Newsletter

NSWAI ENVIS

NATIONAL SOLID WASTE ASSOCIATION OF INDIA

ENVIRONMENTAL INFORMATION SYSTEM NODE

Urban Municipal Solid Waste Management

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Editorial

This second News Letter of NSWAI-ENVIS is a continuation of our earlier News Letter of June 2003. Data for 11 more cities of Maharashtra for the year 2003 are presented and discussed briefly. In addition the data of municipal solid waste (MSW) for the year 1999 for 117 cities of India reported here are extracted from the report of Central Public health Environmental Engineering organization (CPHEEO) of the Ministry of Urban Development and Poverty Alleviation of the Government of India, New Delhi 2002.

We look forward to a feedback from municipal bodies, NGOs, institutions, professionals and others to improve the data base. We are aware that quite an amount of this data is derived from secondary sources. Our endeavour to improve this will depend on the response from the concerned bodies.

An effort is made to understand and analyse the data so as to infer the trends, which are likely to change in future.

- Editor

Update of 2003 Data for Urban Municipal Solid Waste

Source: Status Report on Municipal Solid Waste Management (Konkan Division)
All India Institute of Local Self Government, March 2003.

Sources of Waste Generation:

From the data collected freshly from 11 cities, it is observed that domestic waste ranges between 40% to 77% of the total waste generated, commercial waste between 2% to 20%, industrial waste between 0% to 27%, market waste between 2% to 53% and hotel and restaurant waste between 0% to 14% of the total waste generated. [Table 1a, 2a]

Compared to the earlier data in our previous Newsletter of June 2003, domestic waste percentages of the 11 cities match well with those of the 18 cities earlier. Commercial and other waste percentages match fairly well. However, Nalasopara seems to produce very high levels of market waste to the tune of 53% [Table 1a, 2a]. Kalyan-Dombivli and Nalasopara do not produce industrial waste at all as per the report. This is surprising. Kalyan-Dombivli has a large industrial complex. What may be the reason for this is not comprehensible. Perhaps there is a total lack of data.

Solid Waste Generation Rates:

The solid waste generation rates range between 173 gm per capita per day ($gc^{-1}d^{-1}$) to 716 $gc^{-1}d^{-1}$. [Table 1a, 2a]. This falls within the range of the generation rates for the 43 cities reported earlier.

Quantity of Waste Generated:

The daily waste generated by the 11 cities adds up to 2744.5 MT/d, which amounts to 10,01,742 MT/Year [Table 1a, 2a].

Financial Aspects:

The expenditure on solid waste management (SWM) varies from Rs. 134 per metric tonne to Rs. 1553 per metric tonne. Similarly cost per capita per year ranges between Rs. 24 to Rs. 257. Both these values vary by one order of magnitude among the 11 cities. [Refer Table 5a].

Table 1a, 2a, 5a : % wise distribution of waste sources and expenditure on SWM in cities of Maharashtra state

						Waste Source											
Sr. No.	City	Area (km^2)	MSW Generated MT/D	Population 2001	MSW Generated g/capita/day	Domestic MT/D	%	Commercial MT/D	%	Industrial MT/D	%	Market MT/D	%	Hotels& Restaurants MT/D	%	Cost per MT/Year in Rs.	Cost per Capita/Year in Rs.
1.	Ambarnath	35	75	2,03,795	368	55	73	5	7	3	4	10	13	2	3	1553	209
2.	Bhiwandi-Nizampur#	26	320	5,98,000	535	180	56	-	-	-	-	-	-	-	-	1315	257
3.	Kalyan Dombivli	104.57	520	11,66,149	446	400	77	30	6	0	0	50	10	10	2	+822	141
4.	Mira-Bhayander	79.3	255	5,20,000	490	190	75	10	4	43	17	4	2	3	1	131	24
5.	Nalasopara	15	65.5	1,84,664	355	30	46	1	2	0	0	35	53	0	0	190	24
6.	Navghar-Manikpur	16	35	1,16,700	300	15	43	3	9	5	14	7	20	5	14	809	89
7.	Navi-Mumbai	162.5	520	7,26,195	716	270	52	80	17	50	10	70	13	50	10	@778	156
8.	Panvel	12.17	18	1,04,031	173	13	72	2	11	0	0	2	11	1	6	749	47
9.	Thane	147.34	650	12,85,396	506	448	69	25	4	40	6	81	12	56	9	744	137
10.	Ulhasnagar	13	236	4,72,943	499	118	50	31	13	64	27	12	5	12	5	1380	251
11.	Virar	19.58	50	1,18,945	420	20	40	10	20	10	20	8	16	2	4	349	54

