the private sector who bring their capital and/or their ability to deliver projects on time and to budget, while the public sector retains the responsibility to provide these services to the public in a way that benefits the public and delivers economic development and improvement in the quality of life.

Box 10: Loans from International Agencies

All loan projects of bi-lateral and multi-lateral agencies are backed by a sovereign guarantee, the **Department of Economic Affairs, Ministry of Finance**; Government of India plays an important role during the entire process. In line with the development financing objectives of these institutions, projects funded by these institutions are typically in sectors that are not commercially attractive such as SWM.

6.3 Loans from Bilateral and Multi Lateral Agency

Bi-lateral and Multi-lateral bodies also known as *Development Agencies* like World Bank, Asian Development Bank (ADB) etc. provide soft loans and grants for infrastructure projects.

6.4 National/ State level Infrastructure Funds

Infrastructure funds both at the National and State level plays an important role in development of financial market for infrastructure projects. The Finance Budget 2007 has also allowed State Pooled Finance Entities (SPFEs) to issue tax-free municipal bonds.

6.5 Municipal Bonds and Debentures

Municipal Bonds or debentures are issued by the ULBs and Infrastructure funds to be redeemable after a specific period and have a definite rate of interest. In India, the Municipal bond market is still in its nascent stages. Only ULBs which are large and have buoyant revenue base e.g. Ahmadabad, have been successful in the past in raising funds through Municipal Bonds.

6.6 Loans from Financial Institutions

Specialised Financial Institutions e.g. IDFC and IL&FS are some agencies which provide loans and a variety of instruments for infrastructure financing. Other Financial Institutions e.g. ICICI, IDBI, LIC of India, etc. also provide funds for infrastructure projects. These institutions have access to funds which are for longer duration e.g. loans from development agencies, bonds from open market, foreign institutional investors, etc. and are thus able to lend for relatively longer durations than banks.

Box 11: Loans from Funding Agency

Tamil Nadu Urban Development Fund (TNUDF)

- *Established in November 1996 as a Trust*
- *Public Private Partnership between GoTN, ICICI Bank, HDFC and IL&FS*
- *Involved in Project Development, Project Appraisal, Financial structuring and assisting projects in accessing the capital markets*

6.7 Bank Loans

Bank loan is an easier option for finance as the banks have prescribed norms and well laid down procedures.

6.8 Enhancing Revenues in SWM Projects

However it is imperative that the project be planned in such a way that it is self sustainable and can deliver desired outcomes for a longer period. As in case, projects must be planned considering revenue streams which could be availed from a SWM project are from the following areas:

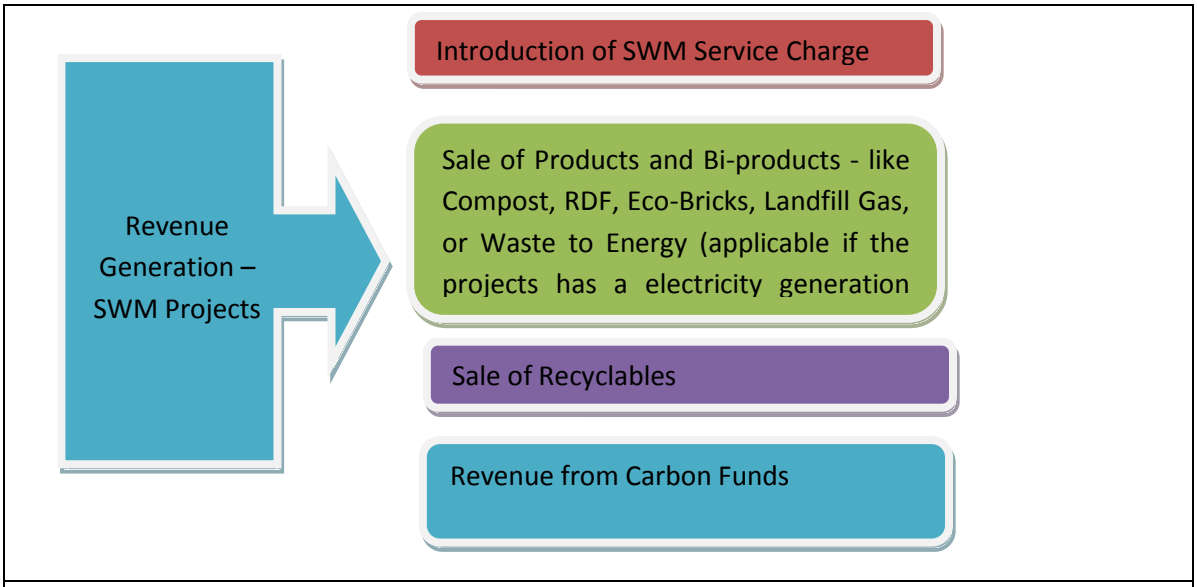


Figure 6.2 : Illustration of SWM Revenue Streams

6.9 Introduction of SWM Service Charge

- The 74th amendment to the Constitution has resulted in devolution of powers and responsibilities upon municipalities in relation to matter listed in the Twelfth Schedule.
- It is desirable to provide for levying of a dedicated tariff for solid waste services.

