



Newsletter

NATIONAL SOLID WASTE ASSOCIATION OF INDIA

ENVIS ENVIRONMENTAL INFORMATION SYSTEM NODE

Urban Municipal Solid Waste Management



Sponsored by: The Ministry of Environment & Forests, New Delhi, under a programme on Environment Management Capacity Building Technical Assistance Project of the World Bank

NSWAI ENVIS

• INAUGURAL ISSUE •

JUNE, 2003

Environmental Information System (ENVIS)

Scope

NSWAI-ENVIS is required to collect and disseminate information on Urban Municipal Waste Management (UMWM). NSWAI intends to cover about 300 cities of India with population of 1,00,000 and above.

Questionnaire

A questionnaire seeking information on city area, population, solid waste generated, sources, physical and chemical characteristics, collection, segregation, processing, transportation, disposal and financial aspects was prepared and this was sent to all the municipal bodies.

Contact

In addition, State Pollution Control Boards and Central Pollution Control Board, All India Institute of Local Self Government were contacted for the same.

Literature collection

In the process, we collected quite a number of publications, reports, proceedings of workshops, manuals, etc.

Collection of Information

The requests for information did not yield fruitful results. NSWAI, therefore, deputed people to cities to collect the information in person. Thus information on more than 40 cities was received. Many of these were incomplete and were inadequate. The information on 43 cities was collated & interpreted to the extent possible. Data analysis is under progress. Personnel deployed for information collection are still sending the necessary data from the field.

Website

As part of this, a website www.nswai.com was launched and most of the data has been uploaded. This site is available to all those who are interested in reading more about MSW.

Newsletter

NSWAI is publishing this Newsletter as a part of ENVIS activities.

Future Plan

- Collection of information for the remaining >250 cities.
- Authentication of data through personal visits
- Data analysis
- Gap identification
- Possible solutions
- Recommendations for improvement

Introduction

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. Urban solid waste is defined as material for which the primary generator or user abandoning the material within the urban area requires no compensation upon abandonment. In addition, it qualifies as an urban solid waste if it is generally perceived by society as being within the responsibilities of the municipality to collect and dispose of. If not managed properly, these wastes can have an adverse impact on the environment and public health arising from contamination of soil, water and pollution of air and through spread of diseases via vectors living on waste.

Municipal Solid Waste (MSW) includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. It is a combination of various heterogeneous waste materials commonly known as garbage, refuse, rubbish or trash. Its main sources are residential premises, business establishments and street sweepings and is a mixture of vegetable and organic matter; inert matter like glass, stones, ashes, cinders, textiles, wood, etc.

Urban Municipal Solid Waste Management (UMSWM) requires the knowledge of:

Sources of waste, Generation rate and quantity, Physical and chemical characteristics, Collection, Storage, Segregation, Transportation, Treatment and processing, Recycling, Reuse, Disposal of waste and Financial aspects.

Magnitude of Urban Municipal Waste Management (UMWM) in India

There are 300 Class I cities in India with population in each of these cities exceeding 100,000. Report of the Committee constituted by the Hon. Supreme Court of India entitled "Solid Waste Management in Class I cities in India" states that 65.2% of the urban population of 217 million lives in these cities. This works out to be a population of 14,14,84,000 (141.484 million). This was the case when Indian population was 844 million (1991 census). About 16.8% of total population lives in Class I cities. The total solid waste generated by 217 million people staying in class I cities is reported to be 23.86 million tonnes per year. This gives us an

average solid waste generation per capita per day of 301 g. The report gives the range of waste generation rate between 200 to 500 g per capita per day.

A booklet entitled "Management of Municipal Solid Waste" published by Central Pollution Control Board gives data for 23 cities only. They produce a total of 30058 MT/d, with the generation rate ranging between 273-657 g per capita per day, averaging about 450 g.

