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INDIAN SCENARIO OF MUNICIPAL SOLID WASTE MANAGEMENT

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Abstract: **The abysmal state of and challenges in municipal solid waste management (MSWM) in urban India is the motivation of the present study. Urbanization contributes enhanced municipal solid waste (MSW) generation and unscientific handling of MSW degrades the urban environment and causes health hazards. In this paper, an attempt is made to evaluate the major parameters of MSWM, in addition to a comprehensive review of MSW generation, its characterization, collection, and treatment options as practiced in India. The current status of MSWM in Indian states and important cities of India is also reported. The essential conditions for harnessing optimal benefits from the possibilities for public private partnership and challenges thereof and unnoticeable role of rag-pickers are also discussed. The study concludes that installation of decentralized solid waste processing units in metropolitan cities/towns and development of formal recycling industry sector is the need of the hour in developing countries like India.**

OBJECTIVES

- **To analyse the existing situation of Municipal solid waste management in India**
- **To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated;**
- **To recommend appropriate activities for waste handling and disposal measures;**

RESEARCH METHODOLOGY

As regards the methodology, the tools and technique employed has been determined in consonance with the set objectives. The present research used several primary and secondary data. The interviews with the concerned officers will made to assess their strengths and weaknesses in the management of municipal solid waste. To achieve of the study on the other hand, the significant part of the study is based on the secondary data obtained from the official websites. The data is also attained from research papers, articles and newspapers.

INTRODUCTION

There has been a significant increase in the generation of urban solid waste all over the world. This was found due to the rate of population growth, industrialization, urbanization, and economic growth. The speed of consumerism has been found to be very high and cover more than 50% of the total population over the past decade due to greater economic growth, which ultimately aggravated the production of solid urban waste. The generation of solid urban waste has shown a different trend and a positive correlation with economic development in terms of solid waste production in kg/person/ day worldwide.

The management of solid urban waste is a mandatory function of municipal companies, municipalities, and other local agencies in India. The municipal laws that govern local urban agencies do not have adequate provisions to effectively address the emerging problem of solid waste management. With rapid urbanization, changing lifestyles and consumption patterns, the problem of managing solid urban waste in urban areas, the situation becomes critical. MSW in urban areas of Asia are mixtures of residential, commercial, institutional, industrial and tourism activities (UNEP, 2004).

The growth of MSW in our urban centers has exceeded population growth in recent years. There are many reasons to raise a huge amount of solid urban waste, that is, changing lifestyles, eating habits and changes in living standards. MSWs in cities are collected by their respective municipalities and transported to designated waste sites, which are usually low, on the outskirts of urban areas. Limited revenue for municipalities that make them less equipped to meet the high costs resulting from the collection, storage, processing and proper disposal of municipal solid waste. As a result, a substantial portion of the generated MSW remains unattended and grows on piles at low-maintenance collection centers. Choosing a disposal site is also more a matter of what is available than what is appropriate. The average efficiency of urban wastewater collection in Indian cities is about 72.5% and about 70% of cities do not have adequate waste transport capacity (TERI, 1998)

Over the years, there has been a significant increase in urban solid waste production in India, 100 grams per person per day in small cities at 500 grams per person per day in larger cities. At present, most of the solid urban waste in India is scientifically eliminating (Akolkar, 2005).

In India, the problem of public health and the deterioration of environmental quality due to improper waste disposal practices is recognized, but especially in the context of large cities (Sundravaidvel, 2000). The MSWM problem was exacerbated by rapid urbanization. Because of the increased public awareness of MSWM, he presented a public issue in the Supreme Court, which gave rise to the Regulation of municipal solid waste (management and handling), 2000. The government, for the first time, the company included private organizations for providing this audience. the service (CCPD, 2002). The Government of India has taken many initiatives and implemented new technologies and methods to provide loans to establish composting facilities to promote proper solid waste management since the 1960s (MoEF, 2005).

