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Urbanization and solid waste management in India: Present practices and future challenges

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Abstract

Urbanization is now becoming a global phenomenon, but its ramifications are more pronounced in developing countries. High rate of population growth, declining opportunities in rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations, largely contribute to urbanization. The unexpected immigration has also caused the burgeoning of slums and the growth of squatters and informal housing all around the rapidly expanding cities of the developing world. In many cities the rapid population growth has overwhelmed the capacity of municipal authorities to provide even basic services. Urbanization directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environment degradation. Solid Waste Management which is already a mammoth task in India is going to be more complicated with the increase in urbanization, changing lifestyles and increase in consumerism. Financial constraints, institutional weaknesses, improper choice of technology and public apathy towards Municipal Solid Waste (MSW) have made this situation worse. The current practices of the uncontrolled dumping of waste on the outskirts of towns/cities have created a serious environmental and public health problem. The focus of the present paper is to see the upcoming trends of urbanization in India and accordingly generation of waste. The present paper evaluates the current practices prevalent in India to deal with this solid waste and problems associated with it. It also provides the measures to deal this waste in healthy and environment friendly manner so that it may prove a resource instead of waste.

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1. Introduction

India, the world's second highest populated country after China with population of 1.21 billion (census 2011) already containing 17.5% of the world's population, is a land of physical, climatic, geographic, ecological, social, cultural and linguistic diversity. The annual rate of growth of urban population in India is 3.35% (Census of India, 2011). The proportion of population living in urban areas has increased from 17.35% in 1951 to 31.2% in 2011 (Census, 2011). High rate of population growth, declining opportunities in the rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations, largely contribute to urbanization. It is interesting to note that Currently 1 out of every 3 person is living in urban area and it is projected that as much as 50% of India's population will live in cities in next 10 years (Khurshid & Sethuraman, 2011). No doubt, India has achieved multifaceted socio-economic progress during last 64 years of its independence. However, in spite of heavy expenditure by Civic bodies, Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in India. Piles of garbage and wastes of all kinds littered everywhere have become common sight in urban life. For most of urban local bodies in India solid waste is a major concern that has reached alarming proportions requiring management initiatives on a war-footing. Though solid waste management is one of the basic essential services to be provided by municipal authorities in India, the present scenario provides rather a clumsy picture in terms of service delivery as evidenced by absence of adequate overall waste management mechanism. Present level of service in many urban areas is so low that there is a threat to the public health in particular and environmental quality in general (Supreme Court Committee Report 1999).

2. Urbanization and present status of waste generation in Indian cities

Urbanisation is an index of transformation from traditional rural economies to modern industrial one. It is progressive concentration (Davis, 1965) of population in urban unit. Natural growth of population, reclassification of habitation, and migration are important factors in increasing the urban areas. Table 1 gives comprehensive picture of urbanisation trends in India.

Table 1 Urbanisation Trends in India (Source: Various Census Reports)

Year	No. of Urban agglomeration/ town	Population in million			% of total population		% increase in Urban Population during a decade	Urban-Rural Ratio
		Total	Rural	Urban	Rural	Urban		
1901	1827	232.9	212.5	25.8	89.0	11.0	-----	01:08.1
1911	1825	252.0	226.1	25.9	89.6	10.4	0.0	01:08.6
1921	1949	251.3	223.2	28.1	88.7	11.3	8.3	01:07.8
1931	2072	278.9	245.5	33.4	87.8	12.2	19.1	01:07.2
1941	2250	318.6	274.5	44.2	85.9	14.1	32.1	01:06.1
1951	2843	361.1	298.7	62.4	82.7	17.3	43.2	01:04.7
1961	2363	439.2	360.3	78.9	82.0	18.0	25.3	01:04.5
1971	2590	598.2	489.1	109.1	80.1	19.9	38.0	01:03.7
1981	3378	685.2	525.7	159.5	76.7	23.3	46.8	01:03.3
1991	3768	844.3	627.1	217.2	74.3	25.7	35.6	01:02.9
2001	5161	1027.0	741.6	285.1	72.2	27.8	31.2	01:02.6
2011	7935	1210.1	833.0	377.1	68.8	31.2	31.8	01:03

It is interesting to note that for the first time since independence absolute increase in population is more in urban areas than in rural areas. Out of total increase of 181.4 million people during the last decade i.e. 2001-2011 90.4 million increase is in rural areas while 91.0 million is in urban areas.