The scope of work of NSWAI-ENVIS on Urban Municipal Waste Management is intended to cover these 300 cities for the UMWM. Whereas this will cover at least about 17% of the population of India, the percentage area covered

Table 1: % wise distribution of waste sources in various cities

State	Cities	MSW generated (MT/d)	Population	GR (gms/capita/day)	Domestic		Commercial		Industrial		Market		Hotel/Rest.	
					MT/d	%	MT/d	%	MT/d	%	MT/d	%	MT/d	%
Karnataka	Mysore	354	879,150	403	NA	-	NA	-	NA	-	13.6-22.6	6.4%	12.27	3.5%
	Bangalore	2,500	5,700,000	439	1,000	40.0%	600	24.0%	-	-	600	24.0%	-	-
Kerala	Cochin	375	700,000	536	249	66.4%	-	-	-	-	38	10.1%	50	13.3%
Maharashtra	Solapur	350	873,009	401	210	60.0%	35	10.0%	88	25.0%	11	3.0%	7	2.0%
	Sangli-Miraj	160	436,639	366	92	57.5%	40	25.0%	-	-	24	15.0%	4	2.5%
	Pune	1,000	2,540,000	394	400	40.0%	250	25.0%	-	-	50 (+5)	5.0%	250	25.0%
	Pimpri-Chinchwad	310	1,006,453	308	270	87.1%	15	4.8%	10	3.2%	10	3.2%	5	1.6%
	Parbhani	54	259,170	208	36	66.7%	8	14.8%	-	-	9	16.7%	1	1.9%
	Nanded-Waghela	149	430,000	347	110	73.8%	19	12.8%	5	3.4%	10	6.7%	5	3.4%
	Latur	120	299,828	400	58	48.3%	25	20.8%	5	4.2%	20	16.7%	12	10.0%
	Kolhapur	165	485,183	340	105	63.6%	15	9.1%	10	6.1%	25	15.2%	10	6.1%
	Jalna	35	235,825	148	27	77.1%	2	5.7%	-	-	1	2.9%	5	14.3%
	Beed	25	138,091	181	14	56.0%	2	8.0%	2	8.0%	5	20.0%	2	8.0%
Tamil N.	Aurangabad	300	1,000,000	300	130	43.3%	90	30.0%	20	6.7%	20	6.7%	30	10.0%
	Barsi	30	104,786	286	16	53.3%	8	26.7%	1	3.3%	3	10.0%	2	6.7%
	Satara	35	108,043	324	14	40.0%	6	15.7%	2	4.3%	9	25.7%	5	14.3%
	Ichalkaranji	65	257,600	252	26	40.0%	7	10.0%	13	20.0%	10	15.0%	10	15.0%
Tamil N.	Tiruchirapalli	360	746,000	483	271	75.1%	90	24.9%	-	-	-	-	-	-

NA - Data not available

will definitely be much less. This thus represents a high density locale with respect to the area, population and the urban municipal solid waste.

Sources of waste generation

Municipal solid waste comprises of:

Domestic waste: consists of households waste, kitchen waste, house cleaning, old papers, packing, bottles, crockery wares, furnishing materials, garden trimmings, etc.

Commercial waste: waste generated at business premises, shops, offices, markets, departmental stores (paper, packing material, spoiled/discarded goods), organic, inorganic, chemically reactive and hazardous waste.

Institutional waste: schools, colleges, hospitals, large hotels and restaurants, markets selling vegetables, fruits, meat, fish, etc, community halls, religious places, etc.

Street sweeping: unconcerned throwing, litter by pedestrian and vehicular traffic, stray animals, roadside tree leaves, rubbish from drain cleaning, debris, etc.

Industrial/Trade waste: manufacturing and material processing trade generated waste.

Debris or construction rejects: frequent digging of roads by various utilities comprising earth, brickbats, stones, wooden logs, etc.

Waste – offal, dead animals etc.: offal wastes generated from slaughterhouses, food packing institutions and cold storage premises, etc.

Out of the data collected from 43 cities, only 18 cities have given the source information and it is observed that domestic waste ranges between 40 to 87% of the total waste generated, commercial waste between 5 to 30%, industrial waste up to 25% (max), market waste between 3 to 26%, hotel and restaurant waste between 1.6 to 25%. (Table 1)

Solid waste generation rates

From the data collected from 43 cities, the solid waste generation rate ranges between 148 gms per capita per day to 878 gms per capita per day, the overall average amounting to 415 gms per capita per day. (Refer Table 2 & Figure 1). Cities having daily per capita waste generation rate of more than 500 g are 10 in number, those with 400 – 500 g are 13 in number, 300 – 400 g are 11 and those with less than 300 g are 9 in number.