The size of the city (population density) has influenced the amount of waste production. It has been observed that this phenomenon occurs all over the world and India is no exception to this. Urban centers with a population of over 0.1 million generate most of the waste produced. With 72.5% of the waste generated in the country contribute to the other 3955 urban centers that produce only 17.5% of the total waste.

Table 1: India: Waste generation in urban centres

S.N.	Types of cities	Tones/Day	Percent of total garbage
1	07 Megacities	21,100	18.8
2	28 Metro cities	9,643	17.1
3	388 Class cities	2,635	37.1
4	3955 Urban cities	20,125	17.5

Note: The megacities have more than 4 million inhabitants and metropolitan cities (also known as more than one million cities) are the same as those cities identified in the JNNURM proposal. Class 1 cities with a population between 100,000 and 1 million are 388 in number)

(Source: MOUD report, 2005.)

Estimating the amount and characteristics of the USW in India and forecasting the future generation of waste is critical to successful waste management planning. The amount of MSW generated depends on the standard of living, the extent, and the type of commercial activity, the eating habits and the season. India generates about 133,760 tons of MSW per day, of which about 91 152 tons are harvested and about 25,884 tons are processed. The per capita MSW generation in India varies from about 0.17 kg per person per day in small cities to around 0.62 kg per person per day in the city.

The rate of waste production depends on factors such as population density, economic status, level of commercial activity, culture and the city/region. generation of MSW in several states, indicating a high-yield production in Maharashtra (115 364-19 204 tons per day), Uttar Pradesh, Tamil Nadu, West Bengal (11 523-15 363 tons per day), Andhra Pradesh, Kerala (7683-11 522 tons per day) and Madhya Pradesh, Rajasthan, Gujarat, Karnataka and Mizoram (3842-7662 tons per day). Less waste production occurs in Jammu and Kashmir, Bihar, Jharkhand, Chhattisgarh, Orissa, Goa, Assam, Arunachal Pradesh, Meghalaya, Tripura, Manipur, and Nagaland (less than 3841 tons per day).

Table 2: Statistics of MSW generated in different states in India

Sr. No.	States	MSW TPD (2000)	MSW TPD (2009-11)	Collected TPD (2009-11)	Treated TPD (2009-11)	Growth (%)
1	Andhra Pradesh	4376	11500	10655	3656	163
2	Assam	285	1146	807	73	302
3	Delhi	4000	7384	6796	1927	85
4	Gujarat	NA	7379	6744	873	-
5	Karnataka	3278	6500	2100	2100	98
6	Kerala	1298	8338	1739	4	542
7	Madhya Pradesh	2684	4500	2700	975	68
8	Maharashtra	9099	19204	19204	2080	111
9	Manipur	40	113	93	3	182
10	Meghalaya	35	285	238	100	713
11	Orissa	655	2239	1837	33	242
12	Punjab	1266	2794	NA	Nil	121
13	Puducherry	69	380	NA	Nil	451
14	Rajashthan	1966	5037	NA	Nil	156
15	Tamil Nadu	5403	12504	11626	603	131
16	Tripura	33	360	246	40	991
17	Uttar Pradesh	5960	11585	10563	Nil	94
18	West Bengal	4621	12557	5054	607	172

Source: CPCB (2000b, 2013).