The waste other than domestic is 44%. Break up composition is not given in the report

+ Calculated in the report assuming 550 MT/d. @ Calculated for 460 MT/D

Urban Municipal Solid Waste Management – 1999

Source: Report of the Technology Advisory Group on Solid Waste Management 2002, Central Public Health & Environmental Engineering Organization (CPHEEO).

Class I cities are those having a population greater than 100,000. About 65% of the urban population live in 300 Class I cities (1991 Census)[1]. India produced 39 million metric tonnes of Urban Municipal Solid Waste annually by the year 2001. Data collected by Central Public Health & Environmental Engineering Organization (CPHEEO) in 1999 represents at least 117 cities. The data in annexure 3 of the CPHEEO report is used here.

Waste Generation: The total waste generated by these 117 cities calculates to 35350.9 metric tonnes per day amounting to 12.9 million metric tonnes per annum. This amounts to 33% of the total 39 million tonnes of urban solid waste. [Table 6]

Generation Rates (GR): The calculated waste generation rates vary from 16 grams per capita per day ($gc^{-1}d^{-1}$) to 1369 $gc^{-1}d^{-1}$. That is, the rates vary by two orders of magnitude. It is clear that more than 80% of the cities have GR values greater than 200 $gc^{-1}d^{-1}$.

GR values reported in the publication of CPHEEO[2] do not always match with the calculated values; at least 60 of the 117 cities do not tally. The reason may be due to errors in the values of population, waste generation or even typography.

In many cases the individual data on domestic, commercial & industrial waste is not available.

The solid waste generation rate is stated on the basis of the population of the cities. National Environmental Engineering Research Institute has given values for various population ranges[1, 2]. This data is plotted against GR values. The linear regression line can be expressed by:

$y = 3.8x + 200$
where y is the generation rate in $gc^{-1}d^{-1}$,
x is the population in lakhs.

That is, the minimum GR is 200 $gc^{-1}d^{-1}$.

Available data for 19 states in the report has been analysed. The regression lines obtained for some states are as follows;

Andhra Pradesh :
$y = 134.6x + 111.7$ (12 cities)

Gujarat :
$y = -2.85x + 469.1$ (11 cities)
$y = 15.82x + 415.7$
(excluding Surat & Vadodara, 9 cities)

Madhya Pradesh :
$y = 22.65x + 190.9$ (7 cities)

Maharashtra :
$y = 1.69x + 362.9$ (22 cities)
$y = 17.5x + 293.4$
(excluding Nagpur & Mumbai, 20 cities)

Tamil Nadu :
$y = 3x + 38.9$ (19 cities)
$y = 15.29x + 350.5$
(excluding Chennai, 18 cities)

Uttar Pradesh :
$y = 45x + 172.5$ (8 cities)

For the six states the intercept on Y-axis i.e. generation rate at insignificantly low population, ranges from 38.9 to 470 $gc^{-1}d^{-1}$.

Among the six states considered, the slope values for Gujarat, Madhya Pradesh, Maharashtra, Tamil Nadu range between 15 to 22, that for Uttar Pradesh, this value is 45 and for Andhra Pradesh, it is 134.6. This indicates that Uttar Pradesh and Andhra Pradesh tend to generate increased amounts of waste as the population increases.

