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Urbanisation and Waste Management in India

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Abstract
Urbanisation is a global phenomenon in which cities experience high population growth due to immigration. Excessive population concentration in urban areas is a key contributor to the significant increase in waste generation, which is managed unscientifically, leading to various health hazards and environmental degradation in urban areas is one of the key contributors to the huge influx of waste generation that is managed unscientifically, leading to various health hazards and environmental degradation. Besides various issues related to waste management, there are best practices followed in towns and cities across India. The objectives of the present paper are to examine the impact of urbanisation on municipal solid waste generation in India, to analyse the present status of municipal solid waste management in India and identify best practices adopted by selected municipal corporations.
Keywords- Solid Waste Management, Municipal Solid Waste Management, Urbanisation, Success of MSWM

1. Introduction

According to the 2011 Census, India is the world's second-most populous country, with a population of 1.21 billion, of whom 31% reside in urban areas. It is expected that the urbanisation's positive contributions to urbanisation in India will increase to 40% by 2036 and 2050 (Kouamé, 2024). Urbanisation has played a crucial role in a country's economic development, with around 70% of GDP generated by urban areas alone, driving the country's social and economic progress. As Urbanization and growth go together, no country has ever reached middle-income status without a significant population shift into cities.
Despite the positive impact of excessive population concentration in urban areas, issues related to municipal solid waste management remain a key concern in urban development. In India. The majority of urban local bodies are unable to manage the large volume of solid waste generated daily. The municipalities are struggling to manage waste, as most of it is unsegregated and has low calorific value, indicating that open dumping and landfills are prevalent across multiple sources. The present paper provides an overview of best practices that are followed in selected cities.

2. Urbanisation and Waste Generation in India

Urbanisation is a form of social transformation from traditional rural societies to modern urban communities. It is a long-term, continuous process. Urbanisation can be defined as "a process which reveals itself through temporal, spatial and sectoral changes in the demographic, social, economic, technological and environmental aspects of life in a given society". It is a Progressive concentration of population within an urban unit (Davis, 1965).
These changes manifest themselves in the increasing concentration of population in human settlements, larger than villages, in the increasing involvement of the people in the secondary and tertiary production functions, and in the progressive adoption of certain social traits which are typical of traditional rural societies".
Kingsley Davis has explained urbanisation as a process (Davis, 1965) of a shift from a spread-out pattern of human settlements to one of concentration in urban centres. It is a finite process- a cycle through which a nation passes as they evolve from agrarian to industrial society (Davis and Golden, 1954).
He has mentioned three stages in the process of urbanisation.
Stage one is the initial stage, characterised by a rural, traditional society with a predominance of agriculture and a dispersed settlement pattern.
Stage two refers to the acceleration stage, where basic restructuring of the economy and investments in social overhead capital, including transportation and communication, take place. The proportion of the urban population gradually increases from 25% to 40%, 50%, 60% and so on. Dependence on the primary sector gradually dwindles.
The third stage is known as the terminal stage, in which the urban population exceeds 70%. At this stage, the level of urbanisation (Davis, 1965) remains more or less constant. The growth rates of the urban and total populations become equal at this terminal stage.
India is at an accelerating stage; the suburban population is gradually increasing, and more economic and industrial investments are expected to come to the country, making urban areas more densely populated.