Table 3: Per Capita Waste Generation

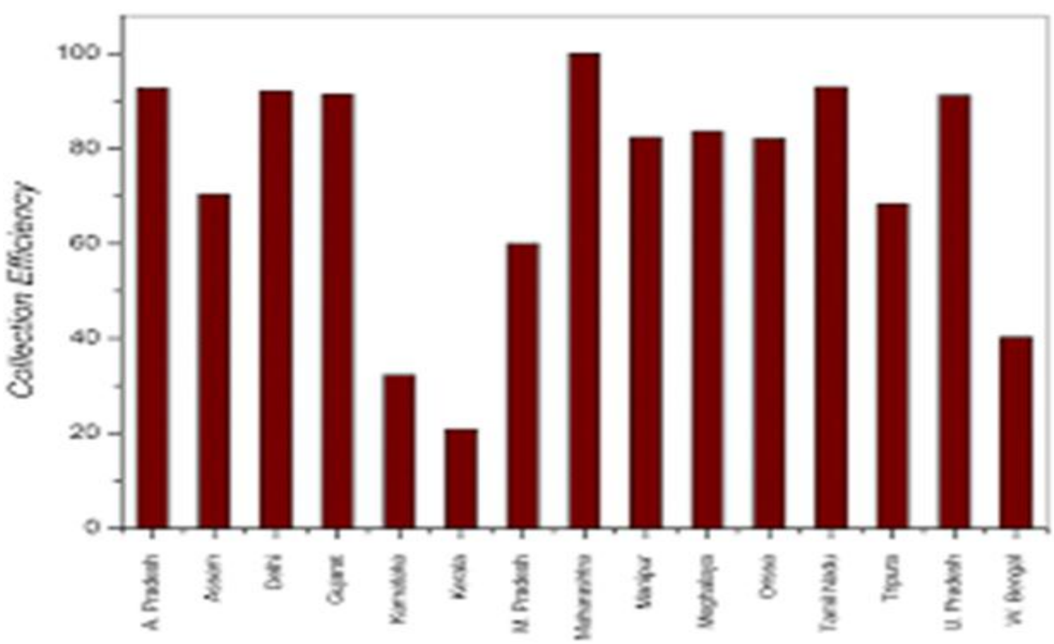
Population size	Waste generation* (kg/Capita/day)	Waste generation** (kg/Capita/day)
>2000000	0.43	0.55
1000000-2000000	0.39	0.46
500000-1000000	0.38	0.48
100000-500000	0.39	0.46
<100000	0.36	-

Source: CPCB Report (2000b)* and Calculated from R.K. Annepu (2012)**.

Generation and Collection

In India, rapid urbanization and the uncontrolled growth rate of the population are the main reasons why RSU becomes a serious problem. Based on the size of the population, the rate of generation of waste per capita and their growth over a decade are shown in Table 3.8 (Annepu, 2012). India's population is expected to be around 1,823 million by 2051 and around 300 million tonnes of MSW will be generated annually, which will require about 1,450 km2 of land to be disposed of, if the ULBs in India continue to rely filling for the management of RSU (position paper on the solid waste management sector in India, 2009). However, these projections are conservative and maintain an annual growth rate of 1.33% in the generation of MSW per capita (Bhide and Shekdar, 1998, CPCB, 2000a, Pappu, Saxena and Asolekar, 2007, Shekdar, 1999). Therefore, with an annual growth of 5% in the area of production of landfill per capita necessary for waste disposal could be many folds (CPCB, 2013)

Figure1: Collection efficiency of selected Indian states (CPCB, 2013).



The Report of the Planning Commission (2014) reveals that 377 million people living in urban areas generate 62 million tonnes of MSW per year and it is expected that by 2031 these urban centers will generate 165 million tonnes of waste each year and 2050 could reach 436 million tons. To accommodate this amount of waste generated by 2031, approximately 23.5 × 107 cubic meters of landfill space is required and in terms of area, it would be 1,175 hectares of land per year. The area required from 2031 to 2050 would be 43,000 hectares for stacked 20-meter high dumps. These projections are based on waste production of 0.45 kg/capita/ day. In India, due to the lack of availability of primary data on per capita waste generation, inadequate data on waste characteristics and the influence of informal sectors, different reports give different values and projections. Therefore, it is difficult to assess the land requirement and select the appropriate treatment/disposal techniques. The study conducted in 59 cities (35 metropolitan cities and 24 state capitals) by the National Institute of Environmental Engineering Research (NEERI, for its acronym in English) reveals that 39,031 TPDs of RSM were generated in these cities/towns during the year 2004 -2005. For the same 59 cities, the CIPET conducted a study again in the period 2009-2010 for the CPCB, in which it was observed that these cities generate 50,592 TPDs of waste (CPCB, 2013). During 2011, approximately 1.2786 MSDs of TPD were generated throughout Italy, of which only 89,334 TPDs (i.e. 70%) and 15,881 TPDs (or 12.45%) were processed or treated (CPCB), 2013). During the last decade, the generation of solid waste has increased by 2.44 times (CPCB, 2013).