Quantity of waste generated

The daily solid waste generated by the 43 cities adds up to 35678 MT/d, which amounts to 13,022,652 MT/Year i.e. 13.0 million metric tonnes per year. (Refer Table 2)

Physical Characteristics of MSW

Data available on physical characteristics is limited to 13 cities out of 43 amounting to 33% of the total. Data available is also incomplete. Biodegradable material ranges between 10% - 93%, paper between 0.18% - 15%, plastic between 0.2% - 15%, glass between 0.1% - 5%, metal between 0.06% - 15% and inert material between 2% - 54%. (Refer Table 3 & Figure 2). One can infer that the characteristics for each city can be really different and variable.

Chemical characteristics of MSW

Availability of data on chemical characteristics of municipal solid waste is practically non-existent. Values of only four cities are available and some are incomplete. Other cities have not supplied any data on this. There is a need to generate this data for a meaningful understanding of the nature of MSW (Refer Table 4 & Figure 3)

Collection of Solid Waste

As reported by most of the Municipal Corporations, almost all the waste generated at source are being collected. However, there are certain cities like Mysore, which collects only 40% of the generated waste. Whereas in cities like Pune and Sangli- Miraj, the waste collected is 48 and 36% respectively. Though house- to - house collection is being carried out in many cities, unfortunately, none of the corporations has reported about the same. Similarly the information regarding the collection bins is not adequately reported by any of the municipalities except Delhi, Tirupati, Ludhiana & Rishikesh. Segregation of waste is very important for proper management. It is observed that in most of the metropolitan cities, citizens are being educated by various agencies, NGO's, voluntary organizations and municipal staff by displaying the placards, posters and through workshops etc, however the success is dismal.

