



## Solid Waste Management in India - Current Trends

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### Abstract

India faces significant environmental challenges as a result of waste generation and insufficient waste collection, transportation, treatment, and disposal. Current waste management systems in India are incapable of dealing with the volumes of waste generated by an expanding urban population, which hurts the environment and public health. The obstacles and challenges are significant, but so are the opportunities. Waste separation at the source, as well as the use of specialized waste processing facilities to separate recyclable materials, is critical. The disposal of the residual waste following material resource extraction necessitates the construction of engineered landfill sites and/or the investment in waste-to-energy facilities. This paper reports on various government initiatives, public health aspects on solid waste management, and current trends on solid waste management.

**Keywords:** Solid Waste Management; Landfill; Government Initiatives; Sustainability

### Introduction

Waste generation rates are increasing all over the world. In 2016, the world's cities generated 2.01 billion tonnes of solid waste, equating to a 0.74 kilograms per person per day footprint. Annual waste generation is expected to increase by 70% from 2016 levels to 3.40 billion tonnes in 2050 due to rapid population growth and urbanization.

Every year, India generates 62 million tonnes of waste. Approximately 43 million tonnes (70 per cent) are collected, with approximately 12 million tonnes being treated and 31 million tonnes being dumped in landfill sites. With changing consumption patterns and rapid economic growth, urban municipal solid waste generation is expected to reach 165 million tonnes by 2030 [1]. Because of its rapid industrialization, urbanization, and population growth, India has captured the world's attention. However, increased economic development has resulted in increased waste generation and consumption of natural resources, resulting in environmental degradation and pollution.

The issue of municipal solid waste management (MSWM) affects everyone on the planet, posing serious problems for public health and the environment. Solid waste management is critical in our community because it protects our household from the potentially hazardous effects of solid waste material through which we can protect our loved ones and the environment by properly disposing of the majority of these waste materials. MSWM has reached a tipping point in almost every region of the world, necessitating the development of MSW strategies for a sustainable environment. Most of the developed countries have achieved solid waste management (SWM) hierarchy and focus on 4 R's - Refuse, Reduce, Recycle and Re-use, whereas the developing countries are still struggling to achieve their target [2]. This paper reviews the government initiatives, challenges, actions, and opportunities available for proper biomedical waste management in Tamilnadu and India. It is the output from various guidelines and norms of the Pollution control board and biomedical waste management.

### MSWM classifications

Municipal solid waste (MSW) is classified into four categories: hazardous wastes, industrial wastes, agricultural wastes, bio-medical wastes.

### Statistics on solid waste generation

In 2015, urban India generated approximately 62 Mt of solid waste (450 g/capita/day). Approximately 82% of MSW was collected, with the remaining 18% being litter. Only 28% of the waste collected was treated, leaving the remaining 72% to be dumped openly. In major metropolitan cities, waste collection efficiency ranges between 70% and 95%, whereas in several smaller cities, it is less than 50%. According to 2021 census, total waste generated (Metric Tonnes/Day) are as follows.

S NO	States	Total waste generation (MT/D)	Percentage
1	Maharashtra	22401	15.93%
2	Tamil Nadu	12464	8.87%
3	Delhi	10823	7.70%
4	Gujarat	9228	6.57%
5	Karnataka	6158	4.38%
6	Andhra Pradesh	6063	4.31%
7	Bihar	4734	3.37%
8	Kerala	2400	1.7%
9	Chhattisgarh	1650	1.1%
10	Meghalaya	1	0%
Total average of 35 states	= 1,40,557 metric tonnes/day		

**Table 1**

Maharashtra generates the highest, at 22,401 MT per day (from 6,451 wards), while Meghalaya generates the lowest, at 1 MT per day (from 123 wards). Amongst the Union Territories (UTs), Delhi generates the highest amount of waste, at 10,823 MT per day.

### Infrastructure development and SWM

Rapid population growth in India has resulted in natural resource depletion. Wastes are potential resources, and effective waste management combined with resource extraction is critical

to effective solid waste management. Value extraction from waste can be in the form of materials, energies, or nutrients, and this can provide a living for a large number of people. The goal of future India should be to convert waste into energy while adhering to sustainable development goals [3].

### Aspects of public health concerns regarding solid waste management

Unmanaged waste, particularly excreta and other liquid and solid waste from households and the community poses a serious health risk and contributes to the spread of infections such as skin and blood infectious and chronic diseases. Mixing industrial hazardous waste and municipal waste can expose people to chemical and radioactive hazards; Intestinal infections are more common since it gets transmitted by flies feeding on the waste. Air pollution is caused by improperly operated incineration plants and improperly managed and designed landfills that attract all types of insects and rodents that spread disease. Eye and Respiratory infections are more common in landfill operations. The plague outbreak in Surat is an excellent example of a city suffering as a result of the local government's callous attitude toward maintaining city cleanliness.

Certain chemicals such as cyanides, mercury, and polychlorinated biphenyls, are highly toxic if released untreated and can cause disease or death. Some studies have found an increase in cancer in residents who have been exposed to hazardous waste.