Table 4: Change in composition of municipal solid waste with time (in %)

Year	Biodegradable	Paper	Plastic/ Rubber	Metal	Glass	Rags	Others	Inert
1996	**42.21**	**3.63**	**0.60**	**0.49**	**0.60**	**-**	**-**	**45.13**
2005	**47.23**	**8.13**	**9.22**	**0.50**	**1.01**	**4.49**	**4.02**	**25.16**
2011	**42.51**	**9.63**	**10.11**	**0.63**	**0.96**	**-**	**-**	**17.00**

(Source: Planning Commission Report.)

The survey conducted by FICCI reveals that the realization of MSW in landfills varies from 16 to 100%, as in Kozhikode it is 16% and in Greater Mumbai, it is 100%. Greater Mumbai (Maharashtra) and Ludhiana (Punjab) have a 100% waste disposal, in Delhi and Surat (Gujarat), about 95% of the MSW has reached their landfills, and in the rest of the cities/cities less than 90% % of waste arrived at the CPCB landfills, 2013; FICCI, 2009). The variation in collection efficiency (ie 100% of collected waste / generated waste) from the Indian states selected in 2011 is shown in the figure above (CPCB, 2013).

Composition and characteristics of Indian solid urban waste:

The following main categories of waste are generally present in the MSW of India:

• **Biodegradable waste:** food and cooking waste, green waste (vegetables, flowers, leaves, fruit) and paper.

• **Recyclable material:** paper, glass, bottles, cans, metals, some plastics, etc.

• **Inert waste:** C & D, dirt, residues.

• **Residues of composite materials:** used clothing, Tetra containers, plastic waste like toys.

• **Dangerous domestic waste (also called "hazardous household waste") and toxic waste:**

Medicinal waste, electronic waste, paints, chemicals, light bulbs, fluorescent tubes, aerosol cans, containers of fertilizers and pesticides, batteries and shoe shine.

The MSW in India has about 40-60% of compostable, 30-50% of inert waste and 10% to 30% of recyclable waste. The analysis conducted by NEERI reveals that in its entirety, Indian waste consists of a nitrogen content (0.64 ± 0.8%), phosphorus (0.67 ± 0.15%), potassium (0.68) ± 0.15)% and percentage of C / N (26 ± 5)%. Change in the physical and chemical composition of the Indian MSW over time

