

MINISTRY OF URBAN DEVELOPMENT  
CENTRE OF EXCELLENCE IN URBAN DEVELOPMENT

in the area

SOLID WASTE AND WASTE WATER MANAGEMENT

STRATEGY AND FRAMEWORK FOR MUNICIPAL SOLID WASTE MANAGEMENT



CENTRE FOR ENVIRONMENT AND DEVELOPMENT

THIRUVANANTHAPURAM

OCTOBER 2011

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**STRATEGY AND FRAMEWORK FOR MSW MANAGEMENT**



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## PREFACE

The Ministry of Urban Development (MoUD), Government of India, through its activities proposed under the Capacity Building Scheme for Urban Local Bodies (CBULB) established Centres of Excellence (CoE) in reputed institutions in the country to create the necessary knowledge base for improving municipal service delivery and management. The establishment of CoEs is an acknowledgement of the need for high quality Indian-context-specific research and creative interventions in the areas of governance, institution and capacity building, citizen-centric administration and resource and performance management. In establishing the CoEs, the MoUD expected that the CoEs would be able to find solutions to the many issues faced by Urban India. The basic objective of the CoEs is to foster cutting-edge and crosscutting research, capacity building and technical knowledge base in the area of urban development. The CoEs will address urban development issues at national, state and local levels and will provide support to state and local governments in:

The MoUD has approved a project to Centre for Environment and Development to set up a Centre of Excellence on 'Solid Waste and Waste Water Management'. The basic objective was to develop the capacity of the institution to support the Urban Local Bodies (ULB) in the country on solid waste and waste water management related activities. The CoEs will work with selected ULBs to develop strategies and framework to implement activities.

The CoE at CED which is concentrating on 'Solid Waste and Waste Water Management' has been focusing on three major aspects (i) Development of Strategy and Framework for Solid Waste and Waste Water Management in ULBs (ii) Capacity Building, Training and Awareness and (iii) Development of Knowledge Centre and Technical Support Unit on Solid Waste and Waste Water Management. CED is also working with Thiruvananthapuram City Corporation and Payyannur Municipality on these two sectors and trying to integrate the field experience to develop the strategy and framework.

The CoE team at CED has developed eight Resource Materials on SWM such as (1) Strategy and Framework for MSW Management (2) SWM Technology Manual (3) Operation and Maintenance Manual (4) Byelaw for ULBs on Solid Waste (Handling & Management) (5) Strategy and Framework for Wastewater Management, (6) Course Material on Solid Waste Management (7) Course Material on Wastewater Management and (8) Capacity Building and Training Manual. These documents had already submitted to MoUD and also to ASCI for Peer Review and their comments has also been incorporated in this final document.

The Strategy and Framework for MSW Management is meant for policy-decision makers, planners and other functionaries of ULBs to formulate programmes and procedures for SWM. It explains the different types of solid wastes, its characteristics and strategy to be adopted in each step and the framework for each activity components. The strategy and framework is developed through analysing the secondary information, discussions with municipal functionaries and experts and also integrating the experiences of CED in working with the ULBs in general and Thiruvananthapuram and Kochi City Corporations and Payyannur Municipality in particular. Each activity components are analysed on the background of field experiences and tried to incorporate those learnings in to the strategy and framework.

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## 1. INTRODUCTION

Efficient delivery of public services and infrastructure are pressing issues for Urban Local Bodies (ULBs) in most developing countries; and in many countries, solid waste management has become a top priority. Solid Waste Management (SWM) is a system for handling of all type of garbages. The end goal is to reduce the amount of garbage clogging the streets and polluting the environment, whether it is disposed of or recycled into something useful.

Different types of interventions are essential to improve the quality of our cities and reducing the adverse health and environmental effects. Improper and unscientific SWM measures usually adopted in many countries not only has its local significance but pose much wider global implications. Climate change and effects of greenhouse gas emissions have made SWM, one of the most pressing environmental challenges globally as well as locally. It is well understood that inappropriate SWM practices, such as improper incineration and uncontrolled disposal of wastes are major contributors to greenhouse gas emissions; the anaerobic degradation of waste in landfills produces methane, a gas that is 21 times more potent than carbon dioxide.

The total Indian urban population amounts to approximately 285 million (World Bank, 2008). There are 4,378 cities and towns in India. Of these cities, according to the 2001 census, 423 are considered class I, with a population exceeding 100,000 (one lakh). The class I cities alone contribute to more than 72 percent of the total municipal solid waste (MSW) generated in urban areas. This includes 7 mega cities (which have a population of more than 4 million), 28 metro cities (which have a population of more than 1 million), and 388 other towns (which have a population of more than 1 lakh) (NEERI, 1996). The Central Public Health and Environmental Engineering Organization (CPHEEO) estimated per capita waste generation in Indian cities and towns in the range of 0.2 to 0.6 kilograms per day.

According to Central Pollution Control Board (CPCB), average collection coverage ranges from 50 to 90 percent. Of the collected wastes, 94 percent is disposed of without any scientific management practices. Hence, there is severe pollution of groundwater and surface water through leachate, as well as air through uncontrolled burning of wastes.

About 40 per cent of the urban population is currently residing in 40 Metros in India (World Bank, 2008). The urban local bodies responsible for providing the basic services like water supply, sewerage and solid waste management and other amenities to the people are finding it extremely difficult to cope up with the ever increasing demand due to fast growth of urban population.

Management strategies should be in such a way as to perform (i) Protection of environmental health (ii) Promotion of the quality of environment (iii) Supporting the efficiency and productivity of the economy and (iv) Generation of employment and income.

There are different types of solid wastes which need to be dealt with. The first is those wastes which can be recycled. Solid waste management includes the construction of facilities to recycle these goods, which include scrap metal, glass, cans, paper, plastics, wood, and similar materials. Another category is toxic waste, which could potentially contaminate the environment, meaning that it needs to be handled with care. This category includes electronic waste, a growing problem in many industrialized nations. Next is green waste which can be composted and returned to the earth.

The objective of solid waste management is to reduce the quantity of solid waste disposed off on land by recovery of materials and producing energy from solid wastes. Municipal solid waste management (MSWM) involves the application of principle of Integrated Solid Waste Management (ISWM) to municipal waste. ISWM is the application of suitable techniques, technologies and management options dealing with all types of solid wastes from all sources to achieve the twin objectives of (a) waste reduction and (b) effective management of wastes still produced after waste reduction (Cointreau, 2001).

### 1.1 Waste Generation and Composition

Information on waste quantity and composition is important in evaluating alternatives in terms of equipment system, plans and management programmes. For example, if wastes generated at a commercial facility consist of only paper products, the appropriate equipments are shredders and balers. Similarly, on the basis of quantity generated, we can plan appropriate means for separation, collection and recycling programmes for wastes.

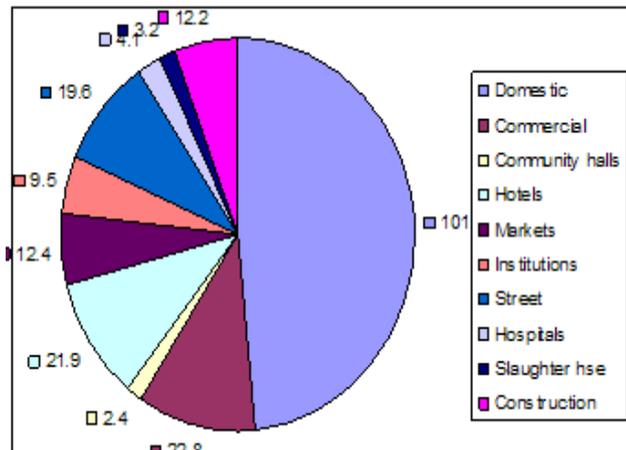


Fig. 1 : Waste generation by sources

The studies carried out by the National Environmental Engineering Research Institute (NEERI) in Indian cities have revealed that quantum of MSW generation varies between 0.21-0.35 kg/capita/day in the urban centres and it goes up to 0.5 kg/capita/day in large cities (NEERI, 1996).

Waste composition also depends on the moisture content, density and relative distribution of municipal wastes. CPCB with the assistance of NEERI has conducted survey of solid waste management in 59 cities (35 metro cities and 24 state Capitals: 2004-05)

### 1.2 Waste Characteristics

The characteristics of wastes can be divided into physical and chemical characteristics. The analysis of characteristics is very important in determining the appropriate processing options and identification of technology.

The major components for determining the physical characteristics are density of waste, moisture content, size, etc

The knowledge on chemical characteristics is essential if solid wastes are to be used as fuel, or are used for any other purpose. The major components to be assessed are lipids, carbohydrates, proteins, natural fibres, synthetic organic materials (plastics), non-combustibles, heating value etc. When evaluating incineration as a means of disposal or energy recovery, we need to consider the heating values of respective constituents. (The waste characteristics of some Indian cities are given in Table.1)

**Table. 1**  
**Waste characterization in major Indian cities**

S. No	Name of City	Compostables (%)	Recyclables (%)	C/N Ratio	HCV* (Kcal/Kg)	Moisture (%)
1	Panjim	61.75	17.44	23.77	2211	47
2	Kohima	57.48	22.67	30.87	2844	65
4	Simla	43.02	36.64	23.76	2572	60
5	Agartala	58.57	13.68	30.02	2427	60
6	Pondicherry	49.96	24.29	36.86	1846	54
7	Jammu	51.51	21.08	26.79	1782	40
8	Dehradun	51.37	19.58	25.90	2445	60
9	Bhubaneswar	49.81	12.69	20.57	742	59
10	Thiruvananthapuram	72.96	14.36	35.19	2378	60
11	Chandigarh	57.18	10.91	20.52	1408	64
12	Guwahati	53.69	23.28	17.71	1519	61
14	Amritsar	65.02	13.94	30.69	1836	61
15	Bhopal	52.44	22.33	21.58	1421	43
16	Lucknow	47.41	15.53	21.41	1557	60
17	Ahmedabad	40.81	11.65	29.64	1180	32
18	Hyderabad	54.20	21.60	25.90	1969	46
19	Bangalore	51.84	22.43	35.12	2386	55
20	Chennai	41.34	16.34	29.25	2594	47
21	Kolkata	50.56	11.48	31.81	1201	46
22	Delhi	54.42	15.52	34.87	1802	49
23	Greater Mumbai	62.44	16.66	39.04	1786	54

Source: CPCB, 2004-05

### 1.3 Classification of Solid Waste

Knowledge of the sources and types of solid wastes as well as the information on composition and the rate at which wastes are generated is essential for the design and operation of the functional elements associated with solid waste management. Solid wastes are generally classified in to two, based on **source** of generation and **type**.