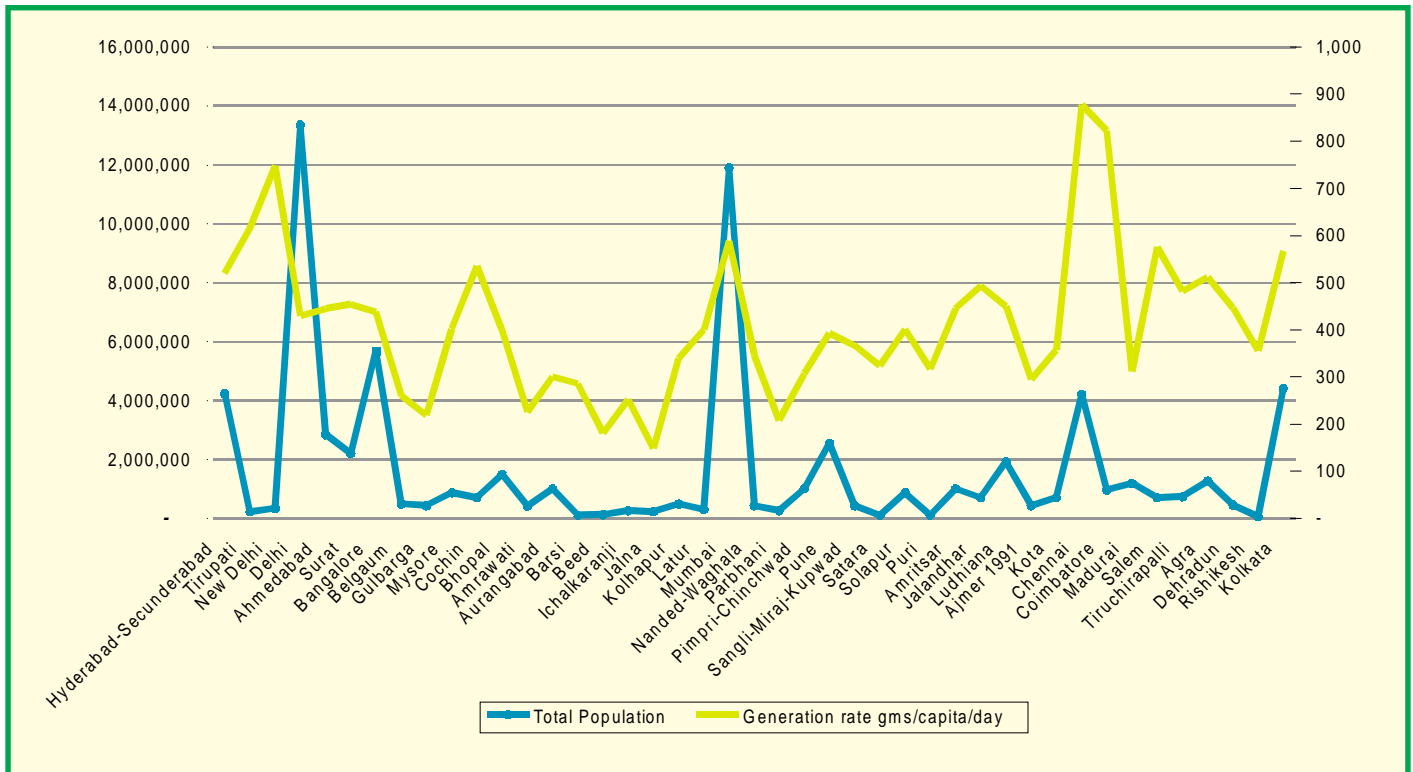
Sweeping & Drainage Cleaning

It is a common tendency of all the citizens to litter, to throw paper waste, plastic bags etc. on the roads. This practice leads to choking of drains, which ultimately causes blockage of

Table 2 : Waste Generation and Generation Rates in various cities in India

Sr.	State	City	Area km ²	Total Waste Generated MT/day	Total Population	Generation rate gms/capita/day
1	Andhra Pradesh	Hyderabad-Secunderabad	170.00	2,200	4,231,796	520
2	Andhra Pradesh	Tirupati	24.00	140	227,000	617
3	Delhi	Delhi	24.00	5,750	13,363,471	430
4	Delhi	New Delhi	1397.29	262	350,000	749
5	Gujarat	Ahmedabad	190.15	1,272	2,854,000	446
6	Gujarat	Surat	42.74	1,000	2,200,000	455
7	Karnataka	Bangalore	112.48	2,500	5,700,000	439
8	Karnataka	Belgaum	91.23	130	500,000	260
9	Karnataka	Gulbarga	226.00	95	435,000	218
10	Karnataka	Mysore	190.15	354	879,150	403
11	Kerala	Cochin	50.00	375	700,000	536
12	Madhya Pradesh	Bhopal	94.08	600	1,500,000	400
13	Maharashtra	Amrawati	35.00	95	421,000	226
14	Maharashtra	Aurangabad	94.88	300	1,000,000	300
15	Maharashtra	Barsi	179.00	30	104,786	286
16	Maharashtra	Beed	285.88	25	138,091	181
17	Maharashtra	Ichalkaranji	8.17	65	257,600	252
18	Maharashtra	Jalna	138.20	35	235,825	148
19	Maharashtra	Kolhapur	8.29	165	485,183	340
20	Maharashtra	Latur	20.00	120	299,828	400
21	Maharashtra	Mumbai	437.71	7,025	11,914,000	590
22	Maharashtra	Nanded-Waghala	66.82	149	430,000	347
23	Maharashtra	Parbhani	32.00	54	259,170	208
24	Maharashtra	Pimpri-Chinchwad	46.00	310	1,006,453	308
25	Maharashtra	Pune	264.00	1,000	2,540,000	394
26	Maharashtra	Sangli-Miraj-Kupwad	171.00	160	436,639	366
27	Maharashtra	Satara	437.71	35	108,043	324
28	Maharashtra	Solapur	179.00	350	873,009	401
29	Orissa	Puri	121.65	35	110,000	317
30	Punjab	Amritsar	110.00	450	1,011,327	445
31	Punjab	Jalandhar	27.52	350	709,255	493
32	Punjab	Ludhiana		862	1,914,471	450
33	Rajasthan	Ajmer 1991	45.50	131	445,000	295
34	Rajasthan	Kota	495.00	250	700,000	357
35	Tamil Nadu	Chennai	51.85	3,700	4,216,268	878
36	Tamil Nadu	Coimbatore	200.00	800	971,409	824
37	Tamil Nadu	Madurai	146.90	375	1,200,000	313
38	Tamil Nadu	Salem	105.60	400	695,000	576
39	Tamil Nadu	Tirchirapalli	45.50	360	746,000	483
40	Uttar Pradesh	Agra	10.00	650	1,271,000	511
41	Uttaranchal	Dehradun	174.00	200	447,808	447
42	Uttaranchal	Rishikesh	91.34	20	56,117	356
43	West Bengal	Kolkata	187.33	2,500	4,400,000	568
			6,827.97	35,678.50	72,343,699.00	415.21

