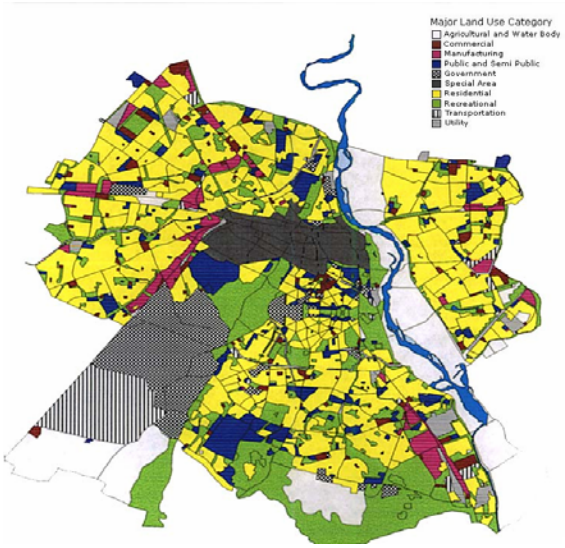

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Chapter – 12 : Solid Waste Management

IL&FS ECOSMART

CDP-Delhi

CHAPTER – 12
SOLID WASTE MANAGEMENT

12.1 INTRODUCTION

Appropriate solid waste management of a city is crucial for public health and aesthetic surroundings. It is essential for a clean look. Therefore, the removal of any scattered and littered waste is as important as effective street sweeping and drain cleaning. This also brings to focus the necessity of synergy in the design, construction and maintenance of roads, surface (storm water) drains and storage, collection and transport of solid waste.

Due to its size and multiple activities, different types of solid waste are generated in Delhi:

- Municipal solid waste (from the domestic and commercial sectors and common areas such as, parks, gardens, street sweepings and drain silt)
- Construction and demolition debris (C&D waste)
- Bio-medical waste (waste generated by health-care and veterinary establishments)
- Slaughterhouse waste (organized as well, as un-organized activities)
- e-Waste
- 'Special' waste (small quantities of toxic and hazardous waste generated by the household and trade sectors)
- Industrial waste generated within the city area

The presence of these different types of waste streams complicates the solid waste management scenario leading to deficiencies in planning and management. This is further aggravated by the unplanned settlements – slums and squatter settlements. Apart from the fundamental issue of service provision and problems of accessibility, some of these areas undertake unauthorized recycling of plastics; batteries etc. which may have grave environmental implications.

12.2 LEGAL AND INSTITUTIONAL FRAMEWORK

12.2.1 Legal Framework

The Delhi Municipal Corporation Act 1957 has section 42 C, 355-5.8; stating the functions and role of MCD and citizens in disposal of the waste. The violation of

the sections 353, 354, 355(2), 356 and 357 are subject to fines ranging from Rs. 25 – 100 Section 357 (1) "Keeping rubbish and filth for more than 24 hours", carries an additional daily fine of Rs. 10. The brief obligation of MCD is to provide receptacles, depots and places for waste disposal; and not necessarily house to house collection. It is the obligation of occupiers to use these for disposal of their waste.

12.2.2 Institutional Framework

Municipal solid waste management being the responsibility of Local Bodies, the following municipal entities are responsible for their respective areas:

1. Municipal Corporation of Delhi (MCD): Thus the MCD area includes urban areas, rural and urban villages, slum clusters and regularized unauthorized colonies. The services of CSE include collection, transportation and disposal of municipal solid waste; road sweeping; cleaning of surface drains, construction and maintenance of public conveniences.

S. No.	Item	Area (sq. km)	Number	Responsible Department
1	Total area	1397.30		Conservancy and Sanitary Engineering Department (CSE), presently changed to the Department of Environmental Management Services (DEMS)
2	Urban area (approx.)	595.00		
3	Rural area (approx.)	795.00		
4	Administrative zones of MCD		12	
5	Total number of employees		More than 52000	
6	Number of workers (*Safai Karmachari*)		About 50000	

2. New Delhi Municipal Council and (NDMC) : The activities include street sweeping everyday; removal of the garbage deposited in 'dhalao' (masonry dustbins) and metallic bins; and transporting the waste to MCD landfill sites at Ghazipur. The green (mainly horticulture) waste is transported to the NDMC compost plant at Okhla.