Box 12: MSW Service Charge in Sanand

In Sanand, a small municipality in Gujarat, a nominal service charge of Rs. 100 per annum per household as SWM cess for MSWM activities is collected along with Property Tax.

- The municipal authorities can use a percentage of the property tax for solid waste services and accordingly introduce a sanitation /or SWM cess to meet the cost of providing MSWM services.
- The rate of service charge can be based on any one or more of the following principles:-
    - The Marginal Cost of Solid Waste Management
    - Ability to Pay
    - Willingness to Pay
- The urban local body must take account of the three factors while deciding SWM charges. The Marginal cost is calculated considering infrastructure capital and O & M cost, revenues and unforeseen liabilities liabilities to the project, while the other two factors, i.e. Ability to Pay and Willingness to Pay must be determined by taking up detailed surveys.

Web link: Model Questionnaire for Demand Assessment and Willingness to Pay Survey: World Bank.
http://www.worldbank.org/urban/solid_wm/erm/Annexes/US%20Sizes/New%20Annex%204D.3.pdf

6.10 Carbon Credits through Kyoto Mechanism

The Carbon finance is designed on the rationale that more polluting 'industrial' countries shall pay for such projects in developing countries which contribute to the reduction of Green House Gas (Green House Gas) emissions. This provides an excellent opportunity to tap an additional source of revenue for SWM projects in developing countries like India. About National CDM Authority – Ministry of Environment and Forest

The National Clean Development Mechanism (CDM) Authority of Ministry of Environment and Forest (http://www.cdmindia.gov.in/) is the Nodal Agency for all CDM activities in India. The National Clean Development Mechanism (CDM) Authority receives projects for evaluation and approval as per the guidelines laid down by the United Nations Framework Convention on Climate Change(http://cdm.unfccc.int/).

7. Private Sector Participation in Solid Waste Management

7.1 Defining PPP, and Scope of PPP in SWM

PPP typically involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project. PPPs cover the entire gamut of contracts ranging from simple service contracts to long-term concessions.

Table 8.1. Cities providing SWM Services through PPP

S.No	Service through PPP	Name of City
1	Door-to-door Collection	Bangalore, Ahmadabad, Nagpur, Jaipur, North Dumdum, New Barrackpore (West Bengal), Gandhinagar, Delhi
2	Street Sweeping	Surat, Hyderabad
3	Storage and Transportation	Surat, Ahmedabad, Mumbai, Delhi
4	Treatment & Disposal	Delhi, Bangalore, Coimbatore, Kolkata, Chennai, Ahmadabad, Chennai
5	Integrated MSWM (complete value chain)	Guwahati, Hyderabad, Chennai,

The MOUD through its JnNURM has a mandate to propagate PPP and has done much by improving capacities with urban local bodies through documentation and journals. Some of the initiatives could be traced following the web links;

Box 13: PSP publications available

Private Sector Investment in Infrastructure has been dealt in detail by several initiatives from Government of India.

1) Toolkit for Analysis of Urban Infrastructure Projects for PPP under JnNURM
http://jnnurm.nic.in/wp-content/uploads/2011/01/10.ToolkitPP.pdf

2) PPP in SWM Procurement Guidelines:
http://jnnurm.nic.in/wp-content/uploads/2011/01/Model%20PPP%20Framework%20(Bleed%205%20mm).pdf

3) MSW Treatment Process and PPP Prospects:
http://jnnurm.nic.in/wp-content/uploads/2011/01/MSWM%20Brochure%20(Bleed%205%20mm).pdf

4) Sample EOI for PPP projects in SWM
http://jnnurm.nic.in/wp-content/uploads/2011/01/Sample%20EOI_11.12.2011.pdf

5) Sample RFP and Draft Concessionaire Agreement for PPP projects in SWM
http://jnnurm.nic.in/wp-content/uploads/2011/01/Sample%20RFP-Concessionaire%20Agreement_11.12.2011.pdf

6) Schemes and Guidelines for India Infrastructure Public Development Fund
http://www.urbanindia.nic.in/programme/uwss/Guideline_Scheme_IIPDF.pdf