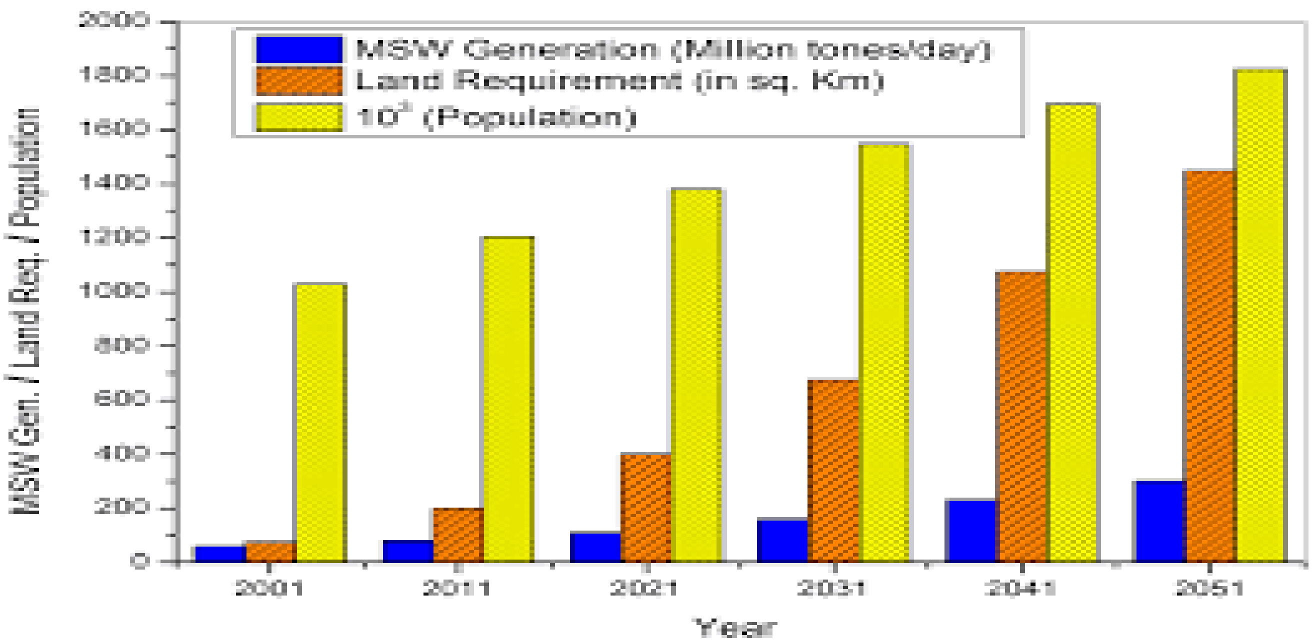
Solid waste management practices and challenges in India:

In India, MSWM is governed by MSWR. However, most of the ULBs do not have adequate action plans for the execution and dissemination of the MSWR (CPCB Report, 2013). Unfortunately, no city in India can claim 100% segregation of waste in the housing unit and, on average, only 70% of the waste collection is observed, while the remaining 30% is again confused and lost in the environment urban. Of the total waste collected, only 12.45% of the waste is treated scientifically and the rest is disposed of in open landfills (CPCB Report, 2013). The existing and future soil requirements for the elimination of MSW together with population growth and the generation of MSW is shown in Figure 3. Environmental compatibility, profitability, and acceptability for the local community are important attributes to obtain an efficient solid waste management system. The critical examination of the important parameters of the MSWM practice compared to the Indian scenario is described below:

1. **Segregation:** there is no organized and scientifically planned segregation of the MSW, at the family level or in the community basket. Waste classification is mainly done by an unorganized sector and is rarely practiced by waste producers. Segregation and classification occur under highly dangerous and dangerous conditions and the effectiveness of segregation is reasonably low, as the unorganized sector segregates only the discarded waste stream components, which can ensure comparatively higher economic performance. in the 2012 recycling market). On several occasions, due to improper use, the separate components were mixed again during transport and disposal (CPCB report, 2013). The lack of segregation deprives the correct scientific elimination of waste (Singhal and Pandey, 2000).
2. **Collection:** the waste produced by the houses are generally transferred into common metal containers, made of cement or in combination with both. Even the trash in the streets reaches the community's containers. These Community waste containers are also used by other essential business sectors in the vicinity of disposal containers together with household waste, except when some commercial complexes or industrial units involve municipal authorities for the transfer of their waste to the disposal site. paying a certain amount (Kumar et al., 2009).
3. **Reuse/recycling:** these are activities such as the collection of such waste materials, which could be recovered and used profitably to make new products. Since non-segregated waste is disposed of in Community containers, their optimal recycling is not possible. However, rags collectors usually classify and take and sell recyclable materials such as plastic, glass, etc. In Pondicherry, almost all recyclable material is classified by rags and absorbed into the flow of material through recycling (Pattnaik and Reddy, 2010).
4. **Transport:** the transport modes for MSWMs practiced in India are: ox cart, manual rickshaw, compactors, trucks, tractors, trailers, and dumpers. In smaller cities, trucks with a capacity of 5 to 9 tonnes are used without an adequate roofing system. Fixed compactors, mobile compactors / closed times and vehicles covered by sheets are used in the transport of MSW and around 65, 15 and 20% of the waste are transported through these compactors, respectively. The maintenance of vehicles used for the transportation of waste is usually carried out in a laboratory run by ULB, but most of these laboratories can perform only minor repairs. It is not surprising that, in the event of a breakdown of these vehicles, the overall efficiency of collection, transport, and disposal is drastically reduced. Only some transfer stations can be found in some metropolitan areas, p. Ex. Mumbai (Joseph, 2002).
5. **Elimination:** in India, almost all cities, towns or villages have adopted the unscientific removal of MSW. The existing practice and availability of technology for MSWM for 59 cities were shown in Figure 4 (Kumar et al., 2009). Among these cities, 40 cities showed an increase in waste generation, 7 cities show a reduction and were more or less the same for 6 cities. Although there has been a population increase in the decade for these cities, the author has not indicated any significant reason for the reduction, as well as the same amount in the generation of waste for these cities. However, the possible reason for the reduction could be that the waste generated could not reach the designated dumping site and were lost in peripheral cities, on the outskirts, along the road, in low areas, in drainage, in green areas, etc. The data reveal that uncontrolled open dumping is a common feature in almost all cities (Kumar et al., 2009). The following disposal practices are used in the hierarchy.
6. **Open Discharge:** In India, the generated MSW is systematically eliminated in low areas, systematically violating landfill practices. Almost no ULB has adequate sanitary facilities for the sanitary landfill and the MSW is launched on the outskirts of

the city along the roads. Unscientific dumping is subject to flooding and is an important source of contamination of surface water during contamination of monsoons and groundwater due to leached percolation (Lo, 1996, Mor, Ravindra, Dahiya and Chandra, 2006).

Figure 2: Prediction Plot for MSW generation, land requirement, and population from 2001 to 2051.



(Source: Cogent Environmental Science (2016))

7. **landfill:** The landfill will continue to be a widely accepted practice in India, although metropolitan centers such as Delhi, Mumbai, Kolkata, and Chennai have limited the availability of land for waste disposal and are exceeding the capacity of the designated landfill (Sharholy, Ahmad Mahmood, and Trivedi, 2008). The development of new health/expansion of existing landfill dumps reported in states such as Andhra Pradesh (Vijianagaram), Delhi (Bhalswa, Okhla, and Ghazipur), Goa, Gujarat (8 sites), Haryana (Sirsa and Ambala), Karnataka (12). sites), Madhya Pradesh (Gwalior and Indore), Maharashtra (Nashik, Sonpeth, Ambad, Pune, Nawapur and Navi Mumbai), Punjab (Adampur), Rajasthan (Jodhpur) and West Bengal (17 sites) (CPCB, 2013). According to CPCB 2013 report, to date, India has built 59 sites and 376 landfills are being designed and implemented. In addition to this, 1305 sites have been identified for future use.
8. **Gas to energy conversion plants:** Methane gas (CH4) and carbon dioxide (CO2) are mainly produced from landfills. These gases have a significant greenhouse effect. The CH4 emission from the landfill is about 13% of global CH4 emissions and is about 818 million metric tons per year in terms of CO2 equivalent (Rachel, Damodaran, Panesar, Leatherwood, and Asnani, 2007). In India, estimated methane emissions are about 16 million tonnes of CO2 equivalent per year through landfills (International Energy Agency, 2008). The energy potential of landfill gas available at selected sites in Delhi (Balswa, Gazipur, and Okhla) is 8.4 MW, Mumbai (Deonar and Gorai) of 5.6 MW, Ahmadabad (Pirana) of 1.3 MW and Pune (Urli) was 0.7 MW per year (Siddiqui). & Khan, 2011). The Design Commission report (2014) indicated that 62 million tons of municipal solid waste generated in urban areas can produce 439 MW of fuel and RDF components, 72 MW of landfill gas and 5.4 million of tons of compost for agricultural use as CH4. Global warming potential 23 times greater than CO2. The use of landfill gas, in particular, CH4 for energy production, is important because it eventually becomes primary constituents (ie CO2 and H2O). A United Nations Program (UNEP) study has shown that greenhouse gas emissions from landfills can be significantly reduced if environmentally sound management of hazardous waste is done and others (UNEP 2008, 2010):