Based on the source of generation, solid waste can be classified into residential, commercial, institutional, industrial, agricultural etc. (Table 2)

There are mainly two categories of wastes based on the type-biodegradable and non-biodegradable. This classification is based on physical, chemical and biological characteristics of wastes. Biodegradable wastes mainly refer to substances consisting of organic matter such as leftover food, vegetables and fruit peels, paper, textile, wood, etc., generated from various household and industrial activities. Because of the action of micro-organisms, these wastes are degraded from complex to simpler



compounds. Non- biodegradable wastes consist of inorganic and recyclable materials such as plastic, glass, cans, metals, etc.

Management of solid waste may be defined as the control of generation, storage, collection, transfer and transport, processing, and disposal based on scientific principles. This includes all technological, financial, institutional and legal/ policy aspects involved for solving the whole spectrum of issues related with solid wastes.

The SWM processes differ depending on factors such as socio-economic status, degree of industrialization, social development (e.g., education, literacy, healthcare etc.), life style and quality of life of a location. In addition regional, seasonal and economic differences influence the SWM processes. (Degeneration time for both types of wastes is given in Table.3)

**Table. 2**  
**Classification of Solid Wastes**

<b>Type</b>	<b>Description</b>	<b>Source</b>
Garbage	Wastes from the preparation, cooking and serving of food, market refuse, waste from the handling, storage, and sale of produce and meat.	Households, institutions and commercial concerns such as hotels, stores, restaurants, market, etc
Combustible and non-combustible	Combustible (primarily organic) paper, cardboard, cartons, wood, boxes, plastic, rags, cloth, bedding, leather, rubber, grass, leaves, yard trimmings etc.	
Ashes	Residue from fires used for cooking and for heating building cinders	
Bulky wastes	Large auto parts, tyres, stoves, refrigerators, other large appliances, furniture, large crates, tree branches, stumps etc	Streets, sidewalks, alleys, vacant plots etc.
Street wastes	Street sweepings, dirt, leaves etc.	
Dead animals	Dogs, cats, rats, donkeys etc.	
Abandoned vehicles	Automobiles and spare parts	
Construction and demolition wastes	Roofing and sheathing scraps, rubble, broken concrete, plaster, conduit pipe, wire, insulation etc	Construction and demolition sites
Industrial wastes	Solid wastes resulting from industrial processes and manufacturing operations, such as food processing, boiler house cinders, wood, plastic and metal scraps, shaving etc.	Factories, power plants etc
Hazardous wastes	Pathological wastes, explosives, radioactive materials etc.	Households, hospitals, institutions, stores, industry etc.
Animals and agricultural wastes	Manure, crop residues etc.	Livestock, farms, feedlots and agriculture
Sewage treatment residue	Coarse screening grit, septic tank sludge, dewatered sludge.	Sewage treatment plants and septic tanks.

Source: Phelps et al., 1995

**Table. 3**  
**Degeneration Time for Biodegradable and Non-biodegradable Wastes**

Category	Type of waste	Approximate time taken to degenerate
Biodegradable	Organic waste such as vegetable and fruit peels, leftover foodstuff, etc	A week or two
	Paper	10-30 days
	Cotton cloth	2-5 months
	Woollen items	1 year
	Wood	10-15 years
Non-biodegradable	Tin, aluminum, and other metal items such as cans	100-500 years
	Plastic bags	One million years
	Glass bottles	Undetermined

Source: Phelps et al, 1995

### 1.4 Functional Elements

There are various functional elements associated with the management of solid wastes such as segregation, collection, transportation, processing and disposal which are given below:

**Waste generation:** Wastes are generated at the start of any process, and thereafter, at every stage as raw materials are converted into goods for consumption. The source of waste generation determines quantity, composition and waste characteristics.

**Waste storage:** Storage of waste after collection and before transportation to the processing/disposal site is an important functional component. The time of storage depends on the type of waste. For example, the biodegradable waste cannot be stored for long in a storage container because of its putrescible nature. There are many options for storage like plastic containers, conventional dustbins (of households), used oil drums, large storage bins (for institutions and commercial areas or servicing depots), etc.

**Waste collection:** Collection refers to mainly two aspects; collection from the source of generation to the next collection point and collection from that point to the large vehicles for transportation or to the transfer stations and finally to the processing plant/disposal area. Collection depends on the number of containers, frequency of collection, types of collection services and routes. Collection is done either directly through the municipal services to franchised services or contracts. Recently, collection of waste from the source to the next step is carried out by Self Help Groups (SHGs) in many cities in India, which is very common in the state of Kerala. (Flow chart of typical SWM system is shown in Fig.2)

**Transfer and transport:** This functional element involves:

- the transfer of wastes from smaller collection vehicles to larger ones at transfer stations.
- the subsequent transport of the waste to disposal sites

**Processing:** Processing of waste is the most important functional component of SWM system, which leads to various types of resource recovery, recycling, energy generation, production of organic manure, etc. There are many processing techniques, which will be discussed in detail later.

**Disposal of final rejects:** Disposal of final rejects after resource recovery is one of the important functional components of SWM system. This is mainly achieved through construction of engineered sanitary landfill. Engineering principles are followed to confine the wastes to the smallest possible area, reduce them to the lowest particle volume by compaction at the site and cover them after each day's operation to reduce exposure to vermin

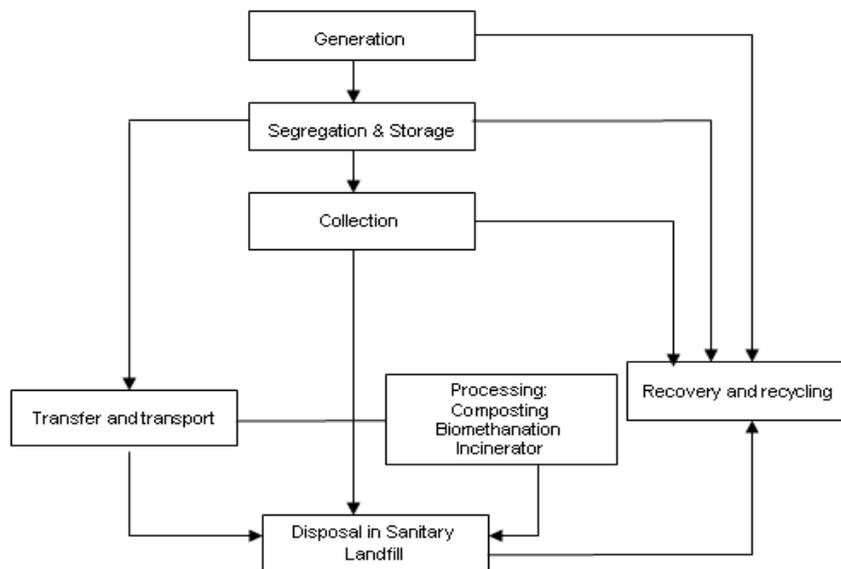


Fig. 2: Flow chart of a typical SWM system with its functional elements and linkages

### 1.5 Factors to be considered in SWM planning

There are many factors influencing the SWM planning (Phelps et al., 1995), such as:

**Quantity and characteristics of wastes:** The quantity of wastes generated generally depends on the income level of a family, as higher income category tends to generate larger quantity of wastes, compared to low-income category. One of the measures of waste composition (and characteristics) is density, which ranges from 150 kg/m<sup>3</sup> to 600 kg/m<sup>3</sup>. (Table.4) Proportion of paper and packaging materials in the waste largely account for the differences. When this proportion is high, the density is low and vice versa.

**Table. 4**  
**Typical Waste Composition**

Characteristics	Low income population	High income population	Comments
Paper	1-4%	20-50%	Low paper content indicates low caloric value.
Plastics	1-6%	5-10%	Plastic is low as compared to high-income areas though the use of plastic has increased in recent years
Ash and Fines	17-62%	3-10%	Ash and fines do not contribute to combustion process
Moisture Content	30-40%	15-30%	Moisture content depends largely on the nature of the waste, climate and collection frequency. Waste can dry out while awaiting collection
Bulk Density	300-400 kg/m <sup>3</sup>	150 kg/m <sup>3</sup>	Heavier waste may cost more to handle and difficult to burn

Source: Ali et al., 1999

**Climate and seasonal variations:** Climate has a major influence in SWM planning. In cold climates, drifting snow and frozen ground interfere with landfill operations, and therefore, trenches must be dug in summer and cover material stockpiles for winter use. Tropical climates, on the other hand, are subject to sharp seasonal variations from wet to dry season, which cause significant changes in the moisture content of solid waste, varying from less than 50% in dry season to greater than 65% in wet months. Collection and disposal of wastes in the wet months are often problematic. High temperatures and humidity cause solid wastes decompose far more rapidly than in colder climates.

**Physical characteristics of an urban area:** In urban areas (i.e.; towns and cities), where the layout of streets and houses are in such a way that access by vehicles are possible, door-to-door collection of solid wastes is comparatively easy using large compactor vehicle or smaller vehicle. Added to this is the problem of urban sprawl in the outskirts (of the cities) where population is growing at an alarming rate. Problems of solid waste storage and collection are most acute in such areas. Complexity of urban areas ranging from well established infrastructures to slums pose severe challenges in SWM.

**Management and technical resources:** Solid waste management, to be successful, requires wide spectrum of work force in keeping with demands of the system. The best system for a region is one which makes full use of indigenous crafts and professional skills and/or ensures that training programs are in place to provide a self-sustaining supply of trained work force.

## 2.0 PRESENT MANAGEMENT PRACTICES

### 2.1 Status in India

Waste generated at households is generally accumulated in small containers (often plastic buckets) until such time, that there is sufficient quantity to warrant disposal into community bins. Containers used for household storage of solid wastes are of many shapes and sizes, and are fabricated from a variety of materials. The type of the container generally reflects the economic status of its user (i.e., the waste generator). Waste segregation at source is not generally practiced.