7) SWM PPP Toolkit Volume I - IV
http://www.urbanindia.nic.in/programme/uwss/SWM_PPP_Tookit-Volume-I.pdf
http://www.urbanindia.nic.in/programme/uwss/SWM_PPP_Tookit-Volume-II.pdf
http://www.urbanindia.nic.in/programme/uwss/SWM_PPP_Tookit-Volume-III.pdf
http://www.urbanindia.nic.in/programme/uwss/SWM_PPP_Tookit-Volume-IV.pdf

7.2 PPP project development process – PPP Lifecycle

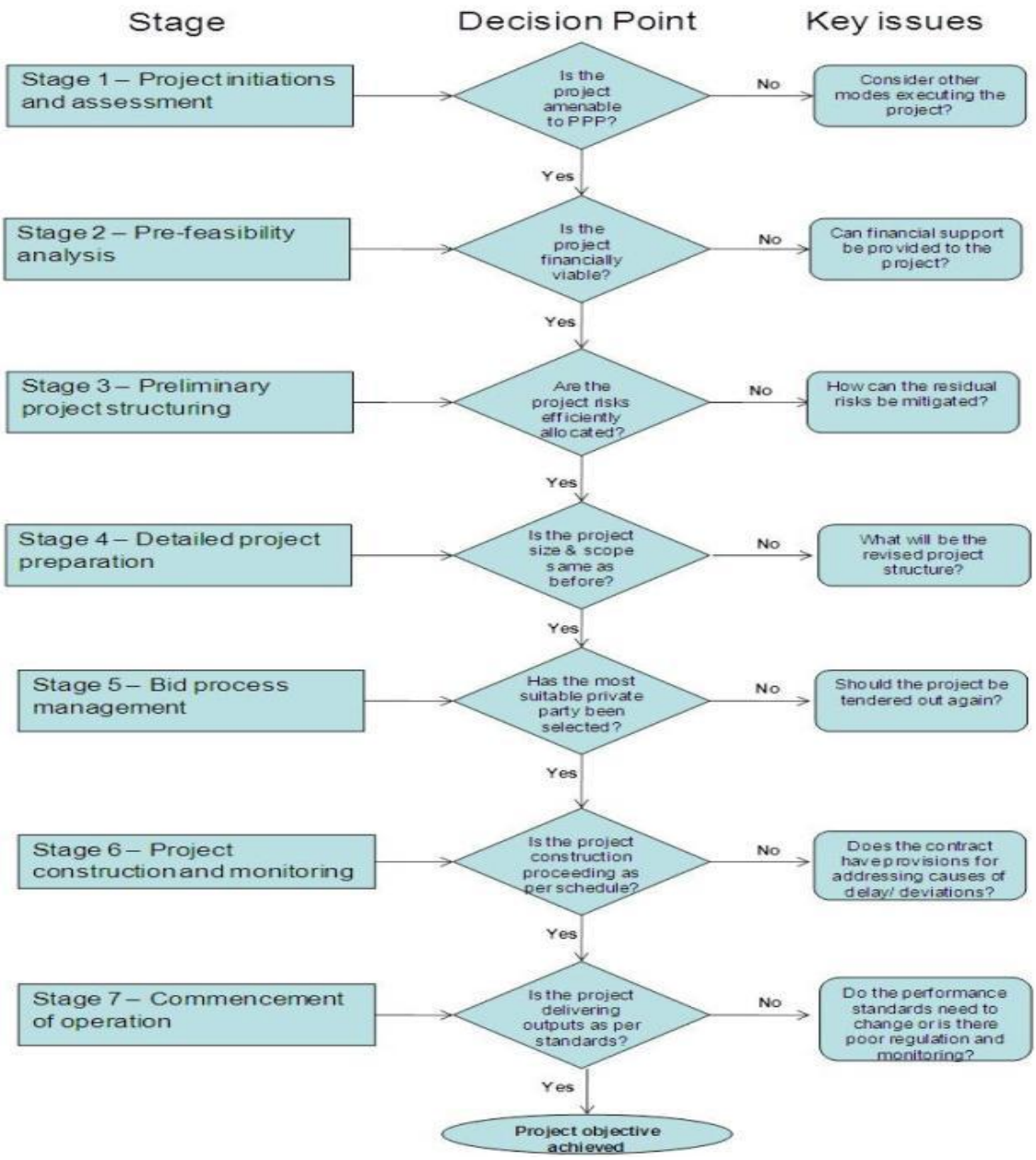
The typical lifecycle of a PPP project consists of similar stages of a project planning discussed in earlier sections of this toolkit. Only that this section has been described focussing PPP feasibility of projects. The stages of a PPP project development includes seven stages (detailed subsequently). The entire lifecycle can be divided into seven distinct stages each, which are briefly discussed below.