These regression lines appear to be similar to the one obtained from NEERI data $y = 3.8x + 200$.

Note the change in regression lines of Gujarat, Maharashtra and Tamil Nadu when large urban centres are excluded. Inclusion of the data of these cities decrease the slope value significantly. This brings out the fact that the large urban centres are different from the majority. The factors responsible for this will have to be evaluated and pinpointed, if possible, with larger and reliable data base on many more such urban agglomerates.

The data of 14 cities of West Bengal does not give any such trend. Data of 13 cities have populations less than 5.5 lakhs and the GR values vary from 250 $gc^{-1}d^{-1}$ to 1183 $gc^{-1}d^{-1}$. Only Kolkata has a population of 90 lakhs and a GR value of 278 $gc^{-1}d^{-1}$.

Similar trend can be seen in Tamil Nadu where cities with population less than 2 lakhs have GR values ranging from 16 – 600 $gc^{-1}d^{-1}$. Such a trend is also true for Maharashtra where cities with population less than 10 lakhs have GR values ranging from 40 – 790 $gc^{-1}d^{-1}$. In Madhya Pradesh, most cities with population less than 4 lakhs have GR values ranging from 120 – 640 $gc^{-1}d^{-1}$. In Andhra Pradesh too, GR values ranges between 160 – 1370 $gc^{-1}d^{-1}$.

When data of all the cities of India are plotted with population less than 6 lakhs on X – axis and GR on Y – axis, the GR ranges from 16 – 1180 $gc^{-1}d^{-1}$. Most points lie in the cities with population between 1 – 5.5 lakhs and GR values between 100 – 600 $gc^{-1}d^{-1}$.

References:

1) Solid Waste Management in Class I cities in India 1999. Report of committee constituted by Honourable Supreme Court of India.

2) Report of the Technology advisory group on Solid Waste Management 2002 CPHEEO, Ministry of Urban Development and Poverty Alleviation, Govt. of India, New Delhi.

Table 6: Urban Municipal Solid Waste - 1999

Sr. No.	City	Area km^2	Population 1998 Lakhs	Total Waste Generated MT/d	Generation Rate g/capita /day	Population Growth Rate/Year %	Ratio of Dom: Com+Ind
Andhra Pradesh							
1	Qutbullapur	46.87	2.50	70	280	13.13	6
2	Ramagundam	93.67	3.50	280	800	7.25	1.5
3	Eluru	11.88	2.52	142	563	2.5	0.875
4	Anantpur	15.95	2.40	120	500	4.63	1
5	Tirupati	24.00	2.10	125	595.00	2.69	1.75
6	Khamman	18.53	1.80	81	450	4.99	4
7	Mahabubnagar	13.00	1.80	30	167	6.61	-
8	Warangal	68.50	6.50	890	1,369	4.81	21.25
9	Guntur	47.50	6.00	280	467	3.52	2.4
10	Proddalur	7.12	1.60	35	218	2.59	4
11	Tenali	15.12	1.44 ('91)*	96	668 ('91)	-	3.8
12	Nellore	48.39	4	202	500	3.55	1.525
Assam							
13	Jorhat	9.20	1.70	20	117	6.14	1.22
14	Guwahati	216.00	10.00	250	250	5.23	2.33
Bihar							
15	Bhagalpur	64.00	2.9	72	248	1.89	4.14
Delhi							
16	New Delhi	1484.46	120.0	6,000	500	3.71	-
Gujarat							
17	Jamnagar	26.10	5.0	300	600	6.29	3.33
18	Surat	112.27	22.0	870	395	5.72	0.8125
19	Verabal Patan	9.65	1.15 ('91)*	70	605 ('91)		1.6
20	Navsari	8.55	1.388	40.26	290	1.39	3.026
21	Bharuch	19.90	1.75	100	571	3.99	-
22	Gandhidham	30.96	2.50	110	440	13.26	10
23	Rajkot	104.40	8.50	465	547	6.14	-
24	Junagarh	13.47	1.65	145	879	3.42	1.5
25	Anand	21.13	1.215	11	90	1.4	0.57
26	Bhavnagar	54.4	4.919	165	335	2.91	1.583
27	Vadodara	108	14.0	560	400	4.35	-
Haryana							
28	Karnal	22.10	2	88	400	3.23	3.33
29	Sonipat	22.00	1.439 ('91)*	40	278		-
30	Sirca	27.00	1.38	35	253	2.99	1.33
Karnataka							
31	Mysore	91.73	7.75	303.77	392	2.48	2.083
32	Gadag-Betigeri	19.71	1.50	75	499	1.67	0.4
33	Mangalore	115.40	5	52.50	117	7.46	1.261
34	Raichur	60	2	125	622	3.54	4
35	Hassan	12.5	1	68	523	2.22	2
36	Bellary	81.95	3	86	250	2.58	9.75
37	Hospet	50.95	3	60.75	221	10.7	0.65

