



## Solid waste a gift of urbanization

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### ABSTRACT

Waste is an unavoidable by product of human activities. All the human activities i.e., domestic, commercial, industrial, healthcare, organizations, generates solid wastes that are normally discarded as useless or unwanted. The wastes generated from these activities of more advanced society produce more complex and heterogeneous wastes because of living standards and changing food habits. With rising urbanization, change in life style and improving living standards in cities; have led to increase in per capita waste generation and complexity of generated waste in the recent years. The problem in cities lies not only in the quantity but also in the quality and composition of the wastes, which have changed from being dense and almost entirely organic to voluminous and increasing non-biodegradable with higher percentage of toxic substance. The exponential growths of human population & resource consumption have left outstripped the ability of the natural environment to assimilate it and municipal authorities to manage it. Increasing migration, high-density population will make waste management a difficult issue to handle in the near future.

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### Introduction

Solid wastes are the most visible forms of environmental bad which are seriously affecting the quality of life and posing serious policy challenges. The increase in generation of solid waste is a result of the rapidly growing population and adopting modern life style. The substantial increase in the solid waste generation results an adverse effect on all components of the environment and human health. Open dumping of Solid waste disposal leads to land pollution, dumping in low land for water pollution and burning for air pollution. Municipal solid wastes have been proved to be extremely toxic and infectious. Unscientific and uncontrolled dumping of such wastes has brought about a rising number of incidents of hazards to human health. Contamination of surface and ground water arise more serious human health risk. Solid Waste Management (SWM) is a multidimensional and challenging task in urban India today. 90% of urban waste is currently disposed of by open dumping and land filling. Poor collection and inadequate transportation are responsible for the accumulation of the solid waste in man's environment. Financial constraints, institutional weaknesses, improper choice of technology, scarcity of land, mixed land uses, legal instruments and public apathy towards Municipal Solid Waste have made the situation worse.

### Urbanization

Urbanization is a global phenomenon. Urbanization has rich history in India since ancient times. The process of urbanization in India dates back to 2350 B.C or 5000 years ago to Indus valley civilization. India is one of the largest developing countries and world's second populous country having a population of 1.21 billion (Census 2011), accounting for nearly 18% of the world's population. According to the 2011 Census, urbanization in India has increased faster than expected. The urban population grew from 286 million in 2001 to 377 million

in 2011 an increment of 91 million, which is larger than the rural population increment of 90.5 million for the first time since independence. ( R.B. Bhagat) A substantial increase in the urban population is due to a net rural-urban classification and rural-to-urban migration. A huge number of new towns emerged during the last decade, contributing significantly to the speeding up of urbanization. It is estimated that the urban population will increase to 417 million by 2015. Urbanization is taking place at a faster rate in India. Table 1 shows the pattern, trends and no of towns in India during 1901 to 2011 shows that urban population has increased more than fourteen times from 26 million to 377 million where as total population has increased five times from 238 million to 1210 million from 1901 to 2011. Indian urban population percentage was 11.4% in 1901 increased to 28.53% in 2001 reaches to 31.2 % in 2011 and expected to 40.76% in 2030. During the same period solid waste generation will increase to over 125million tons by the year 2030. According to UN projections, 70% of the total world population will live in urban areas by 2050 as compared to 50% in 2010. The percentage of urban population to total population in the US, Europe and China is 83%, 73% and 47%, respectively, which is much higher compared to India, which is just 32%.

In addition to increase in population the number of towns has increased. There was only one million plus city (Kolkata) in India in 1901. It has become two in 1911 (Mumbai added) and was constant during 1911 to 1941. Million plus cities increases to five in 1951 and continuously increased after this decade and become 23 in 1991. The number of metropolitan cities has increased from 35 in 2001 to 53 in 2011. Out of these there are 6 mega cities three with population in excess of 10 million & three with population above 5 million. Presently India has 475 urban agglomerations three of which has population over 10 million. Table 2 gives the top five urban agglomerations in terms of

population. The data indicating that the Indian cities are growing at a much faster rate. It is expected that by 2021, India will have the greatest concentration of mega cities in the Asian region. The number of cities with population above one million will nearly double by 2020, and may increase fourfold by 2050. Table 2 gives the top five urban agglomerations in terms of population.