2.1 Level of Urbanisation

Figure 1 and Table 1 clearly depicts that percentage of people living in urban areas now has increased from 17.29% in 1951 to 31.16 in 2011. Accordingly percentage of rural population has declined from 82.7% in 1951 to 68.84% in 2011. Out of the total population growth (17.64%) in last decade urban population growth was 31.8% since 2001 while rural growth of population was 12.18% during the same period (Khurshid and Sethuraman, 2011). It is projected that in coming years the total increase in population will take place in urban areas only and by 2030 50% of total population will be residing in urban areas only.

Percentage of total population living in rural and urban areas

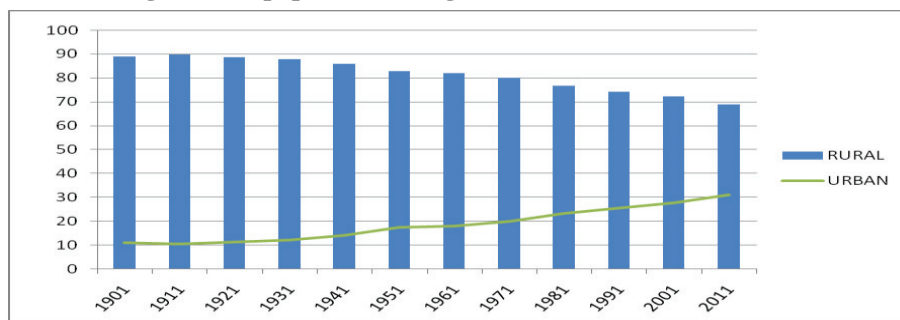


Fig. 1. Level of Urbanisation (1901-2011); Source- Various census Reports

According to 2011 census, among the total states in India Sikkim is the state where urban population grew highest at the rate of 153.43% followed by Kerala (93%) and Tripura (76%) during the last decade (2001-2011) while the least increase in urban population was in Himachal Pradesh (15.64%) followed by Maharashtra (23.67%) during the same period. Four states where the rural population declined during 2001-2011 are Kerala (by 26%), Goa (19%), Nagaland (15%), Sikkim (5%) (Census 2011, Provisional Population Totals).

2.2 Present Status of Waste Generation in India

Urbanization directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environment degradation. Municipal Solid Waste (MSW) is defined to include refuse from the households, non-hazardous solid waste discarded by the industrial, commercial and institutional establishments, market waste, yard waste and street sweepings which are collected by the municipal authorities for disposal (Jain, 2007) As the result of rapid increase in production and consumption, urban society rejects and generates solid material regularly which leads to considerable increase in the volume of waste generated from several sources such as, domestic wastes, commercial wastes, institutional wastes and industrial wastes. Wastes that arise from a typical urban society comprises of garbage, rubbish (package materials), construction and demolition wastes, leaf litter, hazardous wastes, etc. (Rajput et al 2009) MSW is only a relatively small fraction of all the solid waste that is generated in an advanced

urban economy. Modern urban living brings on the problem of waste because of everything in packaging and fast food products which increases the quantity of waste and changes its composition with each passing day as is clear from Table 2.

Table 2 Waste generation Trends in India

Year	Per capita waste generation (g/day)	Total urban municipal waste generation (MT/ yr)
1971	375	14.9
1981	430	25.1
1991	460	43.5
1997	490	48.5
2025	700	Double the amt. of 1997

Source- India Energy portal

Recently, FICCI conducted a survey (August, 2009) to gauge the current status of solid waste management in Indian cities. The survey was conducted among Municipal Corporations of 48 cities including 21 Class I cities and 27 cities with population less than one million. Out of the 48, responses were received from 22 corporations. The results of quantum of waste generated in 22 cities as per FICCI survey are shown in figure 2. The survey covers the small cities such as Shimla, which generates 65 TPD to Delhi which generates 6800 TPD. Among the class I cities, Agartala generates least quantum of waste (200 TPD) and Delhi generates 6800 TPD of waste. Among the class II cities, Shimla generates the least quantum of waste and Chandigarh generates the maximum quantum of waste. This clearly shows that the cities where urbanization rate is high, waste generation rate is also high as Chandigarh whereas the cities where urbanization rate is low production of waste is also less as Shimla. This shows direct link of urbanisation with waste production. Cities of Ahmedabad, Delhi, Greater Mumbai, Jaipur, Kanpur, Lucknow, Pune and Surat generate more than 1000 TPD of MSW and can be classified as cities generating large quantum of waste. Indore, Ludhiana and Vadodara generate municipal solid waste between 500-1000 TPD. Cities that generate less than 500 TPD of waste include Agartala, Asansol, Chandigarh, Faridabad, Guwahati, Jamshedpur, Kochi, Kozikode, Mangalore, Mysore and Shimla.