- **Stage 1: Project initiation and assessment:** The suitability of undertaking the project through PPP route should be analysed by considering the objectives to be achieved by implementing the project.
- **Stage 2: Pre-feasibility analysis:** This involves a quick assessment of the commercial feasibility of undertaking the project. It includes estimation of capital expenditure, operating/recurring expenses, and revenue stream, if any, from the project.
- **Stage 3: Preliminary project structuring:** Allocation of roles and responsibilities in the project to different stakeholders in a manner that the risks are assigned to entities best suited to manage them.
- **Stage 4: Detailed project preparation:** If more information on technical, cost or commercial aspects is necessary, detailed project report may be prepared.
- **Stage 5: Bid process management:** This includes preparation of bid documents, preparation of Expression of Interest (EoI), Request for Qualification (RfQ) and Request for Proposal (RfP), Invitation to Bid (ITB), Bid Evaluation and preparation of draft concession agreement.
- **Stage 6: Project construction and monitoring:** Once project construction begins, it should be monitored on pre-agreed parameters at regular intervals. Corrective action may be necessary to ensure that the project will be completed within agreed time and cost.

- **Stage 7: Commencement of operation and monitoring of contract:** This marks the completion of construction phase. The project is now available for delivering the service for which it was intended. It is necessary to monitor whether the quality and quantity of service delivered by the project meets the performance standards as originally agreed. The monitoring will have to be done throughout the project life time and systems for ensuring quality services will have to be put in place.

- The key decisions and outputs of each of the stages are presented in figure below.

Figure 7.1 – PPP lifecycle – Stages, decision points and key issues



8. Performance Standards in Solid Waste Management

Performance standards are important to evaluate service delivery of any system or an individual, as it is key to improvement of work performance.

8.1 Service Delivery Benchmarking

As part of the ongoing endeavor to facilitate the urban sector, the Ministry of Urban Development has adopted National Benchmarks in four key sectors—Water Supply, Sewerage, Solid Waste Management and Storm Water Drainage. Urban local bodies are to generate performance reports on service level benchmarks (SLBs) periodically.