The community storage system is usually practiced in India. Individuals deposit their waste in bins located at street corners and at specific intervals. The containers generally are constructed of metal, concrete, or a combination of the two. Community storage may reduce the cost of waste collection, and can minimize problems associated with lack of onsite storage space.

However, unless these community storage arrangements are conveniently located, householders tend to throw their wastes into the roadside gutters for clearance by street sweeping crews. Even where storage arrangements are conveniently located, wastes tend to be strewn around the storage area, partly due to indiscipline and partly as a result of scavenging of the wastes by rag-pickers and stray animals.

Different types of vehicles, varying from bullock carts to compactors, are used for waste transportation. However, the general-purpose open body trucks of 5 to 9 tonnes capacity are in common use. In smaller towns, tractor-trailers are used despite being noisy and inefficient. In few cities, compactor vehicles are also being used. The waste is transported mostly by municipal vehicles; though, in some large towns, private vehicles are also hired to augment the fleet size.

Commercial sector like shops, offices, hotels, etc. all use the community waste bins in most of the

places and their wastes are also collected along with the household wastes except in a rare number of commercial complexes where they pay a negotiated fee to the Municipal Authorities for collecting waste from their premises. Most of the shops do not open before 9 am and so do not put out their wastes out until that time, which will be left mostly on the street until the next day's collection. In short, even if there is regular collection services wastes are always seen on the streets.

Several thousands of urban dwellers in India, make their living upon wastes in many small industries using plastics, tin cans, bottles, bones, hair, leather, glass, metal, etc., recovered from MSW. All metals, unsoiled paper, plastics, glass, cardboard, etc., are readily marketable and hence recycled by householders themselves or Rag-pickers. By the time waste reaches the community bins, it contains a very little in the way of recyclable and consists mainly of vegetable / fruit peelings, scraps of soiled paper and plastic, used toiletries etc. (Jalan et al, 1995).

The larger proportion of organic matter in MSW indicates the desirability of biological processing of waste. Though composting was a prevalent biological processing practice in India, in the past due to non-availability of adequate space in the urban centers and poor segregation of wastes, composting has been discontinued as a practice. Recently efforts are being taken to popularize waste segregation and composting. Characteristics of the Indian MSW bring out the fact that a self-sustaining combustion reaction cannot be obtained in a majority of Indian MSW and auxiliary fuel will be required to aid waste combustion.

## 2.2 Municipal Solid Waste Management Planning

Most urban areas in the country are plagued by acute problems related to solid waste. The urban solid waste management involves two integral elements, viz, (i) the ultimate disposal of waste adopting any of the approved methods appropriate for the type of waste generated and (ii) the community action that leads to the proper handling of the waste from its source to the disposal point. The waste is usually generated from the following sources in the urban areas:

- Households
- Hotels, restaurants and lodges
- Shops/malls
- Educational institutions & offices
- Market Stalls
- Slaughter houses
- Marriage/town halls
- Street sweeping
- Temples
- Hospitals
- Industries
- Others (domestic component of biomedical waste, construction waste, museum and zoo etc.)

A typical sequential action for implementing a solid waste management system in any urban local body is given below. Since people's participation is vital for sustenance of the system, participatory methods should be adopted to the extent possible.

- Collecting the Baseline Information: Information required for preparing a proper action plan such as area, population, number of households, number of divisions (wards), number of zones/circles etc.
- Preparation of a detailed map of the ULB showing the road networks and other details using GIS.
- Collecting information about the type, quantity and characteristics of waste generated: The activities involved are (i) waste quantification survey for all the constituents of waste to assess waste generation at houses, commercial establishments and markets (ii) estimation of wastes collected (iii) estimation of wastes transported (iv) estimation of waste recycled (v) physical-chemical analysis of wastes generated.
- Understanding the present situation: This includes the existing mechanism for primary and secondary collection, the transportation system (availability of transfer stations and vehicles-both private and departmental vehicles), availability and adequacy of staff and the disposal methods.
- Understanding the key issues: The issues generally observed in the context of SWM are absence of segregation and storage at source and absence of organized primary collection; absence of need based schedule for sweeping; existence of exposed system of secondary storage; overflowing secondary collection points; irregular collection and multiple handling; absence of long-term, secured landfill; incompatible vehicles and equipments; low community/NGO/CBO partnership; manpower inadequacy; weak institutional set-up; absence of financial planning; and environmental and health issues. The other issues to be taken into account are lack of awareness on the necessity of scientific waste management, poor civic sense of the people, weak political will, inefficiency and lack of motivation of staff, absence of law and law enforcing mechanism etc.
- Draw up a feasible management system which identifies and explains the sources that generate waste, the collection and transportation arrangements and the disposal mechanism.
- Plan for effective transportation can be done using GIS and GPS based vehicle tracking and monitoring system can be planned for major cities.
- Evolving proper strategies for scientific waste management
- Preparation of solid waste management plan and cost estimates: This can include site profile and design approach, layout plan of proposed waste treatment and disposal facility (including composting, landfill, Leachate Treatment Plant, RDF etc.)
- Capacity building, training and awareness programmes.
- Operation & maintenance
- Monitoring

### 3.0 STRATEGY AND FRAMEWORK FOR SWM

#### 3.1 Concept and Rationale

Management of solid waste may be defined as the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes based on scientific principles. This includes technological, financial, institutional and legal aspects involved in solving the whole spectrum of issues related to solid wastes. Waste management practices differ for developed and developing nations, for urban and rural areas and for residential and industrial producers.

There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general and widely used concepts include:

- Waste hierarchy** - The waste hierarchy refers to the "4 Rs" concept (reduce, reuse, recycle and recover), which classify waste management strategies according to their desirability in terms of waste minimization. It remains the keystone of most waste minimization strategies. The main aim is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

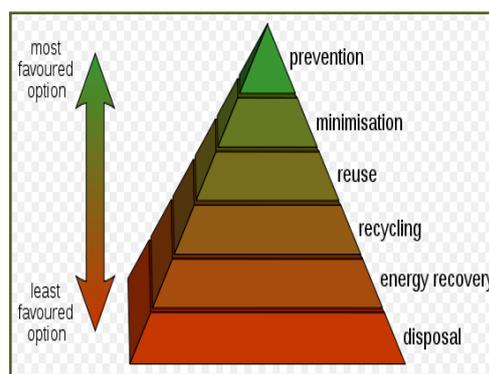


Fig.3 : Waste hierarchy

- Polluter pays principle** - It is a principle where the polluting party pays for the impact caused to the environment. Here, it refers to the requirement for a waste generator to pay for appropriate disposal of the waste.
- Extended producer responsibility** – EPR is a strategy designed to promote the integration of all costs associated with products throughout their life cycle (including end-of-life disposal costs) into the market price of the product. It is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms which manufacture, import and/or sell products are required to be responsible for the products after their useful life as well as during manufacture.

EPR seeks to shift the responsibility dealing with waste from governments (and thus, taxpayers and society at large) to the entities producing it. In effect, it internalises the cost of waste disposal into the cost of the product, theoretically meaning that the producers will improve the waste profile of their products, thus decreasing waste and increasing possibilities for reuse and recycling.

Producers accept their responsibility when designing their products to minimise life-cycle environmental impacts, and when accepting legal, physical or socio-economic responsibility for environmental impacts that cannot be eliminated by design.

Incorporating this principle in the management of biodegradable solid waste is a formidable task at present. Solid waste management is one of the essential obligatory functions of the Urban Local Bodies in India, which is clearly mentioned in Article 243W read along with 12<sup>th</sup> Schedule of the 74<sup>th</sup> constitutional amendment of India.

Most state legislation does not cover the necessary technical or organizational details of SWM. Laws talk about sweeping streets, providing receptacles in various parts of the city for storage of wastes, and transporting wastes to disposal sites in general terms, but they do not clarify how this cleaning shall or can be done. The municipal acts do not specify in clear terms which responsibilities belong to the citizens (for example, the responsibility not to litter or the accountability for storing waste at its source). Moreover, they do not mention specific collection systems (such as door-to-door collection of waste), do not mandate appropriate types of waste storage depots, do not require covered waste transport issues, and do not mention aspects of waste treatment or sanitary landfills. Thus, most state legislation, with the exception of that of Kerala, (still there are gaps which make it difficult to implement SWM by ULBs in the clear terms) does not fulfil the requirements for an efficient SWM service. Given the absence of appropriate legislation or of any monitoring mechanism on the performance of municipal authorities, the system of waste management has remained severely deficient and outdated.

At disposal sites, municipal authorities dump municipal waste, human excreta from slum settlements, industrial wastes from small industrial establishments within the city, and biomedical wastes without imposing any restrictions, thus posing serious problems of health and environmental degradation. A public interest litigation was filed in the Supreme Court in 1996 (Special Civil Application No. 888 of 1996) against the Government of India, state governments, and municipal authorities for their failure to perform their duty of managing MSW adequately.

The Supreme Court then appointed an expert committee to look into all aspects of SWM and to make recommendations to improve the situation. After consulting around 300 municipal authorities, as well as other stakeholders, the committee submitted the report to the Supreme Court in March 1999.

The report included detailed recommendations regarding the actions to be taken by class 1 cities, by the state governments, and by the central government to address all issues of MSWM effectively. On the basis of the report, the Supreme Court directed the Government of India, state governments, and municipal authorities to take necessary actions. The Ministry of Environment and Forests was directed to expeditiously issue rules regarding MSW management and handling. Thus, in September 2000, the Ministry issued the Municipal Solid Waste (Management and Handling) Rules 2000 under the Environment Protection Act, 1986.

#### **Illustration of a Policy**

The Urban Local Body(ULB) through this policy commits to deliver efficient solid waste management services to its citizens and pledges to scientifically manage the waste generated in the city through environmentally sustainable strategies and technologies and in line with the applicable regulations. The ULB also commits to extend the practice of segregation of waste at source to all the households of the city; integrate 4R strategies (Reduce, Recover, Reuse and Recycle) in all stages of waste collection, transportation, processing and disposal; encourage decentralized waste management at all levels of waste generation such as Households, Community, Commercial and Bulk Generators with active participation of community and all stake holders.