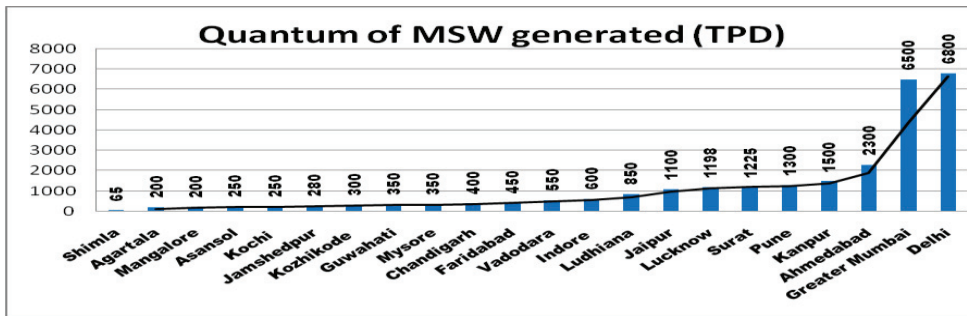


Fig. 2. Bar graph representing the quantum of waste generated Source – FICCI Survey, August 2009

The regional profiling given by FICCI in Table 3 depicts that the Western region generates the maximum quantum of municipal solid waste – 12,775 TPD. Major contributors to this are Greater Mumbai (6500 TPD) and Ahmedabad (2300 TPD). The western region is followed by the Northern region, where, quantum of waste generated is 11,263 TPD. Delhi (6800 TPD) and Kanpur (1500 TPD) are the major contributors to this total. Least quantum of waste is generated by the North-eastern region comprising Agartala (200 TPD) and Guwahati (350 TPD). Figure 2 and Table 3 represent quantum of waste generation and waste disposal to dumpsite. A review of the status of dumpsites in the cities shows that, out of the 17 class I cities, 8 have a single dumpsite, 5 have 2 dumpsites, 1 city has 3 dumpsites and 2 have 4 dumpsites.

Table 3. Representing States, Regions and Quantities of Waste Generated in Cities of India (Source: FICCI Survey, August 2009)

S No	City	State/Union Territory	Region	Class of the City	Number of Dumpsites	Quantum of waste generated (TPD)	Quantum of waste supplied to the landfill (TPD)	Waste supplied to the dumpsite (%)
1	Agartala	Tripura	North-Eastern	Class I	1	200	100	50
2	Ahmedabad	Gujarat	Western	Class I	1	2300	1800	78
3	Asansol	West Bengal	Eastern	Class I	2	250	230	92
4	Chandigarh	Union Territory and capital of Punjab &Haryana	Northern	Class II	1	400	300	75
5	Delhi	Delhi	Northern	Class I	3	6800	6400	94
6	Faridabad	Haryana	Northern	Class I	4	450	375	83
7	Greater Mumbai	Maharashtra	Western	Class I	4	6500	6500	100
8	Guwahati	Assam	North-Eastern	Class I	1	350	150	42
9	Indore	Madhya Pradesh	Central	Class I	1	600	325	54
10	Jaipur	Rajasthan	Western	Class I	2	1100	990	90
11	Jamshedpur	Jharkhand	Eastern	Class I	2	280	240	85
12	Kanpur	Uttar Pradesh	Northern	Class I	1	1500	1200	80
13	Kochi	Kerala	Southern	Class I	1	250	25	10
14	Kozhikode	Kerala	Southern	Class II	1	300	50	16
15	Lucknow	Uttar Pradesh	Northern	Class I	No designated dumpsite	1198	1050	87
16	Ludhiana	Punjab	Northern	Class I	2	850	850	100
17	Mangalore	Karnataka	Southern	Class II	1	200	175	87
18	Mysore	Karnataka	Southern	Class II	1	350	150	43
19	Pune	Maharashtra	Western	Class I	1	1300	1000	90
20	Shimla	Himachal Pradesh	Northern	Class II	1	65	40	61
21	Surat	Gujarat	Western	Class I	2	1225	1175	95
22	Vadodara	Gujarat	Western	Class I	1	550	300	54