(1) Waste reduction. (2) Recycling and re-use. (3) Reduction of fossil fuels by replacing the energy recovered from the combustion of waste. (4) The

energy derived from CH4 of the landfill can be used for the energy needs on the spot.

Unavailability of the quality of the MSW required on the ground, the presence of low-calorie MSW material, i.e. inert waste and C and D, a reserve to use compost generated by farmers, the lack of a policy A correct market for the use of CDR and compost makes such projects economically unprofitable. The Ministry of New and Renewable Energy (MNRE), Government of India set up a 3-megawatt (MW) plant in Solapur, Maharashtra, with a capacity of 16 (MW) in Okhla, Delhi, and plans to support some projects on waste of energy in Bangalore (8 MW), Hyderabad (11 MW), Pune (10 MW) and Delhi in Gazipur (12 MW) (Annual Report MNRE, 2014-2015) also in Delhi, Narela (24 MW). installation.

Although, in developed countries to acquire greater biodegradation and gas recovery, additional percolated /liquid/supplemental/ recirculated water in landfills (Barlaz, ham, and Schaefer, 1990; Reinhart, McCreanor, and Townsend, 2002). But unfortunately, MSWR does not allow the recirculation of leachate in India. Therefore, a great opportunity to improve the energy recovery of the landfill remains unused.

9. **Biological treatment of organic waste**: The waste generated in India has a higher organic content, about 50%, compared to 30% generated by developed countries. The following composting methods are commonly adopted in India:

a. Aerobic composting: composting is defined as the phenomenon whereby the biological conversion of organic matter present in the MSW takes place in the presence of air in a humid and warm environment. The final product of composting, which has a high nutritional value, is hummus (compost). Composting can be laborious or mechanical. Intensive work composting is done in smaller cities. However, in large Indian cities, energy composting units have been installed (Bhide and Shekdar, 1998). An urban waste composting facility located in Indore City (Madhya Pradesh) is one of the best-maintained facilities. Mechanical composting units from 150 to 300 tons/day have also been installed in Bangalore, Vadodara, Mumbai, Delhi, and Kanpur (Sharholy, Ahmad, Vaishya and Gupta, 2007).

b. Vermicomposting: vermicomposting is carried out by introducing earthworms into semi-decomposed organic waste. Earthworms can consume five times more organic matter a day than their body weight. Initially, the biodegradable organic matter is subdivided through microbial enzymatic activity.

Table5: Number of composting/vermicomposting plants in some states

State	No. of Plants (composting/vermicomposting)	State	No. of Plants (composting/vermicomposting)
Andhra Pradesh	32	Madhya Pradesh	04
Chhattisgarh	15	Maharashtra	125
Delhi	03	Meghalaya	02
Goa	05	Orissa	03
Haryana	02	Punjab	02
Gujarat	86	Rajasthan	02
Himachal Pradesh	13	Tripura	13
Karnataka	05	Uttarakhand	03
Kerala	29	West Bengal	09

(Source: CPCB(2013))

Table 6: Number of energy recovery plants in some states

State	No. of RDF Plant/Waste to energy Plant (PP)/Biogas (BG)	State	No. of RDF Plant/Waste to energy Plant (PP)/Biogas (BG)
Andhra Pradesh	3-RDF, 4 PP	Delhi(UT)	1-RDF, 1 PP
Chandigarh	1-RDF	Gujarat	2-RDF
Chhattisgarh	1-RDF	Kerala	2-BG
Maharashtra	19-BG		