Figure 1: Total Population v/s Generation Rate



sewer and storm water during the monsoon. Proper maintenance of drainage by removing this litter or garbage and cleaning of roads including the dust generated daily through automobiles or by natural factors should be carried out frequently for better waste management. Most of the cities have reported cleaning of the main roads daily. However none of them has mentioned about the cleaning of drains on regular basis. The streets are mostly cleaned by using manually operated brooms and handcarts.

Transportation

The information regarding transportation of solid waste generated (at source) to community bins and from there to dumping yard is inadequate and uncomfortable. This activity involves various types of carts & vehicles, which vary in sizes, capacities, and also depends on the make and the life of the vehicle. Most of the municipalities have a separate department for transportation of waste, which is not directly controlled by the solid waste management section of the municipality. Some corporations and municipal bodies hire private vehicles for transportation of MSW, at least in part. The above information is not collected fully because of such situations. This needs to be conducted in a very professional way.

Depending on the size and volume of the waste and waste characteristics, it is shifted from one place to another and ultimately it reaches the dumping yard. The efficiency of transportation of the waste depends on the above factors which are to be looked into carefully. So far, informations regarding the above are not well defined in any of the data sheets submitted to us by municipal bodies.

Disposal

It is high time that an urban city designates a site for scientific disposal of solid waste in a proper professional way i.e. sanitary landfill site. At present, the waste is being dumped far away from the city without any precaution and in a very unprofessional manner. There are old dumping sites, a few designated sites and proposed sites. This needs to be reviewed as per the statutory requirements. There are objections regarding the location of the site concerned, proximity of the site with the residential area, sensitive areas, monuments, nature park and other sensitive areas. Disputes especially on the border between two municipal jurisdictions or municipal districts or state jurisdictions also arise. Besides the above, the distance between the location of source of waste generated and the disposal site is very significant.