The survey reveals that large cities which generate above 1000 TPD of solid waste – Ahmedabad, Kanpur, Pune have a single dumpsite, whereas cities such as Asansol, Faridabad and Jamshedpur which generate less than 450 TPD of solid waste have 2 dumpsites each. These figures bring forth the disparity in the waste management status of the cities with respect to the quantum of waste generated. The Figure 3 depicts that Greater Mumbai and Ludhiana supply the entire quantum of waste to their dumpsites. Whereas 80-90% of waste is supplied to the dumpsites in Vadodara, Jaipur, Pune, Surat, Kanpur, Ahmedabad and Delhi. Indore supplies 54% of its waste collected to the dumpsite. Lucknow supplies 1050 TPD of the waste collected for disposal, but there is no dedicated disposal site. The waste is spread on the outskirts of the city centre.

The survey also reveals that there is lack of adequate number of sanitary landfills in Indian cities. Out of the 22 surveyed cities, only 6 have sanitary landfills (Ahmedabad, Chandigarh, Jamshedpur, Mangalore, Surat and Vadodara). 10 out of the 22 cities do not have sanitary landfills and the fact that large cities like Greater Mumbai, Delhi and Kanpur are included in this list. Guwahati, Indore and Jaipur are in the process of constructing sanitary landfills; and Agartala and Lucknow are considering construction of SLFs. The city of Lucknow has been sanctioned a project under the JNNURM for INR 42.92 crore, which would provide for two sanitary landfills and two composting units of capacity of 12 TPD each. This may be seen as a positive effort since Lucknow which is in the higher end of the waste generation spectrum does not even have a designated dumpsite for disposal of waste. Faridabad plans to stop using the current dumpsite and is focusing on an integrated waste treatment and disposal facility. Agartala is considering construction of a sanitary landfill even though the city generates only 200 TPA of solid waste out of which 100 TPA is being sent for disposal. Table 3 depicts the status of sanitary landfills in the surveyed cities. Greater Mumbai and Ludhiana that generate 6500 and 850 TPD waste respectively (Figure 2) have indicated that they supply the entire quantum of waste collected to the landfill, whereas Kochi supplies the minimum quantum of waste to its dumpsite and most of it is composted (250 TPD generated of which only 25 TPD is sent to dumpsites). In Nutshell, the survey depicts-

2.2.1 Waste Generation and Disposal Status of Indian cities

- 36 % (8 out of 22) cities generate more than 1000 TPD of waste (Ahmedabad, Delhi, Greater Mumbai, Jaipur, Kanpur, Lucknow, Pune and Surat)
- 13.6 % (3 out of 22) cities generate waste between 500-1000 TPD (Indore, Ludhiana and Vadodara)
- 50 % (11 out of 22) cities generate less than 500 TPD of waste (Agartala, Asansol, Chandigarh, Faridabad, Guwahati, Jamshedpur, Kochi, Kozhikode, Mangalore, Mysore and Shimla)
- 63.6 % (14 out of 22) cities supply more than 75% of their waste to dumpsites (Ahmedabad, Asansol, Chandigarh, Delhi, Faridabad, Greater Mumbai, Jaipur, Jamshedpur, Kanpur, Lucknow, Ludhiana, Mangalore, Pune and Vadodara)
- Out of the 17 class I cities, 47.05 % (8) have a single dumpsite, 29.4 % (5) have 2 dumpsites, 5.88 % (1) has 3 dumpsites and 11.76 % (2) have 4 dumpsites. Lucknow does not have a designated dumpsite for waste disposal
- Greater Mumbai and Ludhiana supply 100% of the waste collected to the dumpsite

2.2.2 Status of Sanitary Landfills (SLF)

- 45.45 % (10 out of 22) of cities do not have sanitary landfills which includes major generators such as Greater Mumbai, Delhi and Kanpur
- 27.27 % (6 out of 22) of cities have a sanitary landfill (Ahmedabad, Chandigarh, Jamshedpur, Mangalore, Surat and Vadodara)
- Guwahati, Indore and Jaipur are in the process of constructing a SLF and Agartala and Lucknow are considering construction of SLF
- Gujarat emerges as one of the most active States with respect to initiatives on solid waste management as 3 cities of the State have already constructed sanitary landfills.