Sr. No.	City	Area km^2	Population 1998 Lakhs	Total Waste Generated MT/d	Generation Rate g/capita /day	Population Growth Rate/Year %	Ratio of Dom: Com+Ind
Kerala							
38	Palakkad	26.6	1.23 ('91)*	20	162 ('91)		0.18
39	Kolam	18.48	1.42	62	437	0.2	0.8
Madhya Pradesh							
40	Satna	62.24	2.00	50	250	3.57	-
41	Bhind	17.179	1.75	28	160	6.89	-
42	Rewa	90	1.80	48	267	4.88	-
43	Rajnandangaon	51.13	1.60	39	244	4.15	17.5
44	Korba	215.02	3.50	100	286	5.46	0.82
45	Bhopal	285.09	13.90	700	503	3.19	1.8
46	Shivpuri	72	1.40	30	214	3.74	4
Maharashtra							
47	Kamplee	4.27	0.94	55.45	588	2.31	-
48	Thane	147	11.97	724	605	5.99	4.792
49	Bhusawal	13.58	2.00	30	150	4.69	-
50	Nashik	259.13	8.39	300	358	3.55	11.41
51	Solapur	278	9.29	400	430	5.95	2.4
52	Mumbai	437.11	110.00	6,000	545	1.65	2.5
53	Pimpri-Chinchwad	206	9.00	350	389	8.24	-
54	Nanded	46	4.10	149	363	5.89	2.82
55	Sangli-Miraj	109	3.47 ('91)*	86.87	250		4.6
56	Navi Mumbai	162.5	5.01	400	794	6.69	1
57	Kolhapur	66.82	5.00	155	310	3.05	-
58	Chandrapur	45	2.95	150	508	3.87	0.54
59	Wardha	9.04	1.20	40	333	2.21	0.33
60	Nagpur	217.56	23.00	600	261	5.09	2
61	Ahmednagar	19.87	3.00	145	483	7.49	0.93
62	Parbhani	57.6	2.40	30	125	3.38	-
63	Jalna	NA	2.25	9	40	3.66	2
64	Amravati	121.65	5.70	120	210	4.4	-
65	Bhiwandi	26.54	6.00	300	500	6.8	2
66	Gondia	18.08	1.75	19.50	110	6.93	2.2
67	Aurangabad	138.5	8.68	300	346	6.03	1.56
68	Latur	20	2.71	150	554	5.07	2
Manipur							
69	Imphal	29.57	2.45	61	249	3.09	0.49
Meghalaya							
70	Shillong	10.36	2.17	78	360	7.37	4.32
Orissa							
71	Behrampur	33.52	2.61	270	1,035	3.12	5.14
72	Balasore	19.25	1.06	2.6	25	3.12	0.625
Punjab							
73	Amritsar	133	10.00	600	600	5.04	1.67
74	Ambala Cantt.	5.5	0.99	13	131	1.23	3.33