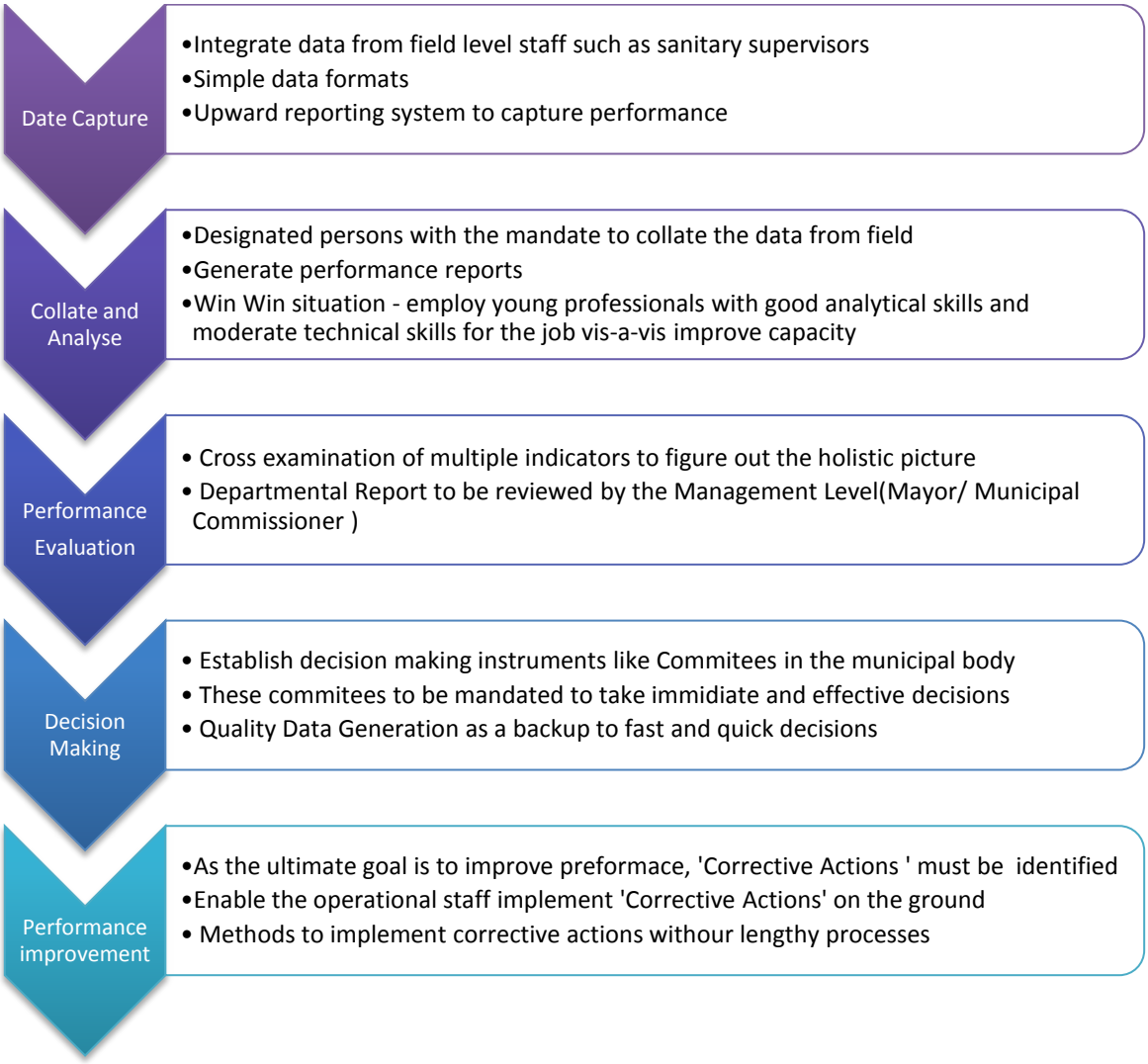


Figure 8.1: Establishing Systems to monitor service delivery

8.2 Service Level Benchmarks (SLB)

The following lists of SLBs have been chosen so as to reflect the multiple facets of service delivery performance.

Table 9.1: SWM Service Level Benchmarks at Glance

S. No	Indicator	Unit	Value
1	Household level coverage of SWM services	As % of households and establishments that are covered by daily door-step collection system.	100%
2	Efficiency of Collection of Municipal solid waste	As % of total waste collected by ULB and authorized service providers against waste generated within the project area (excluding the waste recycled through rag pickers)	100%

S. No	Indicator	Unit	Value
3	Extent of Segregation of municipal solid waste	As % of households and establishments that segregate their waste	100%
4	Extent of municipal solid waste recovered	Quantum of waste collected, which is either recycled or Processed, expressed as %.	80%
5	Extent of scientific disposal of solid waste	As % of waste disposed in a sanitary landfill site against total quantum of waste disposed in landfills and dump sites.	100%
6	Cost Recovery in SWM services	Expressed as % recovery of all operating expenses related to SWM Services that the ULB is able to meet from the operating revenues of sources related exclusively to SWM.	100%
7	Efficiency in Redressal of customer complaints	As a % of total number of SWM related complaints resolved against total number of SWM complaints received within 24 hrs time period	80%
8	Efficiency in collection of charges	Efficiency in collection is defined as - Current year revenues collected, expressed as a % of the Total operating revenues, for the corresponding time period.	90%

9. Community Participation and Role of Information Education and Communication activities in SWM projects

9.1 Public participation in SWM:

Public Participation Environmental issues are best handled with the participation of all concerned citizens (viz school children), on a relevant level. Public awareness, effective community participation, transparent and clean administration, and accountability at all levels can only bridge the gap of governance in waste management and issues pertaining to successful management of waste.

9.2 Essential steps of public participation

Following are the essential steps to be adopted by the municipality during the process of waste management. Stake holder consensus building;

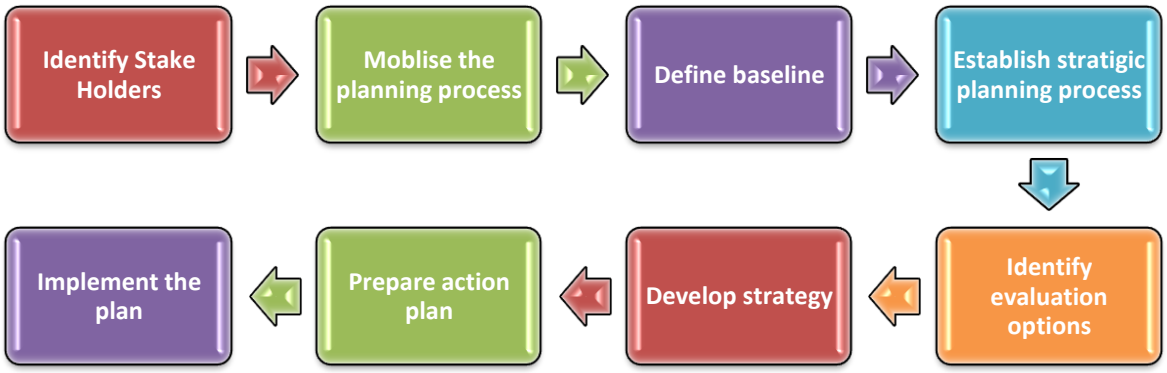


Figure 9.1: Essential Steps to Public Participation

9.3 Confidence Building:

Confidence-building measures (CBMs) have the objective to prevent, manage and resolve crises that are likely to escalate during the solid waste management process. Small activities may be conducted time to time for gap filling before the launch of main activity so a bounding of trust may be developed between waste management team and community.