S. No.	Item	Area (sq. km)	Number	Responsible Department
1	Area	42.74		Health Department
2	Sanitation Circles		13	
3	Number of employees involved with sanitation		1800	

3. Delhi Cantonment Board (DCB): In the cantonment area also, the roads and markets are swept and garbage is lifted.

S. No.	Item	Area (sq. km)	Number	Responsible Department
1	Area	42.97		Health Department
2	Number of employees involved with sanitation		450	

12.3 WASTE GENERATION AND COLLECTION

12.3.1 Waste Collection Services

Total sweeping staff available with MCD and NDMC is in ratio of 1:216 persons and 1:326 persons respectively. This is above (better than) the prescribed norms of 1:500 in Central Public Health and Environmental Engineer Organisation (CPHEEO) manual. Within the municipal area, some zones have been contracted out to private contractors for functions ranging from the primary collection to waste disposal. They have their own sweeping staff, waste collectors and vehicles to transport the waste from collection points to disposal sites.

MCD has privatized collection of municipal solid waste in 6 zones through 3 private operators, in order to save costs and improve efficiency in service delivery. These operators have to put sets of two bins (blue and green coloured) for collection of non-biodegradable / recyclable and bio-degradable waste respectively. These bins are emptied into separate vehicles of similar colour daily. The operators are also expected to do segregation of bio-degradable and non-biodegradable solid waste before the waste is collected into separate vehicles.

NDMC has 900 community bins (masonry built) and 1000 metallic skips (open containers of about 1m^3 capacities).

12.3.2 Waste Generation

In the absence of a streamlined and completely controlled system of solid waste management, the available data is based on per capita generation from some studies (e.g., done by NEERI, 1999[1], Delhi Master Plan 2021[2], State of Environment Report for Delhi, 2001[3]), vehicle trips and fragmented data from landfill records. Table 12.1 gives some idea of the waste generation, arrived at from such sources:

Table 12.1: Waste Generation arrived

S. No.	Local Body	Existing generation for 2001in TPD	Projected * generation for 2021 in TPD
1	Municipal Corporation of Delhi	6300	15100
2	New Delhi Municipal Council	400	550
3	Delhi Cantonment Board	100	100

Source: Public Health Department of MCD, NDMC and DCB
***** 700 g per capita per day for calculation of projected generation in 2021 as per CPEHHO Manual on solid waste Management

[1] Quoted in Delhi Urban Environment and Infrastructure Improvement Project (Status Report for Delhi 21) prepared in 2001: 6000-6300 TPD for MCD, 350-400 TPD for NDMC and about 100 TPD for DCB, the total generation in the National Capital Territory of Delhi shown as around 6500-7000 TPD

[2] As per Delhi Master Plan, 2021 (the generation in 2001 being shown as 5250, 245 and 48 TPD for MCD, NDMC and DCB respectively)

[3] State of Environment Report for Delhi, 2001, prepared by TERI quote the total figure at 6000-7000 TPD form the NCT (6300, 400 and 100 TPD for MCD, NDMC and DCB respectively)

A news paper report (Times of India, May 14, 2006, New Delhi) pegs the solid waste generation at 8000 TPD and garbage dumped at the three landfill sites at 7435 TPD. According to a study carried out by IL&FS Ecosmart in 2005, the total generation is around 7700 TPD. The website of NDMC (as accessed on 12.08. 2006) notes lifting of 200-210 TPD garbage from its area.