(Source: CPCB (2013))

The largest insect composting plant in India, with a capacity of 100 million tons per day, is located in Bengaluru, while there are smaller plants in Hyderabad, Bangalore, Mumbai, and Faridabad. Table 5 shows the details of composting plants and domestic animals installed in different states.

c. Anaerobic digestion: The anaerobic decomposition of waste is also known as the biomethanisation process. It is one of the important and sustainable techniques for treating the biodegradable part of MSW in subtropical climates. In this process, stabilization occurs and the biogas is released from the conversion of organic matter, which in turn can be used as energy. Biogas has 55-60% methane and can be used as fuel for energy production. The Indian government promotes biomethanisation technology using industrial, agricultural and urban waste. A series of biomethanisation schemes are being planned and started for some cities like Delhi, Bangalore, and Lucknow to use the waste generated by the fruit and vegetable market and the garden waste. (Ambulkar & Shekdar, 2004).

10. **Heat treatment:** The heat treatment of solid waste can be obtained by incineration, pyrolysis, and gasification by the plasma arc. Incineration of MSW from India is not adequate since MSW has high organic components, moisture content or inert content in waste between 30% and 60% and calorific value in the 800-1,100 range. kcal/kg in MSW (Jalan and Srivastava, 1995; Joardar, 2000; Kansal, 2002; Sudhir et al., 1996). If the waste has a high humidity or low calorific value, incineration is not feasible without the use of additional fuel. Generally, in India, small incinerators are used to burn hospital waste (Sharholy, Ahmad, Mahmood and Trivedi, 2005). An MSW incineration plant with capacity for 300 TPD at Timarpur, Delhi, built in 1987, was the first large-scale facility. However, the plant could not work long and had to be removed due to the lack of availability of waste that had a calorific value for incineration (Sharholy et al., 2007). Currently, there is no MSW incinerator operating on a large scale in India.

Gasification is also one of the heat treatment techniques used to treat MSW and is able to reduce pollution and increase heat recovery. Limited gasifiers have been installed in India, but are mainly used to burn agricultural biomass. In India, you can see two different types of gasifiers. The first (NERIFIER unit gasification) was installed in Nahar, Hanumangarh, Rajasthan by Narvreet Energy Research and Information (NERI) to burn agricultural waste, sawmill dust, and forest waste, while the latter is the Energy Tata Research Institute (TERI). Gasifier installed on the campus of Gaia Pahari, New Delhi (Ahsan, 1999; Sharholy et al, 2007).

Waste fuel (CDR, in short) is another upcoming technology that can be effectively used for energy/heat energy from MSW and reduce the burden on landfills. RDF some plants have been installed in Hyderabad, Guntur, and Vijayawada in Andhra Pradesh. However, the operating cost of the RDF plant is higher. Waste disposal is the most important aspect of solid waste management. The table shows that only land dumping was used for disposal of municipal waste in 1971. There was no other technique for waste disposal. Afterward, in 1991 about 90 percent of the municipal solid waste was disposed of in a low lying area outside the cities which had no provision of leachate, collection, and treatment. Approximately, 9 percent of municipal solid waste was used for composting .

Table 7: Waste disposal trends in India

Waste disposal method	**1971 (40cities)**	**1991 (23 cities)**
Land dumping	Almost all	89.8%
Composting	-	8.6%
Others (Pelletisation, Vermi - composting	-	1.6%

Source: CPCB, 1999.

CONCLUSION

This research endeavours to include a holistic view of the municipal solid waste management situation in India. In this paper, an attempt has been made to study the existing scenario, quantity and characteristics of MSW. The existing scenario of waste composition emphasizes the importance of segregation for successful operation of waste management facilities. Municipal authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions. The study should be carried out on the generation and characterization of MSW in India. Since the MSW is heterogeneous in nature, a large number of samples have to be collected and analysed to obtain statistically reliable results.

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