### Plastic and its impact on health

The unsanitary use and disposal of plastics, as well as their effects on human health, have become a source of concern. Colored plastics are hazardous because their pigment contains toxic heavy metals. Copper, lead, chromium, cobalt, selenium, and cadmium are some of the hazardous metals found in plastics. Color plastics are legally prohibited in the majority of industrialized countries. The growing amount of plastic waste is posing a significant challenge and is a major contributor to environmental degradation. India generates 26,000 tonnes of plastic waste per day (TPD) or 9.4 million tonnes per year.

### Medical waste management

Healthcare waste includes waste generated by healthcare facilities, laboratories, and research related to medical procedures, out of which 75% to 90% are compared to domestic waste (non-

hazardous), and the remaining 10% to 25% is considered as "hazardous waste" and poses health risks. Disposal of health-care wastes requires special consideration because it can result in serious health risks, such as Hepatitis B and C, through wounds caused by discarded syringes. Rag pickers and others who scavenge in the waste dump for recyclable items may sustain injuries and come into direct contact with these infectious items and are more vulnerable.

### COVID 19 and BMW

The COVID-19 pandemic has caused a global health crisis, as well as numerous effects on the environment, economy, and society. It has posed several challenges to BMW's existing regulations and management practices around the world. According to the Central Pollution Control Board Annual Report- 2018, 28 Indian states have made arrangements for the environmentally safe disposal of BMW. These states have 200 authorized Common Bio-medical Waste Treatment and Disposal Facilities (CBWTFs), while the remaining seven states (Goa, Andaman and Nicobar Islands, Arunachal Pradesh, Lakshadweep, Mizoram, Nagaland, and Sikkim) do not [4].

### Bio medical waste management in Tamilnadu

According to Central Pollution Control Board (CPCB) Delhi, it was estimated that Tamil Nadu generated 6.41 tons/day in July 2021, followed by 4.60 tons/per day, 4.14 tons /day, 3.49 tons/day, 3.17 tons/day, and 2.62 tons /day of biomedical waste in the consecutive months of 2021 during COVID 19 pandemic. The state has 10 Common Bio-medical Waste Treatment and Disposal Facilities (CBWTFs). Under the rules, the TNPCB has so far authorized 25426 private and government hospitals in the state. All of these hospitals have reached an agreement with the CBMWTF to collect, transport, treat and dispose of biomedical waste scientifically. The CBMWTF is made up of an autoclave; a shredder, an incinerator, and secure landfill facilities. In Tamil Nadu, there are ten CBMWTFs in operation. These facilities handle 35 tonnes of bio-medical waste per day on average. WHO estimated that among 5, 47,000 Covid 19 cases in Tamilnadu, 481 tons of BMW were generated (1.49 kg/day). Treatment of biomedical waste includes incinerator, plasma pyrolysis, autoclave, hydroclave, microwave, shredders, sharps encapsulation, deep burial pits, and effluent treatment plant.

### Overviews on biomedical waste management

The study conducted in Chennai city revealed that medical waste management has received insufficient attention in both private and

public hospitals, resulting in insufficient and inefficient isolation, collection, transportation, and storage of biomedical waste. This study concluded and recommended to ensure improvement and adequacy in medical waste management practices; the Ministry of Health should pay more attention to policies for waste disposal and proper management. Furthermore, regular worker training, continuing education, and management evaluation processes for systems and personnel are required [5].

According to a study conducted by WHO, in four Indian states (West Bengal, Bihar, Uttarakhand, and Jharkhand), 72 per cent of hospital wastes are not segregated, and 74 per cent of hospitals are not connected to any CBWTF [6].

According to the Assocham-Velocity MR report, the major challenges in BMW management in India are under-reporting of waste generated and handling capacities, the operation of healthcare facilities without authorization, and a lack of awareness among those involved in BMW handling at various levels [7].

During the pandemic, a study in Bhutan identified a lack of healthcare worker capacity and a lack of implementation of national guidelines as major shortcomings in the proper management of BMW [8].

A study in Saudi Arabia found that healthcare workers are aware of the necessary safety precautions but have limited knowledge of waste management procedures in their healthcare facilities [9].

### Government initiatives

The Government of India (GOI) enacts a variety of SWM-related acts, rules, and regulations. The Municipal Solid Waste (Management and Handling) Rules, 2000 are the most important piece of Legislation. State and central governments are also responsible for resolving MSWM issues in India. With the increase in population over the last few decades, the waste management issue has become more pressing. The government has delegated roles and responsibilities to various ministries, boards, departments, and local governments to improve municipal solid waste management. Swachh Bharat Abhiyan, Swachhata app, Mahatma Gandhi Swachhata Mission, Swachhata Helpline, and Swachhata Survekshan are some major initiatives and activities that have been launched to engage the public and bridge the gap between the public and local bodies or governments [10].

**Evolution of waste management in India: [11]**

Year	Policies/Schemes/Rules/Acts
1989	The Hazardous Waste (Management and Handling) Rules
1994-95	Strategy Paper on MSW Management by NEERI
1998	Bio-medical Waste Handling Rules, 1998
2000	MSW (Management and Handling) Rules, 2000
2005	Report