Sr. No.	City	Area km^2	Population 1998 Lakhs	Total Waste Generated MT/d	Generation Rate g/capita /day	Population Growth Rate/Year %	Ratio of Dom: Com+Ind
Rajasthan							
75	Udaipur	58.89	4.50	150	333	1.88	4.66
Tamilnadu							
76	Karur	5.96	0.73 ('91)*	30	408		-
77	Erode	8.44	1.83	92	502	2.03	1.42
78	Chennai	174	50.00	2,550	510	3.24	1.5
79	Madurai	52.95	10.45	380	364	1.43	1.11
80	Tirunelveli	108.5	4.15	160	386	1.48	2.33
81	Rajapalayam	11.35	1.23	44.25	358	1.11	0.264
82	Padukottai	12.95	1.09	5.43	50	1.32	-
83	Nagercoil	24.27	2.0 ('91)*	35	175 ('91)		6
84	Salem	91.06	6.37	250	393	1.2	1.77
85	Tiruvottlyur	21.45	2.20	120	545	3.88	-
86	Avadi	65	2.25	110	489	2.98	1.16
87	Cuddaloree	27.62	1.59	85	534	1.39	1.64
88	Neyveli	48	1.33	42	315	1.83	3.2
89	Karaikudi	14.5	0.81	3	34	1.68	-
90	Pallavapuram	18	1.43	84	589	3.52	11.83
91	Kumbakonam	12.87	1.45	15	104	0.53	0.5
92	Thoochukudi	13.5	2.06	25	121	0.42	2
93	Kancheepuram	11.72	1.57	60	383	1.21	4
94	Tiruppur	27.2	3.19	350	1,098	4.41	0.75
Uttaranchal							
95	Dehradun	52	5.10	255	500	9.45	5.54
Uttar Pradesh							
96	Hathras	3	1.85	3	16	7.24	5
97	Gorakhpur	147	6.00	300	500	2.49	9
98	Jhansi	29.82	5.07	180	355	7.71	1.66
99	Mathura	25.24	3.00	170	567	4.12	-
100	Faizabad	15.6	1.46	45	307	2.35	2
101	Badaumn	4.09	1.17 ('91)*	35	301		5.88
102	Barally	103.5	9.25	500	540	5.2	1.65
103	Itawa	15	1.95	40.5	208	6.56	19.25
West Bengal							
104	Santipur	25.38	1.34	33.477	250	2.87	1.48
105	Titagarh	3.24	1.21	65	536	0.92	1.5
106	Kolkatta	187.33	90.00	2,500	278	10.81	1.22
107	Raniganj	24.99	1.20	142	1,183	3.02	5.14
108	Midnapore	15.85	1.58	63.4	401	3.39	1.52
109	Rishra	67.83	2.27	128	1,011	2.47	1.51
110	Chandemagar	20	1.70	42	247	2.81	2.5
111	Uttarpara	12.5	1.42	63.98	450	1.11	3.38
112	Kamarhat	10.95	3.10	278.32	899	2.14	1.19
113	Asansol	127.237	5.45	180	330	1.89	2
114	Barasat	34.5	2.60	108	415	5.64	5.35
115	Kanchrapara	9.07	1.37	70	511	3.05	2.5
116	Bally	11.81	2.70	150	555	5.62	1.5
117	Panihati	19.38	3.60	329	914	3.9	9

* Population data is for 1991. Data for 1998 not given in the report.

Urban Agriculture on Stabilised City Waste at Deonar

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Every town and city can improve its existing dumps and manage its city waste hygienically and sustainably, starting today, at minimal start-up cost. Deonar can be an ideal place to start.