**Table 1: Trends of Urbanization in India**

Census Year	No. of Towns	Urban Population (in million)	Percentage Urban Population	Annual Exponential Urban Growth Rate (%)
1901	1916	25.9	10.8	-
1911	1908	25.9	10.3	0.0
1921	2048	28.1	11.2	0.8
1931	2220	33.5	12.0	1.7
1941	2422	44.2	13.8	2.8
1951	3060	62.4	17.3	3.5
1961	2700	78.9	18.0	2.3
1971	3126	109.1	19.9	3.2
1981	4029	159.5	23.3	3.8
1991	4689	217.6	25.7	3.1
2001	5161	284.53	27.8	2.75
2011	7935	377.11	31.2	2.76

Source: census2011

**Table: Urban population of Indian Cities**

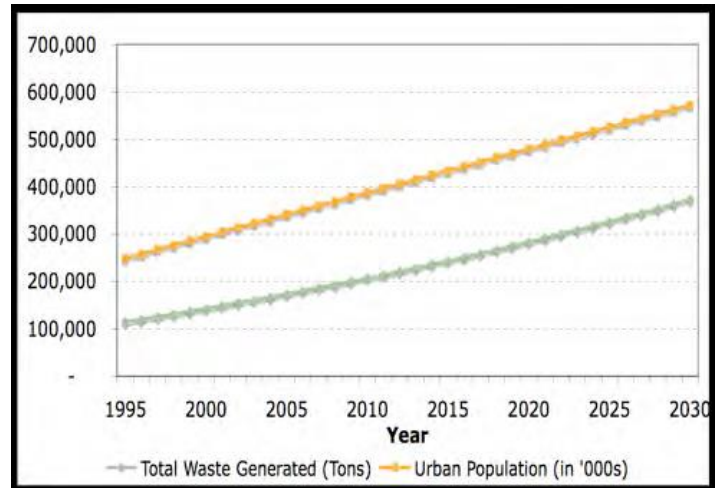
Sl.No	Cities	Population
1	Greater Mumbai	18.4 Millions
2	Delhi	16.3 Millions
3	Kolkata	14.1 Millions
4	Chennai	8.7 Millions
5	Bangalore	8.5 Millions

Source: censusindia.gov.in/2011-Documents/UAs-Cities-Rv.ppt

Cities are centers of economic activity and wealth generators. Urban areas have become the engines of growth and productivity in the country. 60% contribution to the national economy comes from urban areas in 2001 which is supposed to increase to 75% by 2021. This clearly reflects the power of economic growth in bringing about faster urbanization during 2001-2011. The growing urban centers and process of urbanization have brought in many issues to the front; from governance and management of Municipal Solid Waste in particular.

**Solid Wastes Generation**

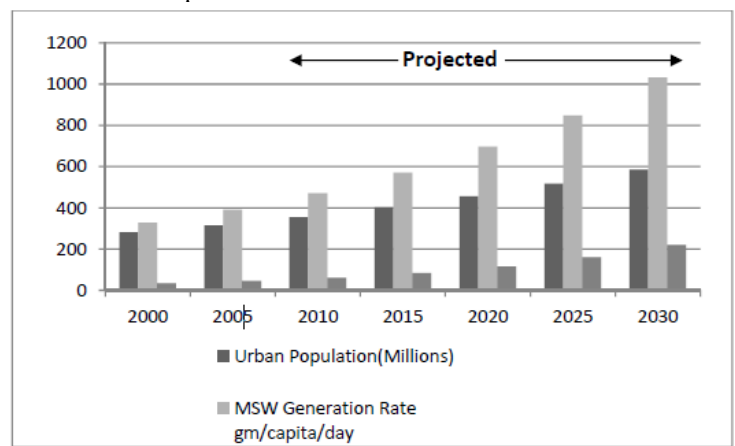
Growth of population, industrialization, urbanization and economic growth, has a trend of significant increase in the urban population. It has been observed worldwide that the increase waste generation annually in proportion to the rise in population and urbanization. As the cities grow economically, business activity and consumption pattern drive up solid waste generation. Urban population causes much pollution than rural due to high per capita income, higher buying power and over consumption of natural resources. The economic status, habits, attitude, customs, standard of living, generates higher solid waste. Technological advances together with economical prosperity have resulted in usage, package and containers for food, beverages & other consumer goods. There has been a significant increase in the generation of MSW (Municipal Solid Wastes) in India over the last few decades. The figure.2 shows the relationship between urban population and municipal solid waste (MSW) generation in urban India. It is clear that the increase in municipal solid waste (MSW) generation in urban India is proportional to urban population.



**Fig.1 Urban population and waste generation in India**

Indian cities now generate ten times more MSW than they did in 1947 because of increasing urbanization and changing life styles. Fig.-2 suggest the projected MSW quantities are expected to increase from 34 million tonnes in 2000 to 83.8 million tonnes in 2015 and 221 million tonnes in 2030. It is also reported that per capita per day production will increase to 1.032 kg, and urban population as 586 million in 2030.