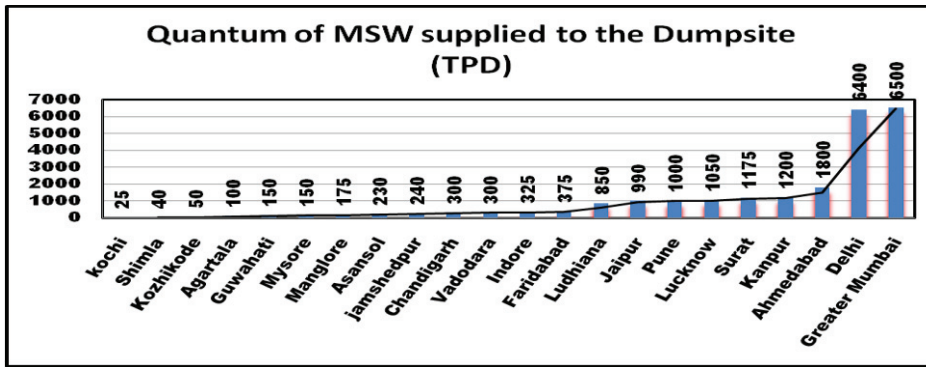


Fig. 3. Bar graph representing the quantum of waste supplied to the dumpsite (Source – FICCI Survey) August 2009

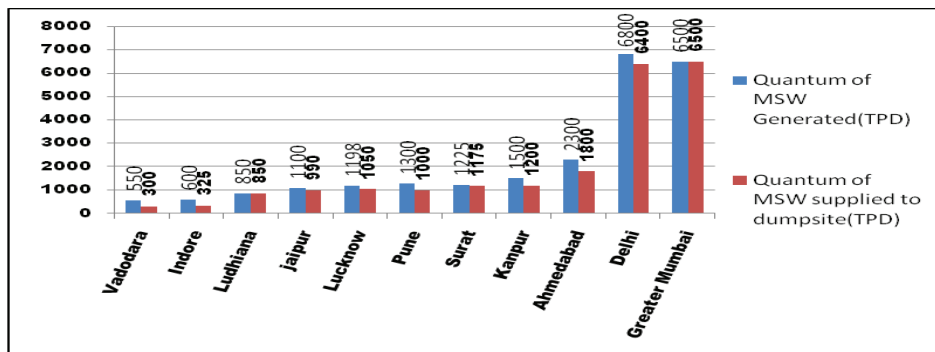


Fig. 4. Bar graph representing the quantum of waste generated and the quantum of waste supplied to the dumpsite for cities generating more than 550 TPD (Source: FICCI Survey, August 2009)

The findings of the survey clearly demonstrate the lack of proper planning in relation to the solid waste status of a city and the need for including treatment and disposal facilities for urban solid waste management as part of a city’s master plan. While the efforts of cities such as Agartala, Kochi, Mangalore, Surat, Vadodara etc must be acknowledged, the fact remains that the major generators like Delhi and Greater Mumbai still have a long way to go. Waste treatment options such as composting and waste-to-energy plants are not being adequately explored by even those cities which are larger not just in terms of size and population but also generation of waste. The immense scope of treatment is not being exercised due to reasons such as lack of know-how, technical manpower and most importantly financial constraints faced by the Municipal Corporations.

In the survey, the Municipal Corporations itself accepted that they are ill-equipped to handle and effectively manage the large quantum of waste generated per day in the cities. The Corporations face constraints in terms of technology, know-how, manpower and most importantly adequate funds to tackle the menace. This survey is about the cities only but if we go to semi-urban areas or rural areas the situation is even worse there the garbage is lying on the roadside with no sanitary landfills and inviting major threats to the health and environment of the residents.