Keeping in view the somewhat varying figures, it is proposed that the present generation of municipal solid waste may be taken as 6500 TPD for MCD, 400 TPD for NDMC and 100 TPD for DCB (total for NCT 7000 TPD). The figure is corroborated by the figure of waste collection of 6500-7000 TPD presented in a paper by MCD[4]

12.3.3 Constituents of Waste

The variation of biodegradable waste ranges from 61.54% for industrial areas to 90.48% for APMC. This indicates marked variation in the biodegradable component of MSW in accordance with the land use pattern. Industrial areas are considered to generate relatively less amount of biodegradable waste while APMC market is considered to generate maximum amount of biodegradable waste. However, majority of land use like, MIG, LIG, HIG, EWS, Local fruits / vegetable markets, institutional areas public / semi public areas and villages are generating waste with a biodegradable component ranging from 71% to 76.5%. This indicates that the Dhalaos catering to these areas are receiving waste from mixed land use areas existing in the vicinity.

The variation in recyclable waste ranges from 1.85 from APMC to 8.24% from industrial areas. The extent of recycling is indicated by the values of individual constituents at the source and at the disposal site. It is evident from this table that the recovery of the recyclable constituent includes paper, plastic, glass crockery, clothes, metal, etc. Paper, plastic and rag contributed a major fraction while glass, metal contributed to a lesser extent. Recyclables from APMC market are expected to be minimum (Refer Table 12.2)

[4] (National Workshop on Municipal Solid Waste Management: Sharing of Experiences and Lessons Learnt, New Delhi, July, 2005 and sponsored by HUDCO, USAEP and WSP).

Table 12.2: Comparative Analysis of Physical and Chemical Characteristics

Parameter	HIG	MIG	LIG	EWS	APMC	Local Fruits / Vegetable Markets	Institutional Area	Commercial Area	Public & Semi Public Areas	Industrial Areas	Village Areas	Landfill
Composition (%)												
Biodegradable	74.9	72.86	72.96	71.28	90.48	76.59	74.63	68.76	74.03	61.54	71.08	62.5
Recyclable	3.86	4.74	5.2	5.99	1.85	4.25	5.00	5.07	5.11	8.24	4.38	3.84
Inert	1.01	1.67	1.43	2.16	0.33	1.16	1.43	1.37	2.37	2.02	1.30	2.75
Others	2.72	3.05	3.95	3.4	0.42	2.18	2.71	8.32	3.20	7.91	3.42	2.45
Bulk Density (MT/m^3)	0.36759	0.373851	0.36774	0.374524	0.372024	0.374651	0.359392	0.375547	0.348429	0.3746	0.349915	0.356667
Ash and Fine Earth Content %	17.44	17.68	16.46	17.17	6.92	15.82	16.23	16.48	15.29	20.29	19.82	28.46
Moisture %	44.53	48.78	45.37	47.19	64.7	47.89	48.4	49.92	57.9	31.425	36.80	44.6
Calorific Value (kCal/kg)	1048	1109.47	1048	1096	1760	1321	1139.8	1133.46	1451.75	1014.3	1346	1366
C/N Ratio	21.29	21.35	20.7	20.19	30.03	22.56	17.82	22.52	24.82	19.05	25.76	22.26

12.3.4 Waste Collection and Storage

Several types of waste receptacles are used in the MCD area – (i) large masonry bins, locally called "Dhalao" (ii) metallic bins of covered and open types (iii) 4-wheeled plastics and FRP bins with large covers, which have been introduced in some areas during the last 2 years and (iv) sites in some localities, where waste has been dumped in the open. The estimated number of dhalaos, metallic bins and open sites is about 2500.

Delhi is divided into 12 zones, and each zone comprises different receptacles at which the waste from different corners in zones gets collected. It is transported to landfill sites for final disposal. Zone-wise list of Dhalaos, dustbins and open sites is described in (Refer Table 12.3)

Table 12.3: Zone-wise list of Dhalaos, Dustbins and Open Sites

Name of the Zone	Total Number of Dhalao
Zones Under MCD	
Shahadara South	184
Shahadara North	133
Rohini	219
Civil Lines	156
Narela	35
City	85
Central	285
West	189
Najafgarh	216
Paharganj	44
Karol Bagh	91
South Zone	384
Cantonment Board	161
NDMC Zone	221

Source: Municipal Corporation of Delhi

12.3.5 Waste Transportation

MCD has 689 trucks (majority of the tipping kind), 71 private tipper trucks (8m^3 capacity) and 100 loaders for collection, lifting and carriage of municipal garbage.