MSW generation, in terms of kg/capita/day, has shown a positive correlation with economic development at world scale. MSW generation is in much higher quantities in wealthier regions of the world because the city dwellers are prospering and adopting high consumption life style. United States leads the world in MSW output at 621,000 tons per day; China is a relatively close second, at some 521,000 tons. United States generates nearly seven times more urban refuse than France which is in tenth position.



**Fig.2 Waste Generation in Urban India**

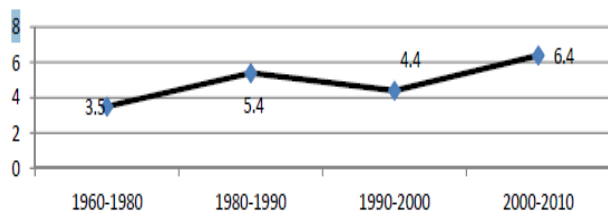
Table 2: shows the relationship between Municipal Solid Waste Generation and GDP from which it is clear that higher the GDP of a country higher is the quantity of municipal solid waste generation because the increase in GDP increases the purchasing power which in turn causes changes in lifestyle. The very high rate of urbanization coupled with improper planning and poor financial condition has made MSW management in Indian cities a herculean task.

Studies have also indicated that for every Indian Rs. 1000 increase in income the solid waste generation increases by one kilogram per month. The growth of GDP for every decade since 1960 is given in Fig-3 which suggests that Indian GDP growing rapidly during last few decades

**Table 2: Municipal Solid Waste Generation and GDP**

Country	Municipal Solid Waste Generation (Kg/capita/day)	GDP Per capita (2005)
India	0.46	3452
Philippines	0.52	5137
China	0.79	6757
Malaysia	0.81	10882
Thailand	1.1	8677
Singapore	1.1	29663
Japan	1.47	31267

Source : World Bank 1999, UNDP, 2007

**Fig-3 Indian GDP Growth Rate**

The per capita generation of MSW has also increased tremendously with improved life style and social status of the populations in urban centers. Waste generation rate in Indian cities ranges between 200 – 870 grams/day, depending upon the region's lifestyle and the size of the city. The total waste production in urban India is estimated to be 115,000 metric tonnes/day. Per capita generation of waste in Indian cities ranges 0.2 Kg -0.6 Kg per day. An assessment states that the per capita waste generation is increasing by about 1.3% per year. With an urban increase in waste quantities has been estimated at 5% per annum ( Dr.Regina Dube). The per capita waste generation rate in India has increased from 0.44 kg/day in 2001 to 0.5 kg/day in 2011, fuelled by changing lifestyles and increased purchasing power of urban Indians. Urban population growth and increase in per capita waste generation have resulted in a 50% increase in the waste generated by Indian cities within only a decade since 2001.

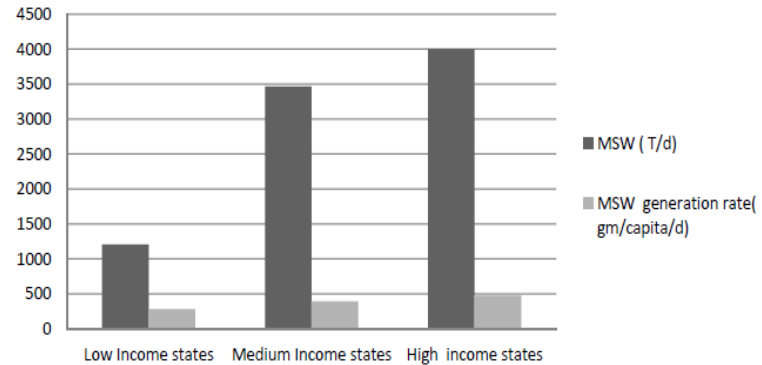
Generation of MSW has an obvious relation to the population of the area or city, due to which bigger cities generate more MSW. Table 3 shows the per capita quantity of municipal solid waste in Indian Cities by NEERI Nagpur. From the table 3 the MSW generation rates in Indian cities ranges from 0.21 to 0.5 kg/day but valves up to 0.5 kg/capita/day in Metropolitan cities i.e. the generation rate are low in smaller towns where as high in cities over 20 lakh population. It is estimated that the waste generation rate in urban areas of India will be approximately more than 0.7 kg/person/day in 2025 and will increase to 1.032 kg in 2030.