Residential Area:

Classification of community may be in three categories-

a. Low income group
b. Middle income group
c. High income group

Commercial Areas:

Commercial area may be classified into following three categories:-

a. Vegetable markets
b. Shopping areas
c. Offices/institutional areas

In each of above areas, issues regarding the SWM are different. Even type of waste also varies. Hence the areas need to be catered separately.

9.4 People's Participation is Essential in the Following Areas

- Reduce, Reuse & Recycling (3R) of waste;
- Not to throw the waste/litter on the streets, drains, open spaces, water bodies etc;
- Pay adequately for the services provided;
- Primary collection and segregation of waste;
- Storage of organic/bio-degradable and recyclable waste separately at source;

- Community storage/collection of waste in flats, multi-storied buildings, societies, commercial complexes, etc;
- Managing excreta of pet dogs and cats appropriately; and
- Waste processing/disposal at a community level (optional).

9.5 Reach the Community:

The local body should decide the methodology to be adopted for reaching the community and seeking their cooperation and effective participation in SWM services. Designing inclusive projects involving and benefiting highest number of stake holders(such as rag pickers in waste collection and segregation) is a way to reach to the masses and make them accept initiatives for change such as segregation at source or recycling of waste etc.

9.6 Identification of Problems:

Consult with the local community at the time when the community is generally available for interaction at home.

9.7 Finding out Optional Solutions

Having identified the deficiencies in the system and known the public perceptions, the next essential step is to think of optional solutions to tackle the problems.

9.8 Consult Community on Options Available

Having done this homework, there should be second round of consultative process and their suggestions may be sought on each solution proposed and be first appraised of the options available and then asked to give their considered opinion on what will work in their area and how much they are willing to cooperate.

9.9 Workout the Strategy of Implementation

After the consultative process, strategy for implementation of the system may be worked out and pilot projects may be taken up in the areas where better enthusiasm is noticed and demonstrate the successes to other areas and gradually implement in rest of the areas of the city/town.

9.10 Public Information, Education, Communication Programs (IEC)

For the successful implementation of any program involving public at large in SWM system, it is essential to spell out clearly and make them known the manner in which local body proposes to tackle the problem of waste management Ensure that the people become aware of the problems of waste accumulation and the way it affects their lives directly.

Public Education: The communication material developed should be utilised in public awareness programmes through variety of approaches as under.

Group Education: This may be done through:

Figure 9.2: Ways to Group Education

Mass Education

This is very essential to cover the entire population as it is not possible to reach all the people through group education programs. Mass Education programs can be planned using following methods communication. *School children can be assigned a definite role as whistle blowers in their areas. Award system to be instituted by the city and there can be a running trophy for the green ward/ green school in the city – this will rope in Councillors, School Children and Citizens*