12.3.6 Processing and Disposal

Currently, Delhi has 4 compost plants:

S. No	Facility	Capacity (TPD)	Area (Ha)	Starting Year	Technology	Remarks
1	Okhla (MCD) **(closed at present)**	150	3.2	1981	Aerobic windrow composting	Proposed to be upgraded to 200 TPD
2	Okhla (NDMC)	200	3.4	1985	-do-	Operated below capacity
3	Bhalswa (Private sector)	500	4.9	1999	-do-	Operating at 50% capacity
4	Tikri Khurd (APMC and	125	2.6	2001	-do-	Dedicated waste stream

S. No	Facility	Capacity (TPD)	Area (Ha)	Starting Year	Technology	Remarks
	Private Sector)					from APMC
	Total	**975**	**14.1**			

Thus out of 7000 TPD, only about 400 TPD is being processed at present in the three compost plants and the balance is assumed to be dumped at the three dump-sites (landfills):

Okhla landfill site

Ghazipur landfill site, fish and chicken market on the left

Slaughterhouse under construction at Ghazipur landfill site

S. No.	Name of site	Location	Area (Ha)	Year started	Waste received (TPD)	Zones supplying waste
1	Bhalsawa	North Delhi	21.06	1993	2200	Civil Lines, Karol Bagh, Rohini, Narela, Najafgarh and West
2	Ghazipur	East Delhi	29.16	1984	2000	Shahdara (south and north), City, Sadar Paharganj and NDMC
3	Okhla	South Delhi	16.20	1994	1200	Central, Najafgarh, South and Cantonment Board

Source: Information provided by MCD

The current expenditure for municipal solid waste management for MCD is Rs. 5030 million (Rs. 3860 million non-plan and Rs. 1170 million plan).

Recycling and rag-picking

Recycling and rag-picking of municipal solid waste is widely prevalent in Delhi through the involvement of an extensive network of informal (rag-pickers and scrap-dealers) and formal (recycling facilities) stakeholders. A wide range of materials and items are involved, such as, paper / cardboard, plastics, metals, glass, rubber, leather, textiles and clothing etc. As per a study the number of rag-pickers in Delhi is in the range of 80,000 to 100,000 (Srishti). It is estimated that about 1200-1500 TPD is removed from the municipal collection and disposal chain by these activities. However, these activities, carried out in un-hygienic and unscientific manner, have unfavourable environmental, occupational health and community health implications.

12.3.7 Construction and Demolition Debris

This category of waste comprises predominantly inert waste generated during construction and demolition activities. Major sources of C&D waste are:

- Residential waste – normally for small amendments, additions to homes
- Property developers – whether residential or commercial
- Other sources (roads / pavements /drains / medians improvement, demolition activities etc.)

Table 12.4 along with the pie-chart presents the results of TIFAC estimates of C&D waste composition in India. In addition, current survey findings and assessment carried out in 2005 by IL&FS Ecosmart are also shown in the Table

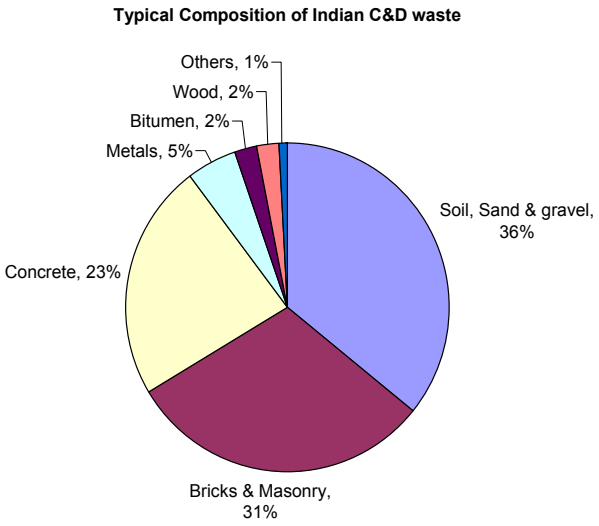


Table 12.4: C&D Waste Composition (in %)

Composition of C&D[5]	Typical as per TIFAC	MCD Survey, 2004	Survey 2005 by IL&FS Ecosmart
Soil/Sand, Gravel	36.0	43.0	31.5
Bitumen	2.0	-	-
Metals	5.0	-	0.4
Masonry / Brick	31.0	15.0	59.0
Concrete	23.0	35.0	-
Wood	2.0	-	1.5
Others	1.0	7.0	7.6
Total	**100.0**	**100.0**	**100.0**

Note: Metal, Timber, glass, plasterboard and plastic are almost entirely recycled.

