

PERSPECTIVES OF SOLID WASTE MANAGEMENT IN INDIA

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1. INTRODUCTION

Municipal solid waste management (MSWM) encompasses planning, engineering, organization, administration, financial and legal aspects of activities associated with generation, storage, collection, transfer and transport, processing and disposal of municipal solid wastes (household garbage and rubbish, street sweepings, construction debris, sanitation residues etc.) in an environmentally compatible manner adopting principles of economy, aesthetics, energy and conservation (Tchobanoglous et al, 1993). The explosion in urban population is changing the nature of solid waste management in developing countries from mainly a low priority, localized issue to an internationally pervasive social problem.

India, the world's second highest populated country with population exceeding a billion and one of the fastest urbanizing countries, is a land of physical, climatic, geographic, ecological, social, cultural and linguistic diversity. The annual rate of growth of urban population in India is 3.09%. The proportion of population living in urban areas has increased from 17.35% in 1951 to 26.15% in 1991(CPCB, 1999). The number of Class I cities with population exceeding 1,00,000 has increased from 212 to 300 during 1981 to 1991 (CPHEEO,2000).It is interesting to note that as much as 65.2% of the urban population is living in these Class I cities. India has achieved multifaceted socio economic progress during the last 55 years of its independence. However, in spite of heavy expenditure by the Civic bodies, the present level of service in many urban areas is so low that there is a threat to the public health in particular and the environmental quality in general (Supreme Court Committee Report, 1999).

Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in India. The 23 metro cities in India generate about 30,000 tonnes of such wastes per day while about 50,000 tonnes are generated daily from the Class I cities. Piles of Garbage and wastes of all kinds littered everywhere have become common sight in our urban life. Magnitude and density of urban population in India is increasing rapidly and consequently the Civic bodies are facing considerable difficulties in providing adequate services such as supply of water, electricity, roads, education and public sanitation, including MSWM. Municipal agencies spend about 5-25% of their budget on MSWM. In spite of such heavy expenditure, the present level of service in many urban areas is so low that there is a threat to the public health in particular and the environmental quality in general. Several steps are being taken towards improving the situation (Shekdar et al, 1991).

2.WASTE GENERATION AND CHARACTERISTICS

The municipal authorities in most of the Indian towns do not weigh the refuse vehicles regularly but estimate the quantities on the basis of number of trips made by the collection vehicle. Database on solid waste generation/ collection is seldom maintained. It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 – 0.4 kg and 0.5 kg per capita per day respectively. Studies carried out by National Environmental Engineering Research Institute (NEERI) indicated that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/d. In the metropolitan areas, values up to 0.5 kg / capita / day have been recorded. The estimated annual increase in per capita waste quantity is about 1.33% per year. As per a recent survey (CPCB, 1999), the quantities of municipal solid waste generation in metro cities are presented in Table 1. These figures were arrived at on the basis of quantity transported per trip and the number of trips made per day. Clearly this is an indication of the solid waste collection rate rather than actual generation rate.

TABLE 1 Status of Municipal Solid Waste Generation in Metro Cities in India (CPCB, 1999)

Sl.No.	Metro city	Municipal Population	Municipal solid waste, (tones/day)	Per capita generated (kg/day)
1	AHMEDABAD	28,76,710	1,683	0.585
2	BANGALORE	41,30,288	2,000	0.484
3	BHOPAL	10,62,771	546	0.514
4	BOMBAY	1,22,88,519	5,355	0.436
5	CALCUTTA	1,06,43,211	3,692	0.347
6	COIMBATORE	8,16,321	350	0.429
7	DELHI	84,19,084	4,000	0.475
8	HYDERABAD	40,98,734	1,566	0.382
9	INDORE	10,91,674	350	0.320
10	JAIPUR	14,58,483	580	0.398
11	KANPUR	18,74,409	1,200	0.640
12	KOCHI	6,70,009	347	0.518
13	LUCKNOW	16,19,115	1,010	0.624
14	LUDHIANA	10,42,740	400	0.384
15	MADRAS	47,52,976	3,124	0.657
16	MADURAI	9,40,989	370	0.393
17	NAGPUR	16,24,752	443	0.273
18	PATNA	9,17,243	330	0.360
19	PUNE	22,44,196	700	0.312
20	SURAT	14,98,817	900	0.600
21	VADODARA	10,31,346	400	0.388
22	VARANASI	10,30,863	412	0.400
23	VISAKHAPATNAM	7,52,037	300	0.399
	Total/Average	6,68,85,287	30,058	0.449

The physical composition of the waste is obtained as a percentage of the different constituents as given in Table 2. The paper content generally varies between 1.0 and 6.0% and increases with the increase in population (Boyar et al, 1996). The quantity of waste paper in India, is much less, as even the quantity thrown away is picked up

by people for its use as a fuel and also for packaging of materials / food sold by road side hawkers. The plastics, rubber and leather contents are lower than the paper content, and do not exceed 1% except in metropolitan cities. The metal content is also low, (less than 1%). These low values are essentially due to the large scale recycling of these constituents. Paper is recycled on a priority basis while plastics and glass are recycled to a lesser extent.