### **3.2 Municipal Solid Waste (Management and Handling) Rules 2000**

The Municipal Solid Waste (Management and Handling) Rules lay down the steps to be taken by all municipal authorities to ensure management of solid waste according to best practices. Municipal authorities must meet the deadlines laid down in Schedule I of the rules and must follow the compliance criteria and procedure laid down in Schedule II. They are responsible for implementing provisions of the 2000 rules and also to provide the infrastructure and services with regard to collection, storage, segregation, transport, treatment, and disposal of MSW.

Municipal authorities are requested to obtain authorization (that is, permission or technical clearance) from the concerned State Pollution Control Boards or Committees to set up waste processing and disposal facilities, and they must deliver annual reports of compliance.

The State Pollution Control Boards are directed to process the application of municipal authorities and to issue authorization to the municipalities within 45 days of the application submission. The CPCB is responsible for coordinating the implementation of the rules among the state boards.

The urban development departments of the respective state governments are responsible for enforcing the provisions of the rules in metropolitan cities. The district magistrates or deputy commissioners of the concerned districts are responsible for enforcing the provisions within the territorial limits of their jurisdictions. The State Pollution Control Boards / Pollution Control Committees are responsible for monitoring compliance with the standards on groundwater, ambient air, and leachate pollution. They must also monitor compliance with compost quality standards and incineration standards as specified in the rules.

The deadline for implementing Schedule I of the 2000 rules has already passed, and compliance is far from effective. Some cities and towns have not even started implementing measures that could lead to compliance with the rules.

Enforcement and sanctioning mechanisms remain weak. Other cities and towns have moved somewhat forward, either of their own accord or because of pressure from the Supreme Court, their state government, or their state pollution control board. Under Schedule II of the rules, municipal authorities have been further directed to set up and implement improved waste management practices and services for waste processing and disposal facilities. They can do so on their own or through an operator of a facility (as described in Schedules III and IV of the rules). Standards for waste processing and disposal facilities are defined in the rules, and municipal authorities are required to meet the specifications and standards specified in Schedules III and IV.

### **3.3 General Approach and Strategy**

The general approach and strategy will be to focus on decentralized waste management as much as possible and with centralised systems wherever decentralised activities are not possible especially in highly urbanised and large cities. In decentralised system, the biodegradable wastes can be collected and processed locally either at the source itself or at community / residents association level. The non-degradable / recyclable wastes can be collected and sent to the recycling units / landfills if there is no use. Decentralized waste management will help to reduce the transportation of wastes, reduce the quantum of wastes reaching the centralised processing plant and thus reducing the requirement of land

and other infrastructures and also major environmental issues related to handling of large quantity of wastes in a single location.

For major cities, instead of bringing all the wastes into a single point for processing, there can be one major windrow composting plant and a number of mini windrow composting plants in the peri urban regions. The biodegradable wastes collected from the peri urban regions, can be processed in the mini compost plants and only the final rejects can be brought to the common sanitary landfill site at the central facility. This will also help to reduce the issues related to collection, storage and transportation of wastes to a large extent.

Authorities need to consider specialized strategies for different waste generators (households, shops and commercial establishments, industries, hospitals, and so forth) and appropriate measures for the different levels in the SWM chain (household level, neighbourhood level, regional level, and so forth). Quantifying waste generation according to season is an important precondition for infrastructure planning. Knowledge of physical and chemical composition helps authorities to determine the scope of retrieval of recyclable material and construction debris and to define appropriate technology for treating waste.

The strategy should be in conformity with the MSW Rules,2000 in general and integrating the experiences of implementation of activities in many ULBs by various organisations in the country. ***The Centre for Environment and Development as part of the Centre of Excellence on Solid waste and Waste water Management supported Thiruvananthapuram and Kochi city corporations and Payyannur municipality to implement various components of SWM and tried to integrate these experiences also in developing this strategy.***

The strategy has been in general framed taking into consideration of the major management components such as Technical/Technological, Institutional, Financial and Policy/Legal aspects. These four components are critically reviewed for each of the seven steps to be implemented to meet the requirements of the national rules for municipal solid waste management. The strategy and framework for MSWM is developed for these seven steps( seven activities) which are illustrated in the following pages.

Thiruvananthapuram City Corporation in Kerala has expanded its area adding 5 more adjacent panchayats recently and now the total area has been increased to 235 sq.km. The SWM facility of the Corporation is located at Vilappilsala 13 kms from the Corporation office (City centre) and the distance from the plant site to the boundary of the Corporation (average distance) comes to about 25-28 kms. It is difficult to transport the waste collected from these long distance areas to the plant site. The Corporation has asked the Centre for Environment and Development, which is supporting the city for SWM to formulate plans for the additional areas also and CED has formulated the following strategies.

- i. To establish mini compost plants in 4-5 peri urban locations to process the biodegradable wastes generated in these areas and
- ii. To maximise processing of wastes at source itself / decentralised processing at community / residents association level. The second activity has already been initiated in 3 divisions of the city, with the same SHGs involved in primary collection of wastes, supporting the residents to set up vermi composting, windrow composting and biomethanation plants in their houses. This has been considerably reduced the volume of wastes to be collected and transported from these divisions to the central processing facility. The recyclable wastes are collected by the SHGs and sell to the hawkers. This strategy of combining decentralised and centralised options in waste management will be ideal for most of our cities in India.

### 3.4 Activity wise Strategy & Framework

#### **Step 1: Improve Waste Segregation and Storage at Source**

##### **Strategy to be adopted**

The main strategy is to separate the biodegradable wastes (organic matter such as leftover food, vegetables and fruit peels, paper, textile, wood, etc) and non-biodegradable wastes (inorganic and recyclable materials such as plastic, glass, cans, metals, etc) at the source itself and store the waste in different coloured bins.

This saves time, makes segregation easy and can cover more area for the waste collectors. Segregated storage can be achieved through a continued and organized awareness creation, motivation and subsequent enforcement. The sole responsibility is for those who generate waste.

Waste segregation at the source is an integral part of the source reduction strategy and is essential for improving the quality of waste for recycling and recovery.

Segregation will enable better value for the recycled material being sold and increases the quantity of recyclables as well.

The ULB shall supply bins for households in the first year and subsequent replacement shall be by the household. Non-domestic sources shall purchase bins at their own expense.

The IEC plan shall be designed to create the desired behavioural changes for storage and segregation of waste.

The storage bins at different sources and the capacity are given in Table. 5

The Thiruvananthapuram (the capital city of Kerala) was the first city which established a scientific SW processing plant in the state in the year of 2000), Municipal Corporation has provided two separate bins, green colour bucket (11 litres) for biodegradable waste & white colour bucket (15 litres) for non-biodegradable. This was quite effective, but lack of proper awareness reduced the efficiency of waste segregation. The segregated storage of waste at source was promoted under the "CAPITAL CITY CLEAN CITY" Project. The commercial establishments were asked to get bins at their own cost. The same experiments have been implemented successfully in other City Corporations and a few municipalities in Kerala during the last 5 years.



The experience shows that, wherever the local Resident's Associations/CBOs/NGOs are taking interest, the segregation seems to be very effective. Strong IEC programmes to change the attitude and mindset of the people, towards managing the waste generated is essential for effective segregation. The ULB has to regularly monitor and enforce the community to do segregated collection. Necessary legal provisions and policies are also required at the ULB level for effective segregate collection.

**Table. 5**  
**Storage Bins at different sources**

Source	Storage of Segregated Waste	
	<i>Food &amp; Green waste (Green Colour Bin)</i>	<i>Non-bio-degradable(White Colour bin)</i>
Households	10-15 litres capacity bin with lid	A bin or bag of suitable size
Hotels & Restaurants	60 litres capacity-LDPE/HDPE bins	A bin or bag of suitable size
Shops & offices	Suitable container not exceeding 60 litres	A bin or bag of suitable size
Market Stalls	40-60 litres bin-LDPE/HDPE	A bin or bag of suitable size
Marriage/town halls	Dumper Skip	A bin or bag of suitable size
Hospitals	60 litres bin for food & bio-degradable waste	Store as per Bio-medical Rules,1998

The segregation of waste into different types is the most important element for the success of any solid waste management programme. The main determining factor to achieve this goal is the attitude of the people. The normal practice of the community is to collect all types of waste together in a plastic carry bag before handing over to the waste collectors. This attitude has to be changed through high voltage IEC campaigns.

In Kerala, at least some of the ULBs (City Corporations and Municipalities) had organized massive IEC programmes for different target groups focusing on “4 R concept in Waste Management” and also segregation of wastes.

Almost all the ULBs in Kerala, the Residents Associations are very active and these Associations are constituted for 100-200 households. They are actively involved in mobilization of effective segregation and primary collection through various awareness programmes.

Sustainability of these activities is also very important. This can be achieved only through the full participation of the local community. There are examples of ULBs where the segregation was effectively done for 1-2 years, and then situation has changed.

The experience in working with many ULBs in Kerala shows that, IEC should be continuous process and only through a continuous and prolonged IEC programmes, the community’s attitude towards best practices in SWM can be sustained.