From the survey findings of IL&FS Ecosmart, it may be inferred that the C&D waste in Delhi mainly contains soil/sand, gravels and brick masonry.

[5] Constituents of C&D waste are, Soil, Concrete, Masonry (i.e, bricks), Stone, Metal, Timber, Glass, Plaster Board and Plastic, porcelain, and Bituminous materials (from road excavations)

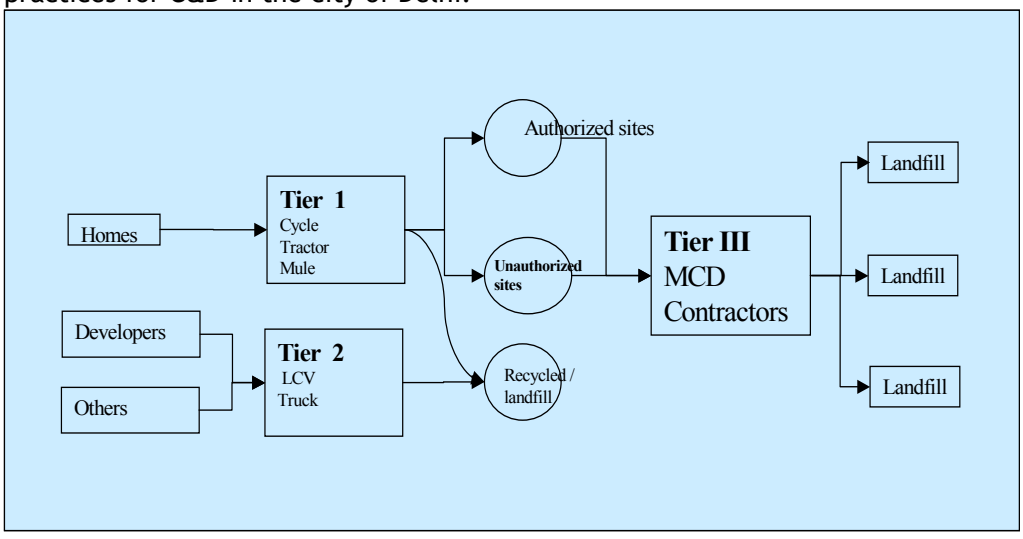
Based on TIFAC study, quantum of waste generated during Construction is of the order of 35 kg / sq.m of construction activity, while during demolition waste generated is about 350 kg / sq.m of demolition. As per the log sheets kept at the landfills, the quantity of C&D waste was found to vary from a high of 2877 TPD in July to a low of 442-446 TPD during August and September during a period of 15 months proceeding May 2005. The average comes to 879 TPD. The higher quantum during July is due to removal of silt from drains. On the other hand, generation of 1600-2000 TPD is indicated as per the transport arrangements of MCD.

However, the quantum reaching the landfill is the quantity collected by MCD and does not reflect the generation. It also needs mention that most of the C&D is consumed internally for land filling and bricks, metal and wood are recycled.

It is not obligatory for MCD to collect and dispose C & D waste. As per the regulations, the responsibility of disposal of construction waste is with the generator and MCD levies a fee of Rs. 250 / Ton of Waste disposed at landfill. However, significant quantities of waste are disposed at unauthorized / designated public locations. From these points, Municipal Corporation of Delhi (MCD) is forced to evacuate C&D to the landfills.

Typically, demolition activity is undertaken by specialized demolition contractors who bring their own equipment and personnel and transport the residual waste. The property owners pay fee to the demolition contractors, which is decided based on the recoverable value of recycled materials – steel, wood, glass, pipes etc. by demolition contractors.