**Table 3: Per Capita Quantity of Municipal Solid Waste in Indian Cities by NEERI Nagpur**

Population millions	No. of Urban Centers	Total Population Millions	Per capita valve Kg/capita/day	Quantity kg/day
>0.1	328	68.3	0.21	14343.00
0.1 to 0.5	255	56.914	0.21	11952.00
0.5 to 1.0	31	21.729	0.25	5432.00
2.0 to 5.0	6	20.587	0.35	7209.00
>5.0	3	26.306	0.50	13153.00

Figure 4 shows the solid waste generation for low, medium and high (per capita) income states which depends on the economy of the people and per capita generation increases with the level of income of the family or individual. The quantity of

MSW (T/d) and per capita generation rate is high in high (per capita) income states (Delhi) in comparison to medium (Andhra Pradesh, Gujarat, Haryana, Himachal Pradesh) and low (per capita) income states (Uttar Pradesh, Madhya Pradesh, Bihar, Manipur) in India. This may be due to the high living standards, the rapid economic growth and the high level of urbanization in comparatively high (per capita) income states.

**Fig.4 Per capita MSW generation low, medium and high (per capita) income states in India**

Source: Information from web site of CPCB

Table 4 shows the Municipal Solid Waste (MSW) generation in the six metro cities, Kolkata, Mumbai, Delhi, Chennai, Hyderabad and Bangalore as per CPCB (2000). From the table 4 it is clear that Chennai is the fourth largest metropolitan city in India with highest per capita solid waste generation rate of 0.6 kg/d. The Municipal Solid Waste (MSW) generation in Chennai has increased from 600 to 3500 tons per day (tpd) within 20 years.

**Table 4: Municipal Solid Waste in Indian Metro Cities**

Sl. No	Name of City	Population (As per 2001 census)	Area (Sq.Km)	Waste Quantity (TPD)	Waste Generation Rate (kg/c/day)
1	Hyderabad	38,43,585	169	2187	0.57
2	Bangalore	43,01,326	226	1669	0.39
3	Chennai	43,43,645	174	3036	0.62
4	Kolkata	45,72,876	187	2653	0.58
5	Delhi	1,03,06,452	1483	5922	0.57
6	Greater Mumbai	1,19,78,450	437	5320	0.45

Source: CPCB (2000)

#### Major problems in Indian cities

Waste management is one of the major problems in Indian cities. The rapid rate of urbanization in India has led to an increasing waste generation. The amount of MSW is expected to increase significantly in near future as the country strives to attain an industrialized nation status by the year 2020. Intensified by rapid population growth, disorganization of city governments, a lack of environmental awareness and limited funding has become one of the biggest environmental problems in Indian cities. This has resulted in a large amount of waste, being littered on planed and mostly unplanned landfills in urban areas (Look 2009). Land fill sites and dumps of consumer waste are increasing in most of India cities due to increasing waste generation. According to the United Nations Development Programme the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNDP 1997). Typically one- to two-thirds of the solid waste that is generated is not collected. The average collection efficiency for MSW in Indian cities and states is about 70%.The

Central Pollution Control Board (CPCB) has collected data for the 299 Class-I cities to determine the mode of collection of MSW. It is found that manual collection comprises 50%, while collection using trucks comprises only 49% (CPCB, 2000). More than 90% of MSW in cities and towns are directly disposed of on land in an unsatisfactory manner.

Availability of land is a constraint in Indian cities and unscientific method of open dumping is affecting the aesthetic value of surrounding area of disposal site. The dumping not only affects the man and environment but decays the property in their vicinity and also has a negative impact on the scarcity of land in the future. Financial constraints, institutional weakness, improper choice of technology, public apathy towards waste management have made this situation worse.

### Conclusions

On the basis of above study it can be concluded that urbanization is taking place at a fast rate in India. Growing prosperity, urbanization and industrialization has caused a tremendous increase of municipal solid waste generation in urban India. But the recent years have witnessed a surge in volume and variety of these wastes due to rapid urbanization, modern lifestyles and consumption patterns. The old age practice of open dumping illegally in and around the cities has complicated the scenario with severe damage to man and his environment. The need of land will be more for disposal of solid waste as municipal solid waste generation will increase in the future. Urgent attention to deal with them efficiently and effectively to reduce the generation of solid waste by adopting scientific methods of solid waste disposal as availability of land is a constraint in Indian cities. Cleanliness is a major factor that influences development of a nation. People and governments should realize an efficient solid waste management system to keep the cities clean and healthy. Hence there is a need for a paradigm shift in our approach to the waste management. The complexity of the problem can be reduced by adopting waste reduction at source, segregation of waste, recovery of recyclable & reusable waste. Reduce; recover; recycle and reuse can be the 4R mantra for urbanities which helps to minimize the problems associated with the generation and safe disposal practices of municipal solid waste.

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