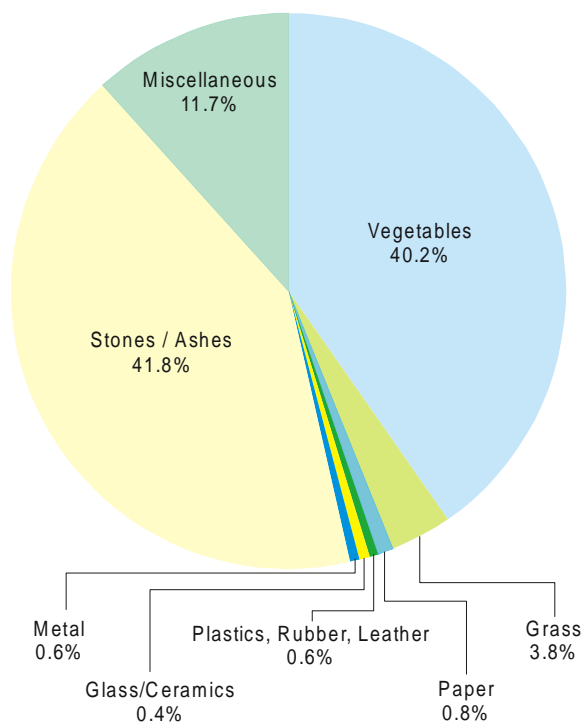
Table 3: Physical Characteristics

State	City	Biodegradable	Paper	Plastic	Glass	Metal	Inert,ash debris
Andhra P.	Tirupati	35.7-72.3	0.18-10.45	0.6-2.21	0.26-4.61	0.06-0.24	-
Goa	Panaji	74.5	15.0	2.7	2.6	0.6	2.4
Gujarat	Ahmedabad	-	4.7	1.6	-	1.6	15.7
Karnataka	Bangalore	60.0	12.0	14.0	4.0	1.0	9.0
Kerala	Cochin	58.0	4.9	1.1	0.3	0.7	35.0
Madhya P.	Bhopal	-	8.5	3.5	1.0	1.5	30.0
Maharashtra	Barsi	93.0	3.0	1.0	1.0	1.0	-
	Kolhapur	-	6.0	3.5	5.0	0.1	-
	Pune	-	10.0	15.0	3.0	-	40.0
	Aurangabad	60.0	3.0	2.0	2.0	15.0	10.0
	Mumbai	37.5	15.0	0.8	0.4	0.8	35.0
Orissa	Puri	10-50	1-3.8	1-6.7	-	0.3	8-67
Rajasthan	Ajmer	31.36 - 57.8	0.3 - 2.35	0.2 - 3.12	0.1 - 0.8	0.1 - 0.15	18 - 54

Table 4: Chemical Characteristics

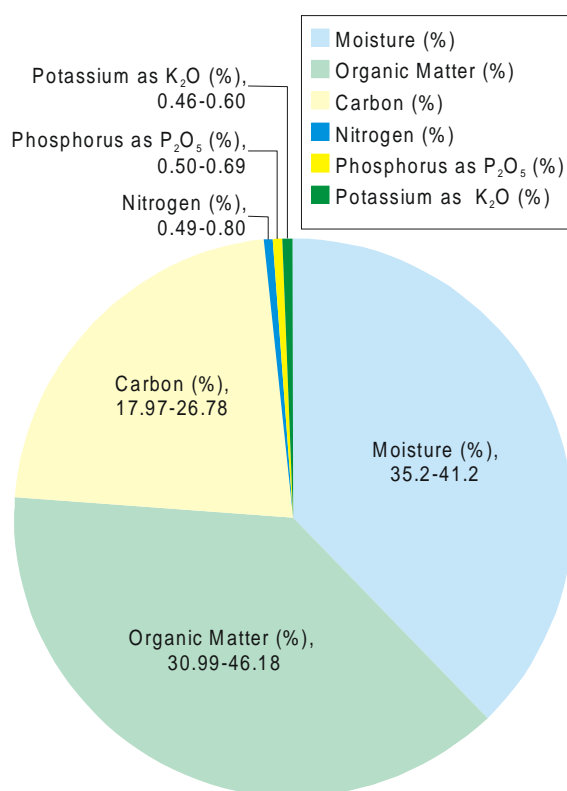
State	City	Moisture (%)	pH	Organic Matter (%)	Carbon (%)	Nitrogen (%)	Phosphorus as P ₂ O ₅ (%)	Potassium as K ₂ O (%)	C/N Ratio
Andhra P.	Tirupati	15-60	5.6-8.9	25.68-74.44	14.89-44.34	0.59-1.6	0.38-0.81	0.43-1.0	24.8-37.1
Goa	Panaji	-	-	-	28.9	1.63	0.83	1.71	18.4
Madhya P.	Bhopal	-	-	-	21.72	0.7	0.65	0.98	28.57
Rajasthan	Ajmer	35.2 - 41.2	7.5 - 8.2	30.99 - 46.18	17.97 - 26.78	0.49 - 0.80	0.50 - 0.69	0.46 - 0.60	33.47 - 38.10

Figure 2: Typical Physical Characteristics of Municipal Solid Waste in India



Source: Management of Municipal Solid Waste - Central Pollution Control Board

Figure 3: Chemical Characteristics of Municipal Waste in Ajmer



In most of the cities, the municipal solid waste is dumped on a site inside or outside of the area of the municipal body. The sites are generally not fenced, do not have any weighbridges, are not lit. Information on the area of the site, its distance from the populated city area is also inadequate. Scientific planning of the landfill sites appears to be non-existent.

Many cities do mention about the sites and their area. What seems to be lacking is the initiative to convert these into designated, scientifically planned and operated landfill sites. This should be on the top of the agenda.

However, this can be successful only if there is a concerted effort of segregation at source supported by reducing the waste quantity through composting, recycling, reuse etc.