**Table 6**  
**Framework for Waste Segregation and Storage**

Activity	Frameworks				
	Technical / Technological	Institutional	Financial	Legal / Policy	
				Municipal Solid Wastes (Management and Handling) Rules, 2000	
				Role of ULB	Role of Generator of SW
1	2	3	4	5	6
Segregation and storage at source	<p><b>Segregated waste collection</b></p> <ul style="list-style-type: none"> <li>➤ Three separate bins <ul style="list-style-type: none"> <li>▪ biodegradable - green colour</li> <li>▪ non-biodegradable - white colour</li> <li>▪ other waste- black colour</li> </ul> </li> <li>➤ Material of the bins – Manufactured out of virgin plastic (HDPE) with lid and side handles</li> <li>➤ Size / capacity vary depends upon the quantity &amp; type with easily openable lid and handle.</li> <li>➤ Preferably circular shape for green bins &amp; white buckets (1x 1 cm square or 1 cm diameter), circular perforations on the side. Eg: if the bucket is 11 litres, then weight – Bucket: 310+10gm (excluding lid) &amp; lid weight: 100 + 10gm</li> </ul>	<ul style="list-style-type: none"> <li>➤ Waste generator will be responsible for the activity</li> <li>➤ The ULB/Local Residents Associations can support in providing bins and buckets free of cost for the first time</li> <li>➤ The ULB will be responsible for social mobilisation, monitoring &amp; evaluation and enforcement</li> </ul>	<ul style="list-style-type: none"> <li>➤ Borne by generator</li> <li>➤ Support from ULB/other agencies</li> <li>➤ Sponsorship from agencies / individuals.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly</li> <li>➤ Storage facilities or „bins“ shall have „easy to operate“ design for handling, transfer &amp; transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be painted white and those for storage of other wastes shall be painted black</li> </ul>	<ul style="list-style-type: none"> <li>➤ It shall be the responsibility of generator of wastes to avoid littering &amp; ensure delivery of wastes in accordance with the collection &amp; segregation system to be notified by the municipal authority.</li> </ul>

	<ul style="list-style-type: none"> <li>➤ Superscribe on the body of the bin/ bucket- biodegradable or non biodegradable in vernacular &amp; it should not be less than 30 mm size letter using screen printing technology/any other suitable technology</li> </ul>			<ul style="list-style-type: none"> <li>➤ The municipal authority shall undertake phased programme to ensure community participation in waste segregation</li> <li>➤ ULB shall organise awareness programmes for segregation of wastes</li> </ul>	
	<ul style="list-style-type: none"> <li>➤ Recycling or reuse of segregated materials.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Waste generator themselves can reuse some of the materials.</li> <li>➤ The waste collectors/SHGs may collect it from households to sell to Recycling units</li> <li>➤ The ULBs together can establish Recycling units or persuade private operators to establish Recycling units</li> </ul>	<ul style="list-style-type: none"> <li>➤ Borne by generator</li> <li>➤ ULBs</li> <li>➤ Private entrepreneurs</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB shall promote recycling or reuse of segregated materials.</li> </ul>	

## Step.2: Primary Collection

### Strategy to be adopted

The strategy for primary collection is the gathering of separately stored biodegradable and non-biodegradable waste from door to door/ kerb / block of waste and direct collection from non- domestic bulk generators. Waste segregated at households or other establishments needs to be collected following a fixed schedule. Biodegradable waste needs to be collected every day. Dry waste (inorganic recyclables) can be collected at least once in a week.

There are different options for door-to-door collection such as door-to-door collection carried out along with street sweeping, door-to-door collection by resident welfare associations and non- governmental organizations, door-to-door collection by private waste collectors. In Kerala, the Self Help Groups under Kudumbasree Programme is engaged in door to door collection in most of the ULBs very effectively for the last 5-6 years.



If door step collection is done in a proper way it can target up to 100 percent.

The construction and demolition waste can be stored within the premises of the generator and later removed on request.

The ULB can collect the primary waste through non-government organisations (NGO), residents association etc.

In the major cities and towns in Kerala, door-to- door collection of both degradable and non-degradable waste are adopted by the women self help groups established under the State Poverty Alleviation Mission under the Kudumbasree. These groups are involved in collection of household waste and waste from other sources directly and transported to the transfer vehicles by auto rickshaw.

Bins are used for door to door waste collection by the Kudumbasree workers which are then loaded into the autorickshaws specially made for this purpose, and from there to large vehicle for transport.

The construction and demolition waste were kept within the premises of the generator and removed by the City Corporation on request on payment. Bio-medical waste (which contains various infectious and toxic wastes in addition to anatomical waste generated in hospitals, clinics and health care centres) are collected by the "IMAGE" scheme operated by the Indian Medical Association daily from most of the hospitals and clinics. The domestic wastes from hospitals find their way to the municipal stream, whereas the industrial waste generated is managed by the industries themselves.

The experience in Thiruvananthapuram and Kochi city corporation shows that before the city started segregated door-to door collection, the mixed wastes were thrown open in the roadsides and public places/or in the bins located in public places which had created an unclean and unhealthy environment everywhere.



After starting the present operation of segregated storage and door step collection, changed the situation and normally no waste is thrown openly anywhere. This point to the importance of door-to door collection which is more effective and efficient and the ULBs shall adopt this strategy for primary collection. (The framework for primary collection and transportation is given in Table.7)

#### **CAPITAL CITY CLEAN CITY (CCCC) PROJECT OF THIRUVANANTHAPURAM CORPORATION**

Corporation had started the integrated waste management project (CCCC) in May 2006 (29 wards) and extended this in a phased manner to the 86 wards of the Corporation. 66 Kudumbasree units from 66 wards in 17 circles were registered and 817 women members are employed in the waste management project. Waste collection from the source is implemented through these kudumbasree workers; an organised government supported Self Help Group (SHG). 10-15 women constitute an SHG and this is operated in an entrepreneurial mode. The Corporation and Kudumbasree act only as facilitators. Each unit was given a financial assistance of rupees 2.5 lakh including bank loan and subsidy for the purchase of three wheeler vehicle and other equipments required for waste collection like plastic trays, PPEs etc. under SJSRY (Swarna Jayathi Shahari Rozgar Yojana), a Government of India Programme.

Two days preliminary training about the programme was given which included topics on collection of waste, possible health risks, precautions to be taken etc. The women were advised to compulsorily wear uniforms (green sari-blouse/ churidar and cotton overcoat) and use PPEs(gloves, masks and chappals). These workers were permitted to collect Rs.30/- per household per month and Rs.100-200/- from institutions like hotels, offices etc depending upon the quantity of waste collected(recently enhanced to Rs.40/-) of which their dividends are taken after deducting the maintenance cost of the unit. The remuneration for each individual is ranging from an average of Rs.3000-6000/- per month.

The Corporation is organising frequent orientation programmes to these groups and also health awareness classes and medical checkups.

**Table 7**  
**Framework for Primary collection and transportation**

Activity	Frameworks				
	Technical / Technological	Institutional	Financial	Legal / Policy	
				Municipal Solid Wastes (Management and Handling) Rules, 2000	
				Role of ULB	Role of Generator of SW
1	2	3	4	5	6
Primary collection and transportation	<p>Door step collection /Kerb / block of segregated and stored waste.</p> <ul style="list-style-type: none"> <li>➤ Auto tipper</li> <li>➤ Wheel barrows/ pushcart/ handcart – to be designed taking into consideration the local topographical situation.</li> <li>➤ If bins are used for primary collection, then                             <ul style="list-style-type: none"> <li>▪ Materials - Virgin Linear high-density polyethylene (HDPE) with UV stabilization. The material should be certified by any competent authority like Central Institute of Plastic and Engineering Technology</li> <li>▪ The lifting handles would be integrated into the frame and be capable of the loads specified with adequate factor of</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB, through different agencies like SHGs(Kudumbasree in Kerala)NGOs, residents association, private entrepreneurs etc</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB shall provide facilities for door step collection, autotipper, wheel barrow, pushcart etc.</li> <li>➤ Sponsorship by individuals / agencies / commercial establishments.</li> <li>➤ Funding from State / National Programs (JnNURM, UIDSSMT, State Sanitation Mission etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Organising house-to-house collection of MSW through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings &amp; scheduling by using bell ringing of musical vehicle</li> <li>➤ Collected waste from residential &amp; other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles.</li> <li>➤ Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.</li> </ul>	<ul style="list-style-type: none"> <li>➤ It shall be the responsibility of generator of wastes to avoid littering &amp; ensure delivery of wastes in accordance with the collection &amp; segregation system to be notified by the municipal authority.</li> </ul>

	<p>safety.</p> <ul style="list-style-type: none"> <li>▪ Durability-The container shall be of proven design and performance.</li> <li>▪ Personal Protection Equipments (PPE) for waste collectors as per Public Health Rule.</li> <li>▪ Capacity building and technical training.</li> </ul>				
	<p>Direct collection from non – domestic bulk generators for biodegradables</p> <ul style="list-style-type: none"> <li>▪ Auto tipper</li> <li>▪ Wheel barrows/ pushcart/ handcart</li> <li>▪ Tipper if large volume of waste is to be transported.</li> </ul>	<p>ULB can arrange the facility for collection and transportation</p>	<p>➤ Borne by generator through providing tipping fee to ULB which can be fixed by the concerned ULB taking into consideration of the quantity of waste</p>	<p>➤ Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas</p> <p>➤ Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes</p>	

### Direct Collection of Bulk wastes

Bulk wastes originating from large hotels and restaurants, marriage and function halls, hospitals, construction waste etc should be directly collected by deploying exclusive vehicles for that purpose. By adopting this strategy, cent percent of the waste generated from different sources are brought under the collection system. The collection of construction waste /garden waste from domestic areas on pre-fixed days, preferably fortnightly will be sufficient and is the responsibility of ULB. The framework for bulk waste collection is given in Table.8 and the operational aspects for collection and storage in Table.9.