3. Current practices regarding solid waste in India

In India, solid waste management services are provided by Municipal Corporations/Municipalities/

Panchayats as per their rules. Many of the laws are quite old and they need change as per requirement. Even their implementation is also very poor. In maximum of the municipalities there is no separate department for waste management. SWM is the responsibility of a health officer who is assisted by the engineering department in the transportation work. The activity is mostly labour intensive, and 2-3 workers are provided per 1000 residents served. The municipal agencies spend 5-25% of their budget on SWM, which is Rs. 75-250 per capita per year (Kumar and Gaikwad, 2004). In spite of this huge expenditure, services are not provided to the desired level. Present practices regarding solid waste in India are as follows

- Generally solid waste is disposed off in low-lying areas, outskirts of cities, alongside roads or any vacant place wherever waste collectors find that they will not be seen or objected by anybody.
- Handling of waste by solid waste workers is done without taking any precautions or protective measures which lead to many communicable and non-communicable diseases to them.
- Community bin collection system is usually practised in India for collection of waste by civic bodies. But these bins neither they are properly designed as per requirements and quantity nor they are placed at proper places so that they are within reach of everybody hence the people who find these bins beyond their reach throw their waste anywhere at vacant place.
- Vehicles transporting this waste are also not designed properly. Neither they are covered nor equipped with instruments to collect the whole waste. So waste scatters here and there during collection and transportation.
- Landfill sites are also not scientifically designed so create air, water and soil pollution. Waste workers work on these sites work without any protective measures are prone to various diseases. Also incineration method is usually followed in maximum places to reduce the waste which itself releases many toxic elements and gases to the environment making the people ill.
- Lack of coordination among various departments of civic bodies also lead to poor management of solid waste management.
- Public apathy and low social status assigned to this task has made the situation worse.

Problems Associated with SWM in India: Waste Management is now a problem not only of urban areas but also in semi-urban and rural areas. Waste lying on roadsides, low lying areas and vacant places, outside drainages etc. not only mars the aesthetic beauty of that place but is a serious health and environmental hazards to the people. Animal feeding on this waste and consuming all polythene and hazardous waste mixed with kitchen waste is a serious health hazard for them. Though solid waste management now exists in metropolitan cities but it is far away in semi-urban and rural areas creating all environmental and health hazards to the residents of those areas. Major weaknesses associated with solid waste management (SWM) system in India are

Mixed Waste: In India all waste whether it is biodegradable, recyclable, construction, hazardous or soiled are mixed together. No system of segregation at the source level exists here. Though in rural areas earlier it was practised that kitchen waste was used to feed to the animals but with increasing income, changing lifestyles, use of more packaging and plastic material all waste are mixed now and put into one dustbin which make the problem of waste management more complex.

Rapidly increasing population and waste respectively: Now we are 1.21 billion (census 2011) and are rapidly increasing. Newly urbanised areas and semi-urban areas are already feeling burden of population and accordingly civic services and waste management is coming as a challenge in these areas. There is no system of Integrated Waste Management (ISWM) here and waste is increasing day by day with increase in population and increase in per capita waste generation rate due to changing lifestyles, increase in income and consumerism.

Lack of Planning: In India, there is no law regarding waste disposal and treatment of residential areas/apartments/flats at the time of passing plan of these areas where there waste will be disposed off and

how it will be treated. Private developers take benefit of this and no place in residential areas is left for disposal and treatment of waste. Result is that their waste scatters here and there at any vacant place or plots or alongside roads. Even newly developed cities are finding it difficult to get the landfill place to dump the waste of the city.

Lack of Resources: As civic bodies give very low priority to SWM accordingly very less budget is assigned for it. Whatever funds are assigned they are only for waste collection and transportation and not for treatment or recycling. According to one estimate 90% of total fund is assigned for collection and rest for transportation hence no fund left for treatment of waste.

Old Equipment and Technology: If we leave big metropolitan cities, in India there is no specifically designed landfill sites in class II and class III cities to dump the waste. Equipment used for collection, transportation of waste are very old and the only method to recycle the waste is incineration which creates serious health and environmental hazards when all mixed waste is burned.

Societal Apathy: Since the social status assigned to SWM is very low and people think it as a degraded task, they tend to throw their waste wherever they find a vacant and lonely place, outside bins, alongside road etc. so the work of collecting staff increases manifold and the result is waste is scattered here and there. Even if it is cleaned one day people again fill it in few days converting it to dumpsite.