Figure 1: Percentage of the population living in urban and rural areas

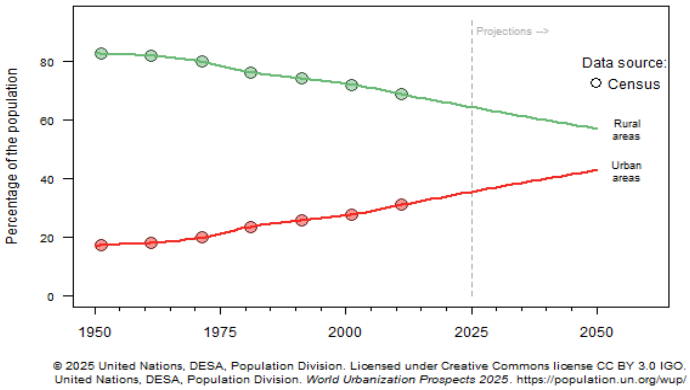
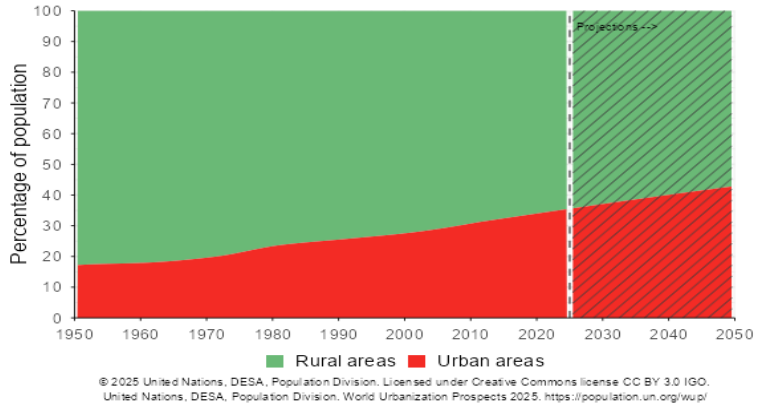


Figure 2: Population Distribution by Urban and Rural Areas



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Urbanisation in India has increased from 17.29% in 1951 to 31.16% in 2011. A decline in the rural population was observed between 1951 and 2011, from 82.7% to 68.84% (Figures 1 and 2). An increase in population in urban areas directly contributes to excessive waste generation, which is increasing at 12.4 per cent, as presented in Table 1. Whereas collection efficiency has increased only by 9.9%. Whereas treatment capacity has seen significant changes, with increases to 87% across different cities nationwide, this can be attributed to the policy shift to the new MSW rules of 2016.

Table 1. National Increase in Waste Management Capacity Over Reporting Years

Indicator	2018–19	2022–23	Absolute Increase	Increase (%)
Waste Generated (TPD)	152,076.70	170,939.00	18,862.30	12.4
Waste Collected (TPD)	149,748.60	164,621.00	14,872.40	9.93
Waste Treated (TPD)	55,759.60	104,216.00	48,456.40	86.91

Source: Generated from Central Pollution Control Board [CPCB], 2024; Open Government Data Platform India, 2025

It is evident from Table 2 that waste generation has increased from 1.5 lakh TPD to 1.7 lakh TPD over the last three years. At the national level, collection efficiency has been over 95% for the last three years, while treatment efficiency has increased from 36.6% in 2018-19 to 60% in 2022-23. Whereas still around 40% of collected waste is untreated and is dumped unscientifically.

Table 2. National Year-wise Trend of Municipal Solid Waste Management in India (2017–18 to 2022–23)

Year	Waste Generated (TPD)	Waste Collected (TPD)	Waste Treated (TPD)	Collection Efficiency (%)	Treatment Efficiency (%)	Untreated Waste (%)
2018–19	152,076.70	149,748.60	55,759.60	98.47	36.67	63.33
2019–20	150,847.10	146,053.80	70,973.20	96.82	47.05	52.95
2022–23	170,939.00	164,621.00	104,216.00	96.3	60.97	39.03

Source: Generated from Central Pollution Control Board [CPCB], 2024; Open Government Data Platform India, 2025

Across the states, 14 states have 100% collection efficiency, while 75% have efficiency above 90%. As per Table 3, only four states, Manipur, Haryana, Kerala and Mizoram, have collection efficiency less than 80%, with the least of 44.6% in Mizoram (refer to Figure 3). Three states/UT have treatment efficacy of 100%, and 25% of all states/UT have treatment efficacy of more than 90%, highlighting a critical gap in treatment capacity in the remaining 75% of states. Of these 75% of states, 14 have treatment capacities below 50%, highlighting that waste management remains a critical issue, with the least efficiency of 6.31% in Nagaland (refer to Figure 4).