Processing of Waste

There are various treatment processes of the solid waste generated in municipalities. Composting, vermicomposting, pelletisation, recycling, biogas generation are the possible processes for treatment of MSW. Composting and Vermicomposting are popular practices in many cities. Several cities have initiated experimental projects on composting and waste to energy. These have yet to develop to a scale where significant quantities of MSW can be put to beneficial use and thus reduce the total quantity of waste. Most of the municipalities are encouraging privatisation on the processing of MSW on Build, Own and Transfer (BOT) or Build, Own and Operate (BOO) bases. However, these systems are not yet functioning to the full capacity and satisfaction due to various causes. As for the information regarding these processes, the data received by us is not good enough, since these have good financial and technical implications in the integrated system of Solid Waste Management in India.

Financial Aspects

In India, municipalities normally depend on various financial resources to fund the solid waste management services viz., collection, transportation, recycle, disposal etc. Most of the metropolitan cities have separate budgetary provision and accordingly the department is also exclusive. However, in most of the small cities the solid waste management is executed through the health department. Since solid waste management has to depend on various other sections of municipalities like labour, transport,

stores & provisions and other related activities, the financial aspects of every section is not exclusive and hence cannot be calculated to give a distinct picture.

The information received by NSWAI-ENVIS is not satisfactory. In this regard, it needs to be collected from each related section of the municipality and allocate the same financial & activity wise to calculate the total expenditure.

There are provisions of grants from Central/ State Government for solid waste management in addition to donations, contributions from various private agencies, international agencies etc. In few municipal corporations, the above figures are not distinctly available in the information given by these municipalities. The expenditure for solid waste management per capita per year of the population is calculated from the total expenses incurred for solid waste management. It varies from Rs.342 to Rs.2,466 per metric tonne of MSW and Rs.43 to Rs.531 per capita per year out of the cities surveyed till date (Refer Table 5). For detailed information, NSWAI-ENVIS website can be referred to.

Table 5: Cost of SWM Services in various cities of India

	Rs. per MT of MSW	Rs. per capita per year
Hyderabad-Secunderabad	954.05	181.03
Delhi	1,543.02	242.33
New Delhi	1,817.68	496.64
Aurangabad	576.79	63.16
Beed	1,008.77	66.66
Jalna	1,455.97	78.94
Kolhapur	1,302.77	161.71
Latur	495.43	72.37
Nanded-Waghela	341.95	43.25
Pimpri-Chinchwad	1,861.14	209.24
Pune	1,067.93	153.46
Sangli-Miraj	579.41	77.50
Solapur	745.62	109.11
Mumbai	2,466.18	530.77
Barsi	759.19	79.33
Satara	513.90	60.76
Ichalkaranji	2,283.48	210.31
Rishikesh	1,077.63	140.18
Dehradun	890.95	145.24
Agra	713.17	133.12

Source: From various municipal authorities & personal interviews, NSWAI-ENVIS 2003



NSWAI, a professional body advocating and promoting sustainable management of solid wastes in India, was established in 1996. It provides a forum for the experts and others interested in the field of solid waste management to exchange information and experience. NSWAI has been recognized by MoEF (Ministry of Environment and Forests), Govt. of India and ISWA (International Solid Waste Association), Denmark as the principal national professional body in respect of solid waste.

Right from the time of its inception, the Association has been active in contributing to the advancement of policy, promotion of common facilities, advising the Government and regulatory bodies through holding round table conferences, workshops, seminars and participating in committees entrusted with drafting Rules by the MoEF in the area of solid waste.

Subscription Fee :

Admission fee	:	Rs. 100	US\$ 10
Annual membership fee	:	Rs. 200	US\$ 20
Life membership fee	:	Rs. 1000	US\$ 100
Institutional membership fee	:	Rs. 5000	US\$ 500

Address for correspondence :

National Solid Waste Association of India
25 Unique Industrial Estate, Veer Savarkar Marg,
Prabhadevi, Mumbai - 400 025.
Tel.: (022) 2437 5363 / (022) 5660 3487
Fax: (022) 5660 3486
E-mail: econpapl@vsnl.com / info@nswai.com

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This Special Bulletin of NSWAI is published by the National Solid Waste Association of India in Mumbai
(Registration No. BOM. 936/1996 GBBSD).

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