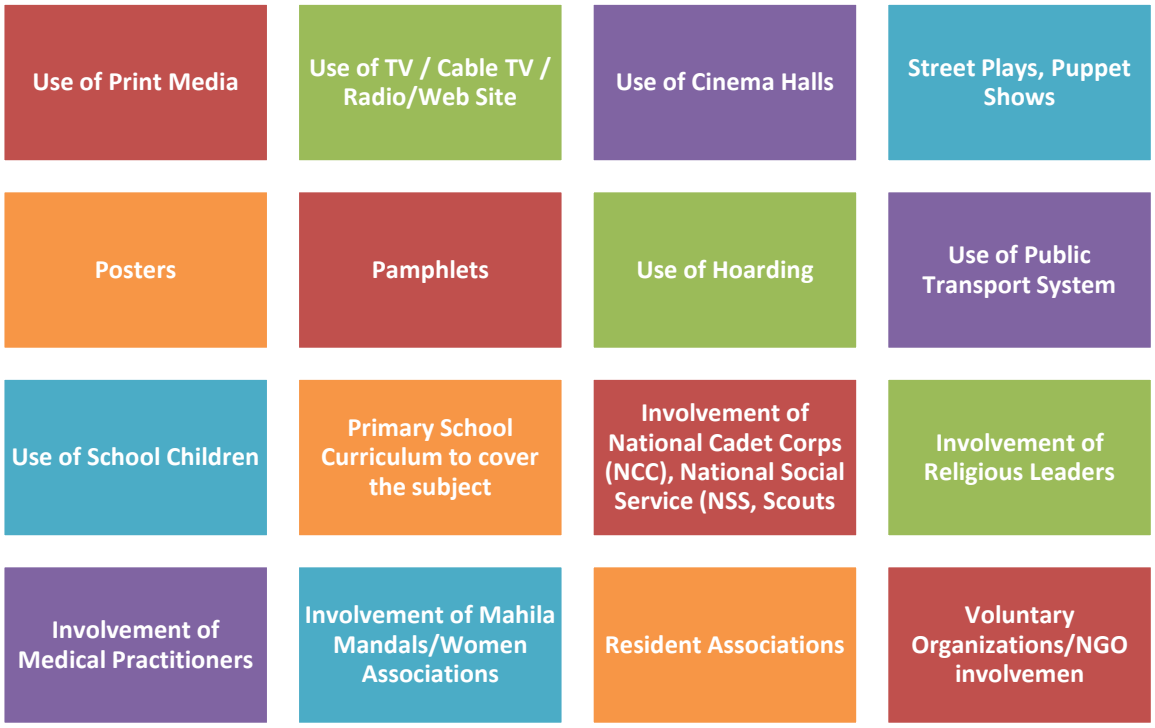


Figure 9.3: IEC Methods

10. Capacity building in MSW management

Capacity building is defined as the "process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in the fast-changing world. Capacity Building is much more than training and includes the following:

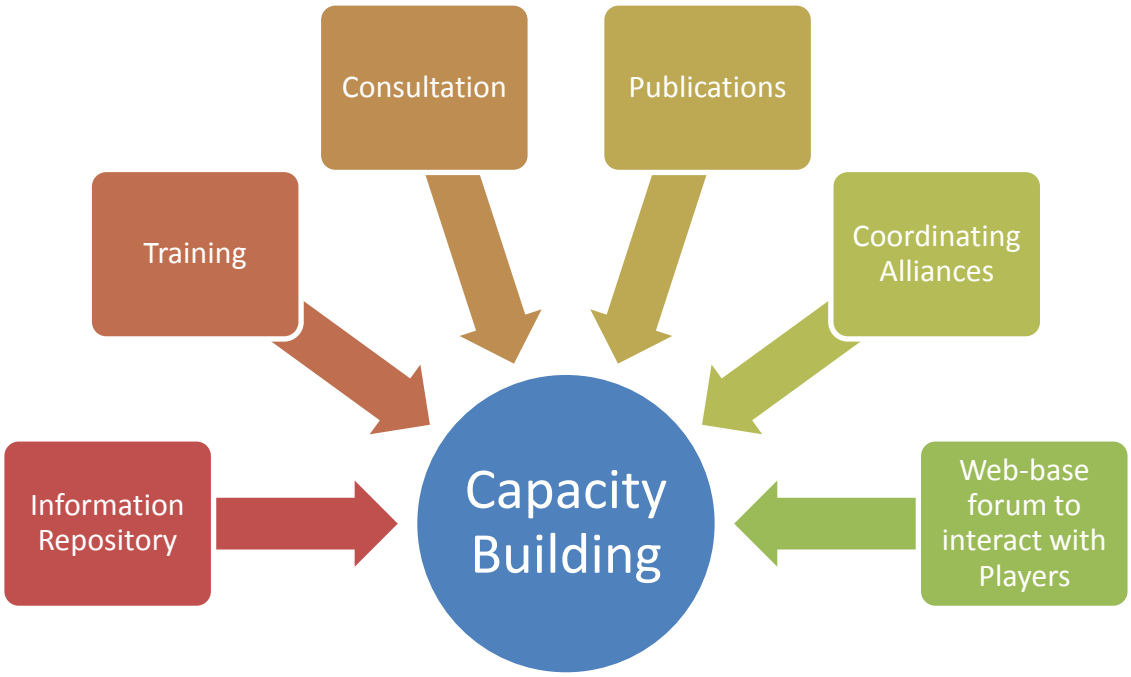


Figure 10.1: Capacity Building Approaches

The type of capacity building activities undertaken usually depends on certain factors, including:

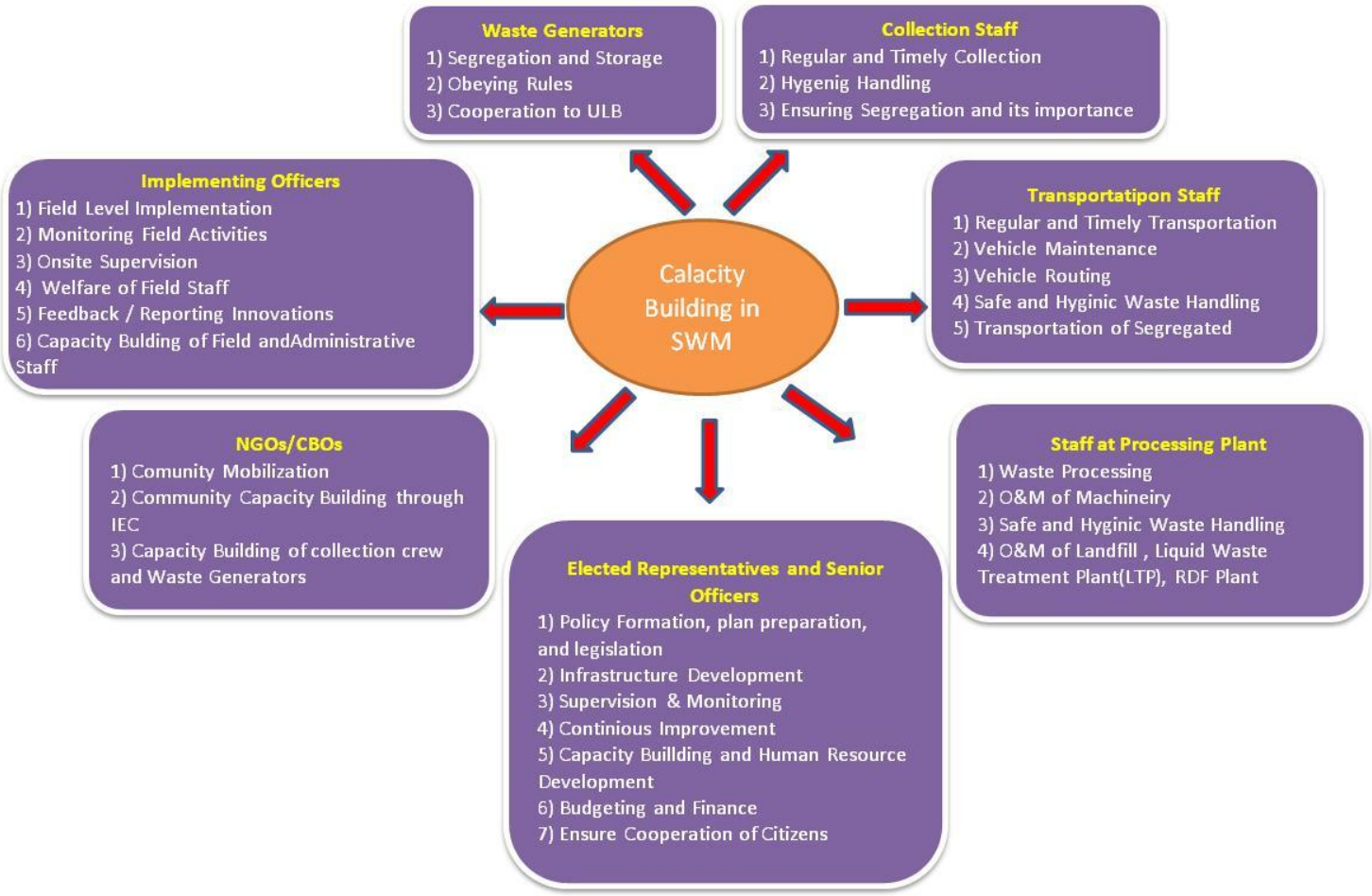
- Organizational resources (time, skills, expertise, money, facilities and equipments)
- Organizational readiness (especially the ability to discern real underlying causes of issues)
- Organizational life cycle (e.g. new ULBs or those who are about to start a waste management plant
- Need help to create, while others who already have an existing facility will tend to focus on increasing efficiency)
- Access to capacity builders and associated resources and tools (e.g. access to trainings, consultants or peer networks)

The approach to capacity building in SWM should be not only about technology and economics but also about:

- Understanding the administration systems for waste management and related activities (multidisciplinary and cross-sectoral).
- Understanding the need for human resource development to achieve better results in SWM.

- Focus on building sound institutions and good governance for attaining improved SWM.
- Delineating strategies for sustenance of achievements.

Figure 10.2: Capacity Building Approaches



Disclaimer

This document has been compiled by the Technical Cell of JnNURM Mission Directorate. The primary purpose of this document is to provide information about SWM sector and project implementation. This document is a guidance document; hence suitable expertise assistance may be engaged during executing waste management projects.

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