There are three different stages of waste management. Firstly, **city waste needs to be sanitised** (free of smell, flies, smoke or fires, and producing minimum leachate that can pollute ground-water). This obligatory duty must and should be done immediately, without waiting for fancy solutions or expecting any income from waste treatment. In small towns, this can be done by sprinkling each day's heaps of fresh waste with a 5% solution of fresh cowdung in water plus 5 kg per ton of rock phosphate powder. Today there are many many biocultures available which can do the same job of starting eco-friendly decomposition more conveniently : fermentation cultures like EM which require no turning of the waste, aerobic cultures like those of Excel Industries and Eco-save, and those like BTM from Earthcrop which can treat both solid waste as well as septic tanks and polluted water. Sanitising costs are low and are more than paid for by savings in health-care costs to both cities and citizens.

As a second step, the stabilized waste can be **sold as compost after sieving** to remove plastics and unwanted items. Sieving is currently the major cost in compost production and will remain so until cities improve their collection of biodegradable waste free of recyclables, debris and road dust. This makes compost hard to sell for two reasons. Firstly, the price seems too high to farmers though one ton of compost can give the same results as 4-5 tons of traditional farmyard manure and, being weed-free, saves labour as well. Secondly, farmers fear they may be paying for just dust and soil instead of useful microbes and water-holding humus content.

Finally, like our century-old grass farms, the ultimate aim of waste management is to **turn waste back into food.** The stabilized garbage after sieving can be moved to farms or gardens for use. Or, unsieved sanitized waste can be spread over the perimeter of the Deonar dumpsite, as at Dhapa in Kolkata, and used to **grow low-cost produce on-site for the city**. In order of preference, one should grow flowers or non-edible crops, or things that can be peeled before eating, such as bananas, maize, pumpkins etc rather than hard-to-wash vegetables like cauliflower or greens. This is called Urban Agriculture, and is lowering the cost of produce for the poor in 30-40 developing countries and even for charities in developed countries. Urban Agriculture also helps to keep down the dust at disposal sites and, at Deonar, could form a Laxman-rekha to prevent illegal encroachment by shanties.

In India, one must avoid arrangements that can confer tenancy or cultivator rights on hard-to-get public lands for waste management. One possible option is to allot plots for cultivation by rag-picker cooperatives, perhaps on rotation basis.

For rapid progress and quick results, some immediate policy decisions are absolutely necessary:

- No municipality should expect or demand payment from private waste managers. They should rather be encouraged to earn profits so as to sustainably do an eco-friendly job of what is basically the obligatory duty of the city administration. Lease rents for space should be a minimal Re 1 per acre or per sq meter per year, payable in compost or produce, not cash.
- Tender-free systems should be put in place for purchase of composting biocultures. AIILSG can take the lead in putting the half-dozen city-tested ones on their product list. Experienced and reputed organizations in the field of testing, compost and agriculture like CESE, KVIC and at Wardha can be asked to help evaluate the effectiveness of such biocultures for the guidance of purchasers, for whom ultimately successful results are the best test.
- If composting or vermi-composting (an alternative to sieving of stabilized waste) is the chosen option for a city's wastes, that effort must be encouraged by purchase of the end-product by the city. There should be a minimum and maximum purchase price established, say Rs 1200-1500 per ton, and a minimum guaranteed monthly purchase quantity equal to at least one-day's waste-production in cubic meters. Payment for this should be through bank against acknowledgment of supply.
- Waste-processors should be given preference in collecting biodegradable market and hotel wastes if they so desire, on the same terms as those negotiated for other contract transporters, without the need for separate tender procedures.
- Decentralised waste-processors who undertake on-site waste-processing that saves transport, stabilizing and landfilling costs to a municipality, should be paid at least 70-80% of such avoided costs, so as to have a win-win situation for both the city and the cooperating residents or entrepreneurs.
- Finally, first and last, **waste minimisation at source** should be the goal of every town and city. This can be achieved by requiring users of above-average open spaces, like golf courses, race courses and clubs, large hotels or halls, colleges, housing estates etc to become zero-garbage campuses, or alternatively to pay **polluter-pays fees for trade wastes** and wastes generated in the course of their activities.

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