The diagram below describes the existing collection and transportation practices for C&D in the city of Delhi.



Disposal practices: Currently the C&D waste is disposed without any kind of processing at Ghazipur and Bhalswa MSW disposal sites. Considerable quantities are disposed off at unauthorized locations or MCD designated dumping sites in Delhi. List of some of the existing C&D waste dumping sites in Delhi, visited recently, is provided in *Annexure 4*.

It is very important that construction and demolition waste is kept separate from the other municipal solid waste so that the processing and disposal is more efficient and the inerts are at least partially utilized.

MCD is considering a pilot project for the collection, transportation and disposal of 500TPD of C&D waste for few selected zones of the city. The rationale for the proposed project is to separate C&D stream from MSW and in this process

- Transfer the responsibility of the costs of collection, transportation, and disposal to the C&D waste generator, and
- Streamline the C&D waste collection and transportation to improve the existing condition of the city
- Explore & develop a market for processed C&D waste.

12.4 CONSTRAINTS – TECHNICAL, FINANCIAL AND INSTITUTIONAL

The technical problems relate to municipal storage, collection and transportation. But the major problem is in the area of processing and disposal.

Open 'dhalao' (masonry built dust bin) is still the major receptacle for municipal solid waste in Delhi. These lead to two-fold problems – exposure of the waste to the environment and multiple handling (from depositing of the garbage to its loading on to the waiting collection vehicle – whether manually or by a front-end loader and again un-loading at the landfill unless the transporting vehicle is tipping type).

The private operators are using smaller bins with lids (plastics or FRP made) and dumper placer containers, where the above mentioned problems are under control. However some of the dumper containers are not covered, leading to environmental pollution.

Open vehicles are being used for transporting the waste across busy roads in majority of the cases, which needs to be controlled in a planned way. Putting a dangling tarpaulin over the open truck of garbage is no solution.

Processing and disposal of municipal garbage is the most crucial issue. The existing landfills (dump-sites) are almost full. They need to be closed immediately in a scientific manner to the extent possible and new sanitary landfill (SLF) sites need to be developed and commissioned at the earliest possible. The major constraints in this are:

1. Provision of adequate land for building new sanitary landfills
2. To make arrangement for disposal of the waste in the intervening period before the new SLFs can receive waste

Proposed site at Bhatti Mines

Proposed site at Jaitpur (dewatering under process)

As of now, MCD is trying to set up 3 new facilities at (a) Jaitpur, (b) Narela-Bawana and (c) Bhatti-mines (Refer Table 12.5):

Table 12.5: Three Proposed Sites for Solid Waste Management

S. No.	Site	Area available (Ha)	Status / Remarks
1	Jaitpur (deep pit, average 25 meter deep)	24.6	The work has been awarded. The deep pit was filled with water. De-watering is being done since last 2 years but is not complete yet. The steep sides would require expertise of high level for planning and execution of the job.
2	Narela Bawana (flat land)	60.0	EIA completed. Land yet to be handed over to MCD
3	Bhatti Mines (deep pits – 4 nos., about 20 meter deep)	68.0	EIA completed. Land yet to be handed over to MCD.
	Total	**152.6**	

From the above, it would appear that there is no possibility of construction and commissioning of any of these facilities in the next one year. Therefore the biggest challenge would be to accommodate the garbage in the existing sites in a scientific manner and at the same time remedy the environmental problems of the existing dump-sites.

12.5 APPROPRIATE PROCESSING AND DISPOSAL

The key issues in Delhi with respect to solid waste management are:

- Efficient service delivery (collection and removal of garbage, construction and demolition debris and other types of waste, street sweeping etc. leading to clean surroundings and feeling of well being amongst the citizens)

- Appropriate disposal of waste in conformity with the applicable rules and most importantly,

- Strategy for reducing land requirement

In the above listing, the most important element is reduction in land requirement for disposal. In the absence of adequate land, the three landfill sites are being over-used. As per the present situation, Delhi is actually in a very serious situation with respect to land required for processing and disposal of solid waste.