Table 2 Characteristics of Municipal Solid Waste Generated by Metro cities (CPCB, 1999)

Sl. No	Name of metro city	Characteristics (% by Weight)							
		Paper	Textile	Leather	Plastic	Metal	Glass	Ash, fine earth and others	Compo-stable matter
1	Ahmedabad	6.0	1.0	-	3.0	-	-	50.0	40.00
2	Bangalore	8.0	5.0	-	6.0	3.0	6.0	27.0	45.00
3	Bhopal	10.0	5.0	2.0	2.0	-	1.0	35.0	45.00
4	Bombay	10.0	3.6	0.2	2.0	-	0.2	44.0	40.00
5	Calcutta	10.0	3.0	1.0	8.0	-	3.0	35.0	40.00
6	Coimbatore	5.0	9.0	-	1.0	-	-	50.0	35.00
7	Delhi	6.6	4.0	0.6	1.5	2.5	1.2	51.5	31.78
8	Hyderabad	7.0	1.7	-	1.3	-	-	50.0	40.00
9	Indore	5.0	2.0	-	1.0	-	-	49.0	43.00
10	Jaipur	6.0	2.0	-	1.0	-	2.0	47.0	42.00
11	Kanpur	5.0	1.0	5.0	1.5	-	-	52.5	40.00
12	Kochi	4.9	-	-	1.1	-	-	36.0	58.00
13	Lucknow	4.0	2.0	-	4.0	1.0	-	49.0	40.00
14	Ludhiana	3.0	5.0	-	3.0	-	-	30.0	40.00
15	Madras	10.0	5.0	5.0	3.0	-	-	33.0	44.00
16	Madurai	5.0	1.0	-	3.0	-	-	46.0	45.00
17	Nagpur	4.5	7.0	1.9	1.25	0.35	1.2	53.4	30.40
18	Patna	4.0	5.0	2.0	6.0	1.0	2.0	35.0	45.00
19	Pune	5.0	-	-	5.0	-	10.0	15.0	55.00
20	Surat	4.0	5.0	-	3.0	-	3.0	45.0	40.00
21	Vadodara	4.0	-	-	7.0	-	-	49.0	40.00
22	Varanasi	3.0	4.0	-	10.0	-	-	35.0	48.00
23	Visakhapatnam	3.0	2.0	-	5.0	-	5.0	50.0	35.00
	Average	5.7	3.5	0.8	3.9	2.1	2.1	40.3	41.80

The biodegradable fraction is quite high in Indian MSW, essentially due to the habit of using fresh vegetables. The high biodegradable fraction combined with the tropical climate warrants frequent collection and removal of refuse from the collection point. The ash and fine earth content of Indian MSW is high due to the practice of inclusion of the street sweepings, drain silt, and construction and demolition debris in MSW.

The proportion of ash and fine earth reduces with increase in population due to improvements in the road surfaces. The high ash and earth content increases the density, which is between 330 and 560 kg/m³. The organic content of the samples on a dry weight basis ranges between 20 and 40%. The nitrogen, phosphorus and potassium of the MSW ranges between 0.5-0.7, 0.5-0.8 and 0.5 - 0.8% respectively. The calorific value ranges between 200 -3000 Btu / lb. (Bhide and Sundaresan, 2001)

3. LEGAL AND INSTITUTIONAL FRAMEWORK

In India, solid waste management services are provided by the Civic Bodies as per the provisions of the respective Corporation/Municipal/Panchayat Acts. Many of the Acts are quite old and the provisions need amendments to reflect the changes in the waste management needs. Except for the metropolitan cities where a separate department headed by an engineer exists, the health officer is entrusted with the responsibility of SWM along with other activities. He in turn is assisted by the engineering department which provides and maintains the transport vehicles. Poor services in SWM are often a result of lack of inter-sectoral coordination. The expense towards SWM is usually met from the Property tax collected from the residents. A few local bodies in India levy administrative charges if any one is found dumping garbage indiscriminately in places other than those specified, one such being the Surat Municipality in Gujarat, which suffered an outbreak of Plague, in 1994.

A National policy and legislation for MSWM, titled the Municipal Solid Waste (Management and Handling) Rules, was notified in 2000 with an implementation schedule as given in Table 3. (MoEF, 2000). The Civic bodies have the responsibility to enforce these Rules. As per the Rules a wide spectrum of functions are to be undertaken by them. The major functions include

- Prohibiting littering of street
- Organizing house to house waste collection
- Conducting awareness programmes to disseminate information to public
- Providing adequate community storage facilities
- Use of colour code bins and promotion of waste segregation
- Transport of wastes in covered vehicles

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- Processing of wastes by adopting an appropriate combination of composting, anaerobic digestion, Pellatisation etc.
- Upgradation of the existing dump sites and Disposal of inert wastes in sanitary landfills

As per the Rules, the citizens are responsible for

- Segregation of wastes at source
- Avoid littering of streets
- Delivery of wastes in accordance with the delivery system notified by the respective Civic body.

Table 3 Implementation Schedule for Municipal Solid Waste Disposal in India (MoEF, 2000)

Compliance Criteria	Cities/towns with population			
	More than 10 lakhs	1 to 10 lakhs	0.5 to 1.0 lakhs	Less than 0.5 lakhs
Setting up of suitable composting facilities to make use of waste	by 31.12.2001 or earlier	by 31.12.2001 or earlier	by 31.12.2001 or earlier	by 31.12.2001 or earlier
Monitoring of disposal facilities set up to meet laid down standards	Once in four months on yearly basis	Once in six months on yearly basis	Once in a year on annual basis	Once in a year on annual basis
Existing landfill sites to be improved as per existing provisions of the rules	by 31.12.2001 or earlier	by 31.12.2001 or earlier	by 31.12.2001 or earlier	by 31.12.2001 or earlier
Identification of landfill sites for future use	by 31.12.2000 or earlier	by 31.12.2000 or earlier	by 31.12.2000 or earlier	by 31.12.2000 or earlier

Most Civic bodies are yet to take initiatives to comply with the Rules citing financial constraints and the deadline for improving the dumpsites have already passed on March 31, 2001. There are separate legislations addressing issues related to management and handling of Hazardous and Bio Medical Wastes. The Government has also banned the use of recycled plastic and non-permissible colour in production of polythene bags for food packaging. Production of polythene bags less than 20 microns has also been banned. But this actually increases the use of more virgin plastics. Although the polythene bags constitute 5% of the total volume of MSW, the

municipalities are being awfully disturbed by the havoc created by the polythene bags. Many of the municipalities are seeking legal provisions to ban them.

4. PRESENT MANAGEMENT PRACTICES

The present system of MSWM in India can be depicted by Figure 1. 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 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 on site 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. In a country like India, where cheap labour is available, the collection methods are labour intensive and cheaper compared to mechanized collection. Due to the absence of adequate storage capacity for the refuse generated and poor discipline among the generators, the wastes are continually dumped on the road (Boyar et al, 1996).

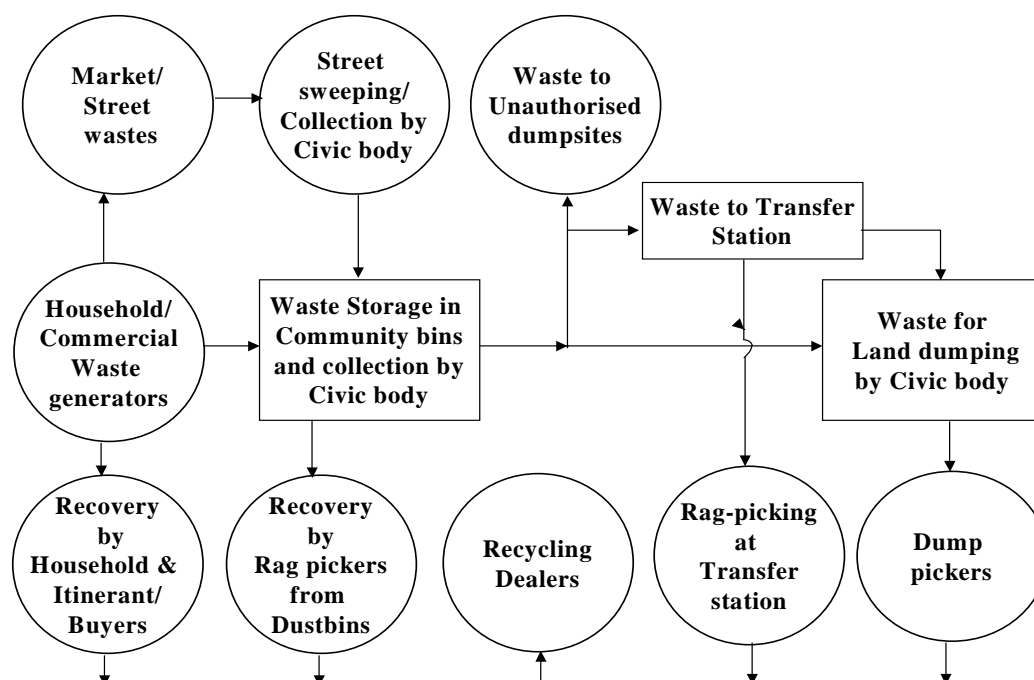


FIGURE 1 SCHEMATIC OF SOLID WASTE MANAGEMENT PRACTICE IN INDIA

To improve conservancy operations, authorities feel that the lack of civic awareness among city residents is proving to be a major hurdle to maintain the city clean. The problem is most acute in slums and low and middle income group areas. It will be nearly impossible for the civic body to provide better surroundings if residents do not take efforts to deposit the waste into the bins and stop the practice of throwing garbage on to the road. A conservancy worker has to cover a certain area by a specific time. If public are going to distribute garbage all along the road, the conservancy worker cannot cover the complete area assigned for him and some areas may not be covered on some days. Because of these poor conditions for temporary storage of wastes, in some areas NGOs have become involved in making arrangements for waste collection from households leading to improvement in local street cleanliness (Shekdar,1999).

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 tones capacity are in common use. In smaller towns, tractor-trailers are used despite being noisy and inefficient. In a 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. The maintenance of the vehicles is carried out in the general municipal workshop along with other municipal

vehicles where the municipal refuse vehicles receive the least priority. Most of these workshops have facilities for minor repairs only. Although preventive maintenance is necessary to maintain collection fleet in proper operating condition, neglect of preventive maintenance is a common situation. Transfer stations are in place only in a few metropolitan cities.

Commercial sector like shops, offices, hotels etc all use the community waste bins 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 waste 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 every 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. An incineration plant of 300 tpd capacity set up at Delhi, has not been operational due to low calorific values encountered. A biomethanation plant was proposed at Pune and Mumbai, but its full-scale operation is yet to begin and viability is yet to be proven. A project for producing 105 tpd fuel pellets from municipal solid wastes (MSW) in Hyderabad has

been installed. Work on a four megawatt MSW – based power plant in Nagpur has commenced. A few other projects for generation of power from MSW in cities such as Chennai, Lucknow, etc. have matured. (Dhussa and Tiwari, 2000).

In a majority of the urban centers, waste is being disposed of by depositing the same in low-lying areas. The disposal sites are selected on the basis of their closeness to the collection areas and new disposal sites are normally identified only when the existing ones are completely filled. In most cases, the waste is simply dumped at such sites and, except in the four metropolitan cities, bulldozers are rarely used for compaction at the disposal site. Even in these cities, they are used only for leveling of the deposited waste (Rao and Shantram, 1995). The incoming SW vehicles are not weighed and no specific plan is followed while filling the dumpsites. Provisions for leachate and gas control do not exist. A soil cover is rarely provided, except at the time of closure of the site. Most of the disposal sites are unfenced and the waste picking is commonly in vogue, posing problems in the operation of the sites. Open firing of MSW at disposal sites is most common, for reducing the volume of wastes and also for easy rag-picking (Luis et al 1997).

5. NATIONAL PLAN FOR MSWM

Considering the present status of MSWM in the country, the committee constituted by the Supreme court of India has summarized in a flow chart as depicted in Figure 2, the elements of MSWM for India.

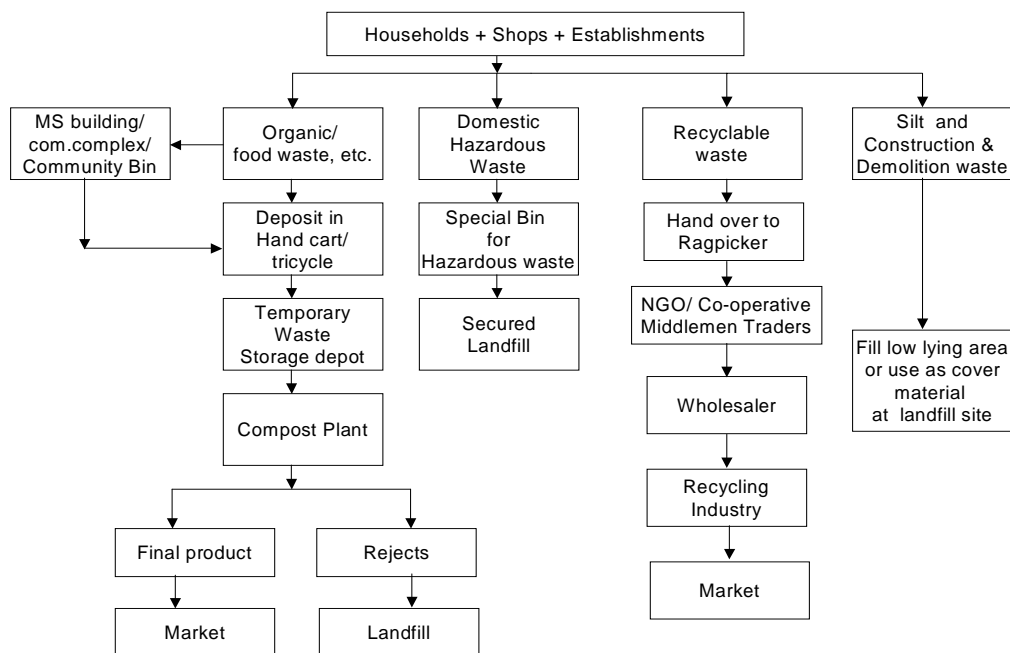


FIGURE 2 RECOMMENDED FLOW CHART OF MUNICIPAL SOLID WASTE IN INDIA
(Source : Supreme Court Committee Report, 1999).

Several attempts are underway to improve better management of municipal solid wastes (Singhal and Pandey, 2001). Deliberation on administrative, technical, financial and legal issues are being considered for the feasible means of management. Foreign investment in garbage management has been appreciated and modalities on bilateral collaboration with willing countries have been explored. Some of the initiatives in this direction included constitution of a National Waste Management Council (1990), formulation of a national Strategy paper on MSWM prepared by National Environmental Engineering Research Institute on behalf of the Ministry of Urban Affairs and Employment, publication of a Manual on Municipal Solid Waste Management (CPHEEO, 2000) and implementation of Municipal Wastes (Management and Handling) Rules (2000) under the Environmental Protection Act by Coordinated efforts of Municipal Agencies, Ministry of Environment and Forests, Government of India, Central Pollution Control Board (CPCB) and State Pollution Control Boards (Indrani, 2002). The recommendation of the Expert Committee (1999) constituted by the Honourable Supreme Court of India points towards the directions in which the country is moving towards improvement of MSWM. Some of the important recommendations are:

- Ban on throwing wastes on streets and levy of administrative charges from those who litter the streets
- Segregation of Wastes at Source
- Doorstep Collection of wastes
- Sweeping Streets on all days of the year
- Work Norms for sweeping of streets
- Provision of Litter bins at Public Places
- Abolition of Open Waste Storage sites and manual collection.
- Conversion of organic wastes into compost
- Upgradation of existing dumpsites
- Siting, construction and operation of sanitary landfills
- Institutional strengthening and capacity building
- NGO Participation in SWM practices
- Public Awareness Strategy
- Financial strengthening of Local Bodies

A time frame ranging from 3 months to 3 years depending on the activities is prescribed for implementing these recommendations (Supreme Court Committee Report, 1999).

7. CONCLUSION

The explosion in world population is changing the nature of solid waste management from mainly a low priority, localized issue to an internationally pervasive social problem. Risks to the public health and the environment due to solid waste in large metropolitan areas are becoming intolerable. The paper has summarized the salient features of the current scenario of MSWM in India and the future directions for improving the situation.

India currently is facing a municipal solid waste dilemma, for which all elements of the society are responsible. The community sensitization and public awareness is low. There is no system of segregation of organic, inorganic and recyclable wastes at household level. There is an adequate legal framework existing in the country to address MSWM. What is lacking is its implementation. In spite of a stringent

legislation in place, open dumping is the most wide spread form of waste disposal. The possible reasons for poor implementation could be a combination of social, technical, institutional and financial issues. Public awareness, political will and public participation as essential for the successful implementation of the legal provisions and to have an integrated approach towards sustainable management of municipal solid wastes in the country.

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