Figure 3: State-wise Collection Efficiency (%)

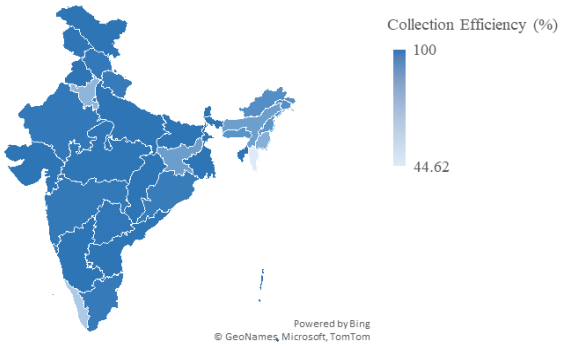
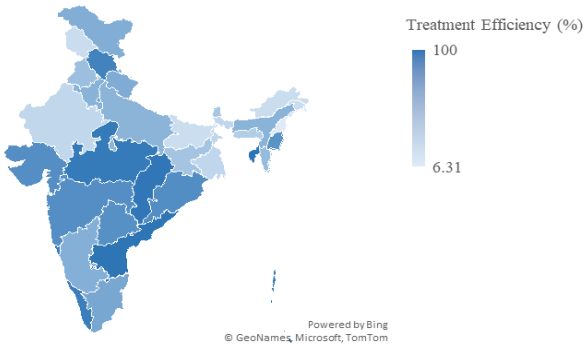


Figure 4: State-wise Treatment Efficiency (%)



Based on treatment efficiency, the states are classified as very high, high, medium, low, or critical performers. The details of treatment efficiency and corresponding states are given in Table 3.

Table 3. Classification of States by Treatment Efficiency (2022–23)

Category	Treatment Efficiency	States/UTs Included
Very High Performers	Above 80%	Andhra Pradesh, Madhya Pradesh, Odisha, Lakshadweep, Tripura, Chhattisgarh, Andaman & Nicobar Islands, Goa, Kerala, DNH & DD, Himachal Pradesh
High Performers	60–80%	Gujarat, Maharashtra, Telangana, Tamil Nadu, Delhi, Manipur
Moderate Performers	40–60%	Haryana, Karnataka, Punjab, Uttar Pradesh, Uttarakhand, Ladakh, Assam, Mizoram
Low Performers	20–40%	Rajasthan, West Bengal, Jharkhand, Sikkim, Meghalaya
Critical Performers	Below 20%	Bihar, Jammu & Kashmir, Arunachal Pradesh, Puducherry, and Nagaland

Source: Generated from Central Pollution Control Board [CPCB], 2024; Open Government Data Platform India, 2025

In terms of dumpsite remediation, there are a total of 2474 dumpsites across the country, of which 15.24% have been reclaimed, and only 1.78% have been converted to sanitary landfill sites, whereas the majority of sites, accounting for 83%, remain unremediated, as shown in Table 4.

Table 4. Dumpsite Remediation Status in India (2022–23)

Indicator	Number	Percentage of Total Dumpsites (%)
Total Existing Dumpsites	2,474	100
Dumpsites Reclaimed/Capped	377	15.24
Dumpsites Converted to Sanitary Landfill	44	1.78
Dumpsites Remaining Unremediated	2,053	82.98

Source: Generated from Central Pollution Control Board [CPCB], 2024; Open Government Data Platform India, 2025

Maharashtra has the highest share of landfills reclaimed or converted to sanitary landfills, at 55.8%, followed by Tamil Nadu at 43.9%, Madhya Pradesh at 36.8%, and Punjab at 29.2%.

2. Success Stories in Waste Management

MSWM is a strategic process comprising generation, segregation, transfer, sorting, treatment, recovery, and disposal. For municipal waste management, the Solid Waste Management (SWM) Rules, 2016, focus on the strategic management of waste through the preparation of a detailed long-term MSWM Plan for 20-25 years. The MSWM plan is prepared with a focus on reducing waste disposal by improving resource efficiency.**Generation and Segregation**: Reduction of waste at the source involves existing practices such as reuse, multiple uses of products, recycling to recover valuable materials from waste, and composting of biodegradable waste to produce manure. Another policy approach adopted in India is extended producer responsibility (EPR), under which guidelines for e-waste were launched in 2011 and for plastic waste management in 2022. Various Research reports indicate that 329 cities across Goa, Gujarat, Karnataka, Madhya Pradesh, Mizoram, Nagaland, Odisha, Sikkim, Tamil Nadu and Telangana have achieved complete door-to-door waste collection coverage. However, with regard to waste processing and disposal, only 22 States/UTs had established such facilities, while the remaining States/UTs had made little to no progress up to 2013. Although 279 conventional composting units, 138 vermi-composting facilities, 172 bio-methanation plants, 29 Refuse-Derived Fuel (RDF) units, and 8 Waste-to-Energy plants were reported to have been set up, a significant number of these facilities were either non-operational or operating below capacity (Ministry of Housing and Urban Affairs, 2025).

Waste segregation at the source, when community involvement and encouragement are in place, can substantially reduce associated costs. There are three approaches to waste management: community participation, private sector participation, and municipal corporations responsible for waste management. The cost of the community managing the waste is the least accounted for, at Rs. 1518/ton of waste, compared with Rs. 1797 with private sector participation and Rs. 1908 when the municipality handles the waste independently (Rathi, 2006).

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Waste dumping directly impacts the groundwater quality. Various studies indicate that leachates from municipal solid waste are a major cause of groundwater degradation. Waste dumping results in elevated ion concentrations, weathering of minerals present in underlying rocks, and the presence of heavy metals such as Arsenic, Cadmium, Chromium, Copper, Manganese, Lead and Zinc, which are attributed to the penetration of waste leachate into groundwater (Kurakalva et al., 2016). To overcome these issues, it is necessary to implement national policies and visions at the ground level to reverse the existing scenario. One basic requirement is the planning of scientifically managed landfill sites, which is considered at the lowest level in the hierarchy of integrated waste management systems (Central Public Health and Environmental Engineering Organisation [CPHEEO], 2016).

The landfills can also be used to capture methane and serve as a source of energy recovery. Similar research was carried out in Delhi that has shown substantial energy recovery by capturing methane over Ghazipur, Okhla and Bhalswa landfills to the extent ranging from 4.16 × 108 to 9.86 × 108 MJ; 2.08 × 108 to 4.06 × 108 MJ and 3.42 × 108 to 8.11× 108 MJ, respectively (Ghosh, 2018).

In addition to available waste treatment technologies, the best option is selected based on population size, the quantity of waste to be treated, and associated treatment costs (Mani, 2016). The available technologies and waste treatment options include vermicomposting, biomethanation, composting, recycling, engineered landfills, refuse-derived fuel (RDF), plasma gasification, incineration, pyrolysis, etc. For the available options, it is best to use segregated waste. However, the majority of the waste, accounting for up to 80%, is disposed of in an unscientific manner, leading to environmental degradation.

3. Best Practices of the Selected Municipal Corporations of India

Massive campaigns with the required infrastructure at appropriate locations and the segregation of waste at its source in the city have helped the Kolkata Municipal Corporation (KMC) manage the city's solid waste. KMC has also explored using the Clean Development Mechanism (CDM) under the Kyoto Protocol, in addition to the proposal for the new landfill site. Various strategies suggested include introducing fines for littering, standardising dustbin sizes to avoid spillage, eliminating open-storage waste containers, distributing labour and equipment, ensuring regular maintenance and replacement of old vehicles, including collection and transportation costs, and addressing unscientific waste disposal (Hazra & Goel, 2009).

Similarly, in Goa, the Margao Municipal Council has achieved 100 per cent door-to-door waste collection, with self-help groups involved in the process. Kochi Municipal Corporation has introduced a bin-less system in selected wards of the city.

Pune Municipal Corporation carries out door-to-door waste collection under the SWaCH programme. User charges ranging from Rs. 10 to Rs. 30 are collected per household. A Zero Waste Management System has been developed in Ward No. 141. Five decentralised waste processing plants have been established in the city. A mobile SMS alert system has been introduced for efficient complaint redressal, which is the first of its kind in India. The Global Positioning System (GPS), Geographic Information System (GIS), and Global System for Mobile Communication (GSM) are used to save travel time, improve monitoring, and minimise human error. In Surat, 60 per cent of door-to-door waste collection is carried out by private operators under a 10-year Public-Private Partnership (PPP) model. The city has closed, leak-proof containers and six transfer stations along with a separate leachate collection system.

Shimla Municipal Corporation formulated the Shimla Environment Heritage Conservation and Beautification (SEHB) Society. Mixed waste, improper collection and transportation, inefficient route monitoring, and foul smell are the major issues.

Ahmedabad Municipal Corporation signed a Memorandum of Understanding (MoU) with the United Nations Centre for Regional Development to make the city zero-waste. Coimbatore Municipal Corporation has planned four transfer stations. Different-sized vehicles are used depending on the quantity of waste generated, trip length, road width and process technologies. Hyderabad uses the Global Positioning System (GPS), Geographic Information System (GIS), and the Global System for Mobile Communications (GSM) to improve waste monitoring. Delhi uses the Global Positioning System (GPS), Geographic Information System (GIS), and the Global System for Mobile Communications (GSM) to improve waste monitoring.

4. Government Support to MSWM

The government of India has allocated grants and funds through various finance commissions and has launched various schemes and missions from time to time to undertake projects that support the improvement of solid waste management. For example, incentive grants for grid-connected MSW-based renewable energy projects, financial support of up to 50 percent of the project's capital cost for composting plants by MoEFCC, capital subsidy for promotion of technological options for waste to energy projects by MNRE, state-level policy measures for waste to energy projects by Andhra Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Haryana, Karnataka, Maharashtra, and Tamil Nadu, higher tariffs for electricity generated from WTE projects as announced by Ministry of Power, Viability gap funding for municipal corporations undertaking MSW projects under Swachh Bharat Mission (Mani, 2016).

However, these efforts are still minuscule in addressing the mammoth of solid waste management. Lack of funds, social apathy, poor planning and management and mixed waste are a few of the waste-associated challenges that still need focus and should be addressed appropriately (Vij, 2012).

5. Conclusions

Urbanisation in India has become a significant driver of municipal solid waste generation, with the country in the acceleration stage of urbanisation. It is generating large quantities of waste, increasing pressure on urban local bodies to manage it. The nationwide trend shows that municipal solid waste is increasing sharply, while collection systems are improving only marginally, leaving a persistent 40% gap in waste treatment. State-wise waste management performance also highlights that it is highly ineffective across the states. Some states have achieved 100 per cent collection and treatment efficiency, but most still fall short and require better, more scientific methods for processing and disposing of waste. The best practises highlight that, even though there are issues that need to be addressed, selected Municipal Corporations have performed better through decentralised planning by involving local communities. Use of technology, inclusion of public sector participation, various models in which door-to-door collection, zero waste wards, GPS-based monitoring, involvement of self-help groups, etc., can be used as models for replication across other cities. The paper also highlights that, although the government has introduced multiple policies, missions, and subsidies to strengthen municipal solid waste management, implementation gaps and inadequate funding have limited municipal capacity to manage the waste.

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