**Table.8**  
**Framework for Bulk waste collection**

Activity	Frameworks			
	Technical / Technological	Institutional	Financial	Legal / Policy
	Municipal Solid Wastes (Management and Handling) Rules, 2000 Role of ULB			
1	2	3	4	5
Direct Collection	<ul style="list-style-type: none"> <li>➤ Direct collection of waste from large hotels &amp; restaurants, marriage &amp; function halls, hospitals, construction waste, slaughterhouse etc. by deploying exclusive vehicles for the purpose.</li> <li>➤ Bi-weekly collection of bulk waste /garden waste from domestic area on pre-fixed days.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB</li> <li>➤ The individual institutions / private groups may arrange vehicles to collect waste and transport to processing / disposal sites.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund for vehicles and tipping fees for collection from generators based on the type and quantum of waste</li> </ul>	<ul style="list-style-type: none"> <li>➤ Horticultural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms.</li> </ul>

**Table. 9**

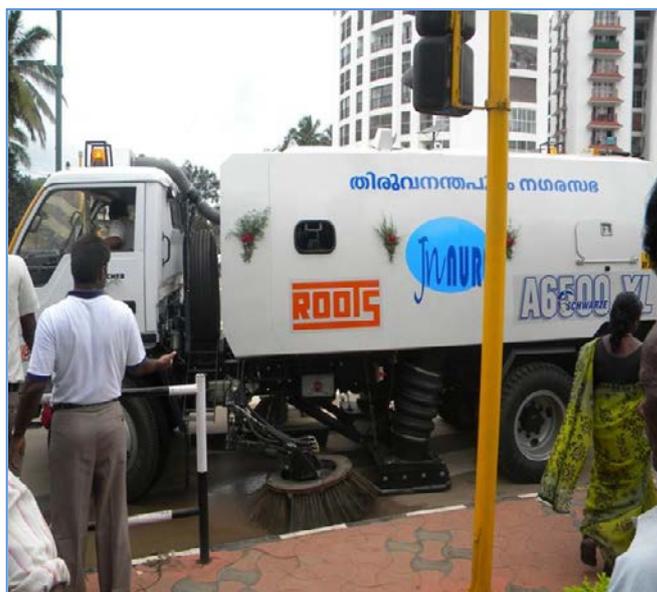
#### Operational aspects for collection and storage

Coverage Area	Primary Collection Vehicle	Secondary Storage
<b>Door to Door collection (NGO, Resident's Association- RA etc.)</b>		
Residential colonies – high density in gentle terrain and within a radius of 500 m from the secondary storage	Hand cart with bins – green colour for Bio-degradable waste, white colour bins for recyclables.	<ul style="list-style-type: none"> <li>• Bio-degradable in dumper container</li> <li>• Non-Biodegradable-Sell or dispose in black container</li> </ul>
Peripheral area covering a radius of 2000 m from secondary storage	Three wheeler	
<b>Kerb / block collection (ULB)</b>		
Settlements of narrow access, commercial area (small shops)	Three wheeler	Transfer of waste to dumper containers / directly to large vehicles.
<b>Direct Collection System (ULB)</b>		
Hotels / restaurants / hospital-non infectious / Garden waste	Closed vehicle (Tipper trucks) to collect biodegradable	Direct transportation to treatment yard.
Construction / demolition waste	Container / tipper truck	Direct transfer to the landfill site.
Street sweeping	Sweepers cart with litter bins	Direct transfer to container-short distance. Transfer to Tipper auto-for long distance

### Step 3: Street Sweeping

#### Strategy to be adopted

In India, daily sweeping of streets and public places is essential since, dust and leaves accumulate rapidly on roads and pathways. Municipal authorities are responsible under the respective municipal laws to undertake regular cleaning of streets and removal of rubbish.



- ❖ The strategy of street sweeping is to sweep all roads/streets and open spaces.
- ❖ The drain cleaning (below 60 cm depth) by the sanitary workers should also be clubbed with street sweeping at convenient time (mostly afternoon).
- ❖ The target is daily coverage of dense commercial areas; sweeping on all days including Sundays in city centre and market area; alternate day coverage of medium density and dense housing area; and weekly coverage (twice/once) in other areas. The responsibility is ULB, through CLR workers.
- ❖ Street sweeping can be rationalised according to the ward maps, so that it can indicate specific area to be swept by each sweeper.
- ❖ Sanitation workers should be provided with tools and accessories required for proper discharge of their functions.

(The framework for street sweeping is given in Table.10)

In Thiruvananthapuram Municipal Corporation (TMC), the main streets and markets are swept every day. Some streets are swept on alternate days, twice a week, weekly and remote areas occasionally. Generally female workers sweep the road using long handled broom and male workers collect the waste with a metallic plate and transfer it to the basket or tray provided.

Recently, TMC has procured a street sweeping machine under the JnNURM Programme with the aim to sweep the major roads and to remove sand from the side of the streets, which pose a problem for motorist especially two wheelers. Street sweeping, primary collection and transportation of solid waste is being carried out through the health circles.

**Table. 10**  
**Framework for Street Sweeping**

Activity	Frameworks			
	Technical / Technological	Institutional	Financial	Legal / Policy
				Municipal Solid Wastes (Management and Handling) Rules, 2000
				Role of ULB
1	2	3	4	5
Street Sweeping	<ul style="list-style-type: none"> <li>➤ Cover all roads/streets and open spaces</li> <li>➤ Daily coverage of dense commercial areas</li> <li>➤ Sweeping on all days including Sundays in city centre &amp; market area; alternate day coverage of medium density &amp; dense housing area &amp; weekly coverage (twice/once) in other areas.</li> <li>➤ Requirement of Vehicles &amp; equipments               <ul style="list-style-type: none"> <li>➤ <i>Long Handled Brooms</i></li> <li>➤ <i>Shovels</i></li> <li>➤ <i>Metal Trays &amp; Metal plate</i></li> <li>➤ <i>Basket</i></li> <li>➤ <i>Wheel barrows/ pushcart/ handcart</i></li> <li>➤ <i>Road sweeping machine</i></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB, through CLR workers</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding support through State / National Program (State Sanitation Mission, JnNURM, UIDSSMT etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ No legal provisions mentioned in the MSW Rules,2000</li> </ul>
Drain cleaning	Cleaning of drains by the sanitary workers	<ul style="list-style-type: none"> <li>➤ ULB, through CLR workers</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding support from other agencies.</li> </ul>	No legal provisions mentioned in the MSW Rules,2000

#### **Step 4: Set Up Secondary Waste Storage Depots and Transfer Stations**

##### **Strategy to be adopted**

Collection and transportation of waste from secondary collection points to the disposal site is termed as secondary collection system. The strategy for secondary collection is abolition of all open collection points by placing containers, i.e., separate containers for organic and inorganic waste. As per the MSW Rules, 2000, solid waste collected from the doorstep through the primary collection system has to be stored at a convenient place for its onward transport in a cost-effective manner.

The secondary collection should provide an additional storage capacity of at least 30% in order to avoid overflow of the containers. The system aims to meet 100% removal of waste generated. The provision of container/ dumper container, dumper placer, container station etc is the sole responsibility of the ULB.

The general strategy adopted in most of the ULBs is to provide community bins/dumper placer container in roadsides and open places to deposit wastes collected from the doorstep as well as to facilitate the residents to drop their waste directly to the bins.

The experience of CED in working with some ULBs in Kerala shows that, this system if not carefully operated and managed, will not yield the desired result. In this situation, it is suggested that, the community bin system can be limited to certain areas such as markets, major junctions, institutional areas and other public places to facilitate the collection of waste from the public place and occasional visitors to the city. The waste generated in households and other sources should be directly transferred in to the large collection vehicles, thus avoiding one step of collection and transfer. (The framework for secondary waste storage is given in Table.11)

The major City Corporations in Kerala such as Thiruvananthapuram, Kochi and Kozhikode have implemented a mechanism through which the waste collected from the source (Primary collection) through door to door collection, or any other means are directly transferred to the small intermediate vehicles like Auto tippers, wheel cart, pushcart etc. and from there directly to specially made single/double chambered tipper lorries.

The dumper placer containers or community bins are restricted to certain locations and no waste from the primary collection is reaching the container. This arrangement seems to be more efficient and effective way of secondary transfer of waste than collection in dumper placers or community bins. This system is running very efficiently in some major ULBs in Kerala for the last 5-6 years and this prevents littering in road sides and public places. The transfer stations are also avoided in these cities which also usually leads to many environmental issues unless carefully handled.

**Table. 11**  
**Framework for Secondary Collection**

Activity	Frameworks				
	Technical / Technological	Institutional	Financial	Legal / Policy	
				Municipal Solid Wastes (Management and Handling) Rules, 2000	
				Role of ULB	Role of Generator of SW
1	2	3	4	5	6
Secondary Collection	<ul style="list-style-type: none"> <li>➤ Abolition of all open collection points by placing containers –separate for organic &amp; inorganic</li> <li>➤ Direct transfer of waste from primary collection vehicle to containers.</li> <li>➤ Storage facilities if any should be attended daily.</li> <li>➤ Manual handling and multiple handling of wastes shall be avoided or done with proper safety and care.</li> <li>➤ Use of Personal Protection Equipments to be used by the waste handlers</li> <li>➤ As mentioned in the previous part, the experiments done by ULBs in Kerala to avoid secondary bins to the maximum yielded good result. (See Box) Transfer stations in special cases only.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB, through collection vehicles</li> <li>➤ SHGs like Kudumbasree groups in Kerala</li> <li>➤ CBOs/NGOs</li> <li>➤ Private entrepreneurs can be involved for secondary collection</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding support from State / National agencies (State Sanitation Mission / JnNURM / UIDSSMT etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing.</li> </ul>	<ul style="list-style-type: none"> <li>➤ It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority.</li> </ul>

## **Step 5: Improve Transport of Waste**

### **Strategy to be adopted**

This step refers to the transport of large quantities of waste to treatment sites or the final disposal site. Under the 2000 rules, a covered vehicle should be used for transportation of waste. Therefore, the present uncovered vehicles will need to provide a cover and in the future suitable covered vehicle should be used.

The strategy should be to transfer the waste collected in auto tippers, wheel carts etc. directly from the source to the large covered vehicles specially made for this purpose. This will eliminate one stage of transfer from primary collection point to dumper placer containers and then the container directly transfers it to the disposal site. The organic waste is removed daily and need based removal of inorganic/ inert waste without allowing overflow.



The daily collection is necessary for premises under direct collection system through transportation vehicle and direct transportation to disposal site. The sole responsibility is of ULBs. The MSW Rules 2000, also suggest transfer stations in between for long distance transport of wastes. But the experience in many ULBs shows that it is always advisable to minimise transfer stations to avoid spillage of wastes during transfer and also to prevent leachate generation. Transfer stations can be established for non-degradable waste transportation, since this type of waste could be stored for longer period before it is transferred finally to the recycling/reuse facility.

Detailed transportation planning and regular monitoring system for effective transportation has to be done using modern tools and techniques. The ULB has to regularly monitor and ensure that all the wastes collected are properly transported to processing plant / disposal site. (framework for transportation is shown in Table.12)

The experience from some of the ULBs shows that, direct transfer of waste collected from source through door to door collection or any other means to the covered vehicles is more efficient and effective than dumper placer container emptying at disposal point. Covered vehicles with necessary provision for corrosion resistance and collection of leachate during transport of wastes with a leachate collection tank below will be ideal. Thiruvananthapuram City Corporation has designed such a vehicle suited to the situation which was purchased under the JnNURM. Here, separate vehicles are designed for degradable and non degradable (single chambered vehicles) and this seems to be more effective than the double chambered vehicles used earlier. The non-degradable wastes are collected separately in bags and transported to the processing locations daily / twice or thrice in a week. These single chambered vehicles are more convenient to handle and also easy tipping of the waste.

<b>Table.12</b>				
<b>Framework for Transportation</b>				
<b>Activity</b>	<b>Frameworks</b>			
	<b>Technical / Technological</b>	<b>Institutional</b>	<b>Financial</b>	<b>Legal / Policy</b>
	<b>Municipal Solid Wastes (Management and Handling) Rules, 2000</b>			
<b>Role of ULB</b>				
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Transportation	<ul style="list-style-type: none"> <li>➤ Closed trucks should be used.               <ul style="list-style-type: none"> <li>▪ Single chambered closed truck for collection of biodegradable waste</li> <li>▪ Mild Steel, 52 grade or any other non-corrosive substance</li> <li>▪ Keel shaped bottom for collection of leachate absolutely leak proof &amp; air tight, so that no fluid or smell comes outside.</li> <li>▪ Suitable ladders are provided for top loading &amp; rear loading.</li> </ul> </li> <li>➤ closed truck for non-biodegradable waste</li> <li>➤ Mild Steel, 52 grade or any other non-corrosive substance</li> <li>➤ Minimise the number of transfer stations</li> </ul>	<ul style="list-style-type: none"> <li>➤ The procurement of vehicles could either be by ULB concerned or could be arranged with private operators under suitable contractual arrangements. But the vehicles should follow the specifications mentioned.</li> <li>➤ The responsibility for transfer and transport of wastes from primary / secondary collection unit to the processing site is vested with ULBs.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding from State / National Program (State Sanitation Mission, JnNURM/UIDSSMT etc.)</li> <li>➤ Private operators with tipping fee provided by ULB</li> </ul>	<ul style="list-style-type: none"> <li>➤ Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering</li> <li>➤ Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.</li> </ul>
Transportation Network Plan and Vehicle Tracking System	<ul style="list-style-type: none"> <li>➤ Transportation network planning using cadastral maps and Geographical Information System (GIS).</li> <li>➤ Vehicle Tracking and monitoring system using Global Positioning System (GPS).</li> <li>➤ Monitoring cell at ULB.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB will be responsible</li> <li>➤ Support from Technical Agency to develop GIS &amp; GPS systems.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding from State / National Program (State Sanitation Mission, JnNURM/UIDSSMT etc.)</li> </ul>	

## **Step 6: Establish Treatment and Recycling Options**

### **Strategy to be adopted**

The sixth step was made mandatory under the 2000 rules. Municipal authorities are expected to set up a plant for composting waste or to adopt waste to-energy technology as may be appropriate to treat the organic fraction of wastes. Currently, there are several technologies for the processing and treatment of organic MSW, such as microbial composting and vermi-composting. There are some other technologies like pyrolysis, which are still not in wide use in India.

Household waste can contain 40 or 50 percent organic matter. Waste from urban fruit and vegetable markets contain even higher amounts of organic materials. Because organic waste causes major hygienic and environmental problems in cities and at landfills, the 2000 rules mandate improved management and treatment of this fraction before final disposal. Several treatment options for organic waste are available such as composting, anaerobic digestion, incinerator technologies, etc.

Waste recycling has great untapped potential that can benefit Indian society as a whole. There is a need to upgrade and reorganize the recycling system, to increase effectiveness of the waste collection and recycling, and to improve the working conditions for rag pickers. The Supreme Court's expert committee acknowledged this potential in its report and recommended further action toward intensified recycling that takes into consideration all stakeholders. Schedule II of the 2000 rules lays down mandatory directions for waste segregation and processing within municipal management services.

The approach is treatment of biodegradable waste in centralized/ decentralized compost, vermi-compost plants and bio-gas units. The management and treatment of solid waste in the processing plant is the responsibility of the ULB. The ULB can perform this function directly or through competent agencies in the public or private sector.

Details of SWM technology options are provided in Part II.

(The detailed framework for treatment / processing and Infrastructure development are given in Table. 13 & 14)

In Thiruvananthapuram and Kochi City Corporations in Kerala, the operation and management of SW processing plant at Vilappilsala and Brahmapuram owned by the city corporations is carried out by Centre for Environment and Development, a R&D institution and Centre of Excellence of MoUD, GoI for Solid Waste and Waste Water Management. CED is also the Accredited Agency of Government of Kerala for SWM and CED is involved in these type of activities without taking any financial benefit apart from the 2% of the actual expenditure given as management fee. Our strategy is to develop the capacity and capability of the respective city corporations within a specified period to operate and manage the Plant. CED will withdraw after that but will continue to give advisory services whenever required. This is an example for Public-Public Partnership and other ULBs may adopt this strategy for operation and management. CED plans to constitute necessary institutional mechanism in the City Corporations within a specified time such as City Sanitation Society organised under ULB with members from different areas and sectors, who will manage different activities related to Solid Waste Management.

**Table. 13**  
**Framework for Treatment / Processing**

Activity	Frameworks				
	Technical / Technological	Institutional	Financial	Legal / Policy	
				Municipal Solid Wastes (Management and Handling) Rules, 2000	
				Role of ULB	Role of Operator of the facility
1	2	3	4	5	6
Treatment/ processing	Treatment of organic fraction <ul style="list-style-type: none"> <li>➤ Centralized Windrow Compost Plant</li> <li>➤ Decentralized vermi compost/ windrow compost plants</li> <li>➤ Bio-gas units</li> <li>➤ Follow the rules and standards specified by State Pollution Control Boards / CPCB.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB - Directly or through competent agencies</li> <li>➤ Technical support from appropriate Technical Resource Agency.</li> <li>➤ Operation and management by City Sanitation Society.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB/operator of the facility</li> <li>➤ Funding support from State / National Programs (State Sanitation Mission / JnNURM/ UIDSSMT etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in Schedules III and IV.</li> <li>➤ The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV</li> </ul>	Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the CPCB to get the standards laid down before applying for grant of authorisation.
	Other Processing methods <ul style="list-style-type: none"> <li>➤ Recycling plastics, metals, glass, etc.</li> <li>➤ Pelletisation/ RDF</li> <li>➤ Incineration</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB - Directly or through competent agencies</li> <li>➤ Technical support from suitable Technical Resource Agency.</li> <li>➤ Operation and management by City Sanitation Society.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB/operator of the facility</li> <li>➤ Funding support from State / National Programs (State Sanitation Mission / JnNURM/ UIDSSMT etc.)</li> <li>➤ Public Private Partnership</li> </ul>	<ul style="list-style-type: none"> <li>➤ Mixed waste containing recoverable resources shall follow the route of recycling.</li> <li>➤ Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases.</li> </ul>	

## Infrastructure Development for Processing / Treatment

**Table.14**  
**Framework for Infrastructure Development**

Activity	Frameworks			
	Technical / Technological	Institutional	Financial	Legal / Policy
				Municipal Solid Wastes (Management and Handling) Rules, 2000
				Role of ULB
1	2	3	4	5
Processing plant infrastructure development	<ul style="list-style-type: none"> <li>➤ Compound Wall &amp; Fencing</li> <li>➤ Road work &amp; drain</li> <li>➤ Water Supply , rain water harvesting system</li> <li>➤ Electrical Work</li> <li>➤ Horticulture</li> <li>➤ Waste segregation facility along with washing area and waste receiving area</li> <li>➤ Building at compost plant site</li> <li>➤ The compost plant should be designed preferably in circular shape.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB</li> <li>➤ Support from Technical Resource Agencies</li> <li>➤ Consultants for technical consultancies if required.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB fund</li> <li>➤ Funding support from State / National Programs (State Sanitation Mission / JnNURM/ UIDSSMT etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ Every municipal authority shall, within the territorial area of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development of municipal solid wastes.</li> <li>➤ The municipal authority or an operator of a facility shall make an application in Form-I, for grant of authorization for setting up waste processing and disposal facility including landfills from the State Board or the Committee in order to comply with the implementation programme laid down in Schedule I.</li> </ul>

## **Step 7: Final Disposal by Constructing Sanitary Engineered Landfills**

### **Strategy to be adopted**

The 2000 rules prohibit open dumps and require municipal authorities to safely dispose of solid waste in engineered landfills. The rules further mandate treatment of the organic fraction of solid wastes before final disposal in the landfill sites. Thus, only rejects and degraded wastes can be placed in landfills.

All cities and towns in India are, therefore, under an obligation to stop crude dumping of wastes at open dumping grounds and instead identify suitable lands for the construction of engineered landfills following the standard prescribed in Schedule III of the rules. Schedule III provides guidelines for the basic landfill requirements for selection and design.



Landfill is a vital component of any well designed SWM system. Environmentally safe landfill shall be

a part of long-term disposal strategy but the landfill should be restricted to waste that cannot be recycled, treated or recovered.

This mechanism will cater to the remediation of already accumulated waste and confinement of subsequent rejects. The landfill can be operated directly by the ULB or through competent agencies in the public or private sector, adopting the procedures and specifications defined in the 2000 MSW Rules as well as SPCB / CPCB norms. (framework for landfill is given in Table.15)

The used plastic carry bags create major environmental problem everywhere. Most of these carry bags are below 30 milli microns in thickness and cannot be processed through recycling or any other method. This is still one of the grey areas in the waste management sector. The general approach of the community to throw away the plastic carry bags after one time use.

The strategy to find solution to this problem should be based on a reuse and reduce approach. The carry bags can be reused 2-3 times, so that, the number of carry bags used can be reduced. The second aspect is to find alternatives to the plastic carry bags such as paper bags, cloth bags etc. Small units for manufacturing paper and cloth bags can be established in each ULBs or jointly by 2-3 ULBs even using the recycled papers.

The approach should be to make aware the community about these aspects and massive IEC programmes have to be organised to change the attitude and perception of the community. In Kerala and other States, at least some institutions and local bodies has started working towards “ Plastic Free Campus and Plastic Free Local Bodies”.

**Table. 15**  
**Framework for Landfill & Leachate Treatment Plant**

Activity	Frameworks			
	Technical / Technological	Institutional	Financial	Legal / policy
				Municipal Solid Wastes (Management and Handling) Rules, 2000
				Role of ULB
1	2	3	4	5
Sanitary Engineering Landfill and Leachate Treatment Plant	<ul style="list-style-type: none"> <li>➤ In many places, wastes are put in Landfills without any processing especially where enough lands are available for this purpose. But development of sanitary landfills are mainly meant for inerts and compost rejects for safe and permanent disposal. The construction of Landfill should adopt scientific methods following the criteria, specifications and standards developed for this purpose.</li> <li>➤ Leachate coming out of landfill and also windrow compost pad has to be treated in the Leachate Treatment Plant established following criteria, specification and standards prescribed by CPCB and SPCBs.</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB - Directly or through competent agencies</li> </ul>	<ul style="list-style-type: none"> <li>➤ ULB funds</li> <li>➤ Funding support from State / National Programs (State Sanitation Mission / JnNURM / UIDSSMT etc.)</li> </ul>	<ul style="list-style-type: none"> <li>➤ The waste processing &amp; disposal facilities to be set up by the ULB on their own or through an operator of a facility shall meet the specifications and standards as specified in Schedules III and IV.</li> <li>➤ Landfilling shall be restricted to non-biodegradable, inert waste &amp; other waste that are not suitable either for recycling or for biological processing.</li> <li>➤ It shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities.</li> <li>➤ Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms.</li> <li>➤ Landfill sites shall meet the specifications as given in Schedule –III.</li> <li>➤ Provisions for management of leachates collection and treatment shall be made. The treated leachates shall meet the standards specified in Schedule- IV</li> </ul>

### **Strategy to be adopted for Product Management (organic manure compost)**

The main product of composting process of biodegradable waste is the organic manure – compost. The compost is a valuable product which can be utilized for a variety of crops. Simple compost coming out after the final sieving in the windrow plant can be directly utilized as a soil conditioner.



The raw compost thus produced can be enriched adding different nutrients and through different combinations, enriched composts suitable for different crops can be produced.

Marketing of compost is the major hurdle the ULB may face. Presently, it is mandatory for all the chemical fertilizer companies in the country to also sell organic manure through their depots (5% of their total revenue is earmarked for this purpose).



The ULBs have to utilize this opportunity. Also, the strategy should be to give maximum awareness among the community to persuade them to utilize organic manure for their crops. Programmes for kitchen gardens / medicinal gardens in the homesteads in the ULBs using organic manure has to be initiated.(framework for product management is given in Table. 16)

<b>Table. 16</b>				
<b>Framework for Product Management (Organic Manure-Compost)</b>				
<b>Activity</b>	<b>Frameworks</b>			
	<b>Technical / Technological</b>	<b>Institutional</b>	<b>Financial</b>	<b>Legal / Policy</b>
				<b>Municipal Solid Wastes (Management and Handling) Rules, 2000</b>
				<b>Role of ULB</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Product Management	<ul style="list-style-type: none"> <li>➤ Adoption of standards               <ul style="list-style-type: none"> <li>- Specification for manure (Fertiliser Control Act, 2006)</li> <li>- Specification as per MSW rules, 2000</li> </ul> </li> <li>➤ Automatic packing machine for 1kg, 2 kg, 5kg and 50kg</li> <li>➤ Use environment friendly packing materials-plastic bag essentially with thickness above 100 microns</li> <li>➤ facility for storing at least 3 months compost</li> </ul>	<p><b>ULB</b></p> <ul style="list-style-type: none"> <li>➤ The ULB will be responsible for social mobilisation, monitoring &amp; evaluation.</li> <li>➤ It shall be the responsibility of the local bodies to market the compost and evolve suitable mechanism for the sale. Promoting sale through public sector fertilizer marketing chain.</li> <li>➤ Marketing through SHGs/Residents Association/NGOs</li> <li>➤ Specific agreement with private agency for sale of compost</li> <li>➤ A separate marketing wing can be attached to the compost processing plant</li> <li>➤ Quality testing of compost through agricultural department on experimental farm lands before consumer supply</li> </ul> <p><b>State Government</b></p> <ul style="list-style-type: none"> <li>➤ May integrate in the policy to utilise organic manure(compost) along with chemical fertilizer and also encourage Kitchen gardening using organic manure</li> <li>➤ State Governments through their agriculture departments and outreach network, may propagate use of compost</li> <li>➤ Government may also consider subsidizing the sale of such compost</li> </ul>	<ul style="list-style-type: none"> <li>➤ Initially ULB fund</li> <li>➤ Later from the profit through sale of compost</li> </ul>	<ul style="list-style-type: none"> <li>➤ It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV.</li> </ul>

## 4.0 OPERATIONAL MODALITIES

As discussed earlier, solid waste management is one of the essential obligatory functions of the Urban Local Bodies in India.

### 4.1 Roles and responsibilities of ULBs

- i. Prepare implementation plan for SWM as per MSW Rules, 2000.
- ii. Procurement of equipments and implements for collection of wastes vehicles for transportation of wastes, establishment of waste processing and treatment facilities as per MSW Rules,2000.
- iii. Planning and Implementation of street cleaning, bulk waste collection programmes etc.
- iv. Identification of suitable sites for waste processing and disposal, identification of sites for future.
- v. Discourage use of undesirable plastic materials, encourage to reduce waste, reuse materials etc.
- vi. Planning for sale of products like compost, MoU with sector departments and fertilizer firms for sale of manure produced; marketing of manure through Local Residents Associations, SHGs, NGOs etc.
- vii. Strict monitoring system and compliance of pollution control norms and enforcement.
- viii. Prescribe user fee in consultation with community.
- ix. Plan for capacity building of staff –both at managerial level and lower level; sensitization and orientation programme on SWM for elected representatives and other functionaries.
- x. Plan for IEC programmes covering entire community leading to social mobilization and community participation. Development of necessary software for IEC programmes, integration with other programmes of ULB etc.
- xi. Establishing linkage with Technical Resource Agencies and R&D institutions for research studies for improvement of SWM system.
- xii. Availing necessary funding support and financial arrangement for implementing SWM system.
- xiii. Constitution of City Sanitation Society under ULB to plan, co-ordinate and implement various components of SWM system as well as other sanitation components.

### 4.2 Role of NGOs/Residents' Associations

NGOs and Residents' Associations can play a vital role in SWM. Some areas where they can effectively work are indicated below:

- Organizing neighbourhood groups (NHGs) and imparting motivational training for storage and segregation of waste
- Organizing waste collection groups
- Propagating the 4R concept

- Propagating the proximity theory
- Organizing, training and equipping the rag pickers as door step waste collectors.
- Generating demand for household level waste management options like vermi composting and providing skilled services in setting up household units.
- Sale of manure from the compost plant by organizing the cultivators/ horticulturists
- Discouraging use of non-degradable/non-recyclable items
- Supporting the ULB to draw up a locally suitable IEC plan.
- Organizing awareness creation/training programmes
- Establishing community vigilance system to ensure, sustain and improve the SWM system.

### **4.3 Man Power Requirement**

- Collection workers and auto three wheeler drivers for door to door collection- to be mobilized by Kudumbashree /NGOs/RAs etc
- Workers and drivers for street sweeping, direct collection and transportation- to be mobilized by ULB / Kudumbashree /NGOs/RAs etc.
- Supervisory and administrative staff of the ULB.

### **4.4 Role of Technical Resource Agency**

The Solid Waste Management involves many complex technical / technological components. The ULB themselves may not be in a position to handle these components by themselves for which they may seek support from some Technical Resource Agency competent in the SWM area.

The National or State level Accredited Agencies in SWM sector / technical institutions like engineering colleges, NIT, IITs and other R&D institutions etc. working in the SW sector can be identified for this purpose. The Centre of Excellences of Ministry of Urban Development, Government of India like Centre for Environment and Development will be able to provide hand holding support to ULBs.

In State of Kerala, there is a system of Accreditation of technical resource agencies by the Local Self Government Department to support the ULBs and Panchayats in different sector related activities. One of the sector is Solid Waste Management. The Centre for Environment and Development is one such agencies which will provide support to ULBs and Panchayats to set up Solid Waste Management System in their areas. The Local Bodies can directly entrust the work to these agencies without any tendering process. These types of agencies can even operate and manage Solid Waste Processing Plants also. The Centre for Environment and Development which is also the Centre of Excellence of MoUD, GoI for Solid Waste and Waste Water Management is providing handholding support to many ULBs in Kerala in establishment, operation and management of SW processing units.

## 4.5 IEC PLAN

Solid Waste Management is an activity in which social mobilization and community involvement are the key to success. It is not the technology but public attitude and behaviour that are going to make the difference. An IEC Plan focusing on solid waste management will therefore basically aim at the following.

- Creating behavioural change for scientific waste disposal. This will include
  - I. adoption of the 4R concept-reduce, reuse, recycle and recover the waste
  - II. storage and segregation at source
  - III. imbining the civic responsibility of keeping the premises clean
  - IV. willingness to accept the civic responsibilities of citizens, and
  - V. willingness to part with the ad hoc approach of unscientific solid waste disposal.
- Awareness creation on the dangers of unscientific SWM. E.g., (i) health hazards (ii) aesthetic damage.
- Awareness creation on the various technical options of solid waste management.
- Exploring the possibility of converting waste as a resource.
- Proximity theory of SWM. (Scientific disposal of waste at the nearest point of source. E.g., biogas plant at a market; composting at households etc.)
- Willingness to pay for services.
- People's participation and cooperation at all stages of waste management.
- Community adherence to rules, orders and directives.
- Adoption of integrated approach. The institutional mechanism created for collection and transportation of waste could, in return, be used for sale of manure manufactured at the compost plant, etc

Taking into consideration the local situation, separate capacity building and IEC plans have to be developed for each ULB. Apart from the positive health impact, solid waste management is a clear indicator of the effectiveness of municipal administration. It is an integral part of good governance and one of the most visible urban services influencing local perception of governance.

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