4. Strategies suggested

Strategies to deal with solid waste so that it may prove a resource instead of waste are given below

Plan Properly: Whenever any plan is passed by civic authorities for any new residential colony/apartments/flats, market areas or malls it must check that there should be proper provision of waste disposal and treatment in it so that its waste should be treated at its source level itself and it should not scatter here and there and money spent by civic bodies on its collection, transportation and treatment can be reduced. This will help in reducing the much burden of the civic bodies and the saved resources can be utilized elsewhere. Stringent laws and their implementation should be enforced in this regard to check this problem to increase at a large level.

Characteristics and Quantity of Waste: Through a pilot study we can find the characteristics of waste in any specific area and quantum of each waste type biodegradable, recyclable, hazardous, construction etc. and with projected annual increase in population future quantum of waste can be estimated in any area and accordingly plan can be finalised for disposal of various types of waste. Where quantity of any type of waste is less 2-5 colonies or villages can be clubbed together and a central facility can be developed for disposal of waste of all these areas.

Collection and Transportation of Waste: Door to door collection system should be encouraged with optimum frequency so that waste should not be accumulated or thrown here and there by the residents or waste collectors. Proper bins or waste disposal pits within proper reach of residents or waste collectors should be kept/developed in each and every area to avoid throwing of waste at any place or roadside. A financial burden or fine can be levied in those areas where these facilities are developed properly for throwing the waste outside the bin. Proper vehicles especially designed for this purpose should be deputed for transportation of waste to landfill site so that no waste may be scattered in between before reaching to landfill sites. Suggested collection frequencies for cities with different population ranges have been provided by NEERI in its report depicted in Table 4

Disposal and Recycling of Waste: Waste should be disposed only at scientifically designed landfill sites where no leachate to soil is there. Since India is an agricultural country and people are fond of fresh food and vegetables so kitchen waste or biodegradable waste is more here and composting can be best method for utilising this waste and converting into resource. It should be popularised among people. Small pits should be dug in new residential colonies and apartments separately for each type of waste

collection and biodegradable waste should be treated at the source level itself by converting it into manure. Recyclables if not in sufficient quantity should be given to kabadiwalas or directly to recyclers to recycle them likewise every waste should be treated. In old apartments/flats where land is not available to dig the pits artificial beds especially designed for this purpose (depending on quantum of waste) can be kept to collect different types of waste and may be treated accordingly.

Table 4. Collection Frequency of Solid Waste (NEERI, 1996)

Types of Locality	Frequency	
	Class I Cities (> 1 lakh population)	Class II Cities (< 1 lakh population)
Residential Areas		
Area with high population density	Once or twice a day	Once a day
Area with medium population density	Once or twice a day	Once in two days
High income and VIP area	Once or twice a day	Once a day
Area with low population density	Once or twice a day	Once a day
Area with low population density	Once in two days	Once in three days
	Once in two days	Once in three days
Markets		
Commercial areas	Twice a day	Once a day
Industrial areas	Once a day	Once a day

Source: NEERI Report 1996

Financial Management: A new charge based on ‘Polluters Pay Principle’ can be levied on people for the whole waste management activity. Either civic bodies can take this responsibility on themselves and charge from the people for whole management from bottom to top or can transfer this responsibility on the people themselves and they can adopt PPP (public Participation Programme) approach to manage their waste themselves.

Community/RWA/NGO's Participation: No waste management programme can be successful without the help of the people because ultimately they are the producers of waste. Proper help should be taken from the effective people of the society like Gram Pradhan, RWAs, NGOs etc. to sensitize and educate the people regarding waste management. Even private sector help can also be taken to manage the waste of these residential and commercial areas. Social status should be provided to SWM activity and waste management workers so that they may also feel that they are providing useful service to the society.

5. Conclusion

Solid Waste Management is the need of the hour which should be seriously taken care of by government/ civic bodies to provide SWM service properly to the public. Public apathy and low social status assigned to SWM activity by civic bodies is a great hurdle in solving this problem. Stringent laws should be passed in this regard for proper disposal and treatment of waste. No new plan of any residential, commercial area should be passed until and unless it has proper place for disposal and treatment of its waste. In India there is a strong case of private sector participation in this area and private sector can come with its expertise, technology, capital, improved and efficiently managed service. Public participation is of paramount importance and can provide big results if seek properly. NSWAI (National Solid Waste Association of India) working to solve the problem of SWM in India has given following (Fig. 5) sustainability model.



Fig. 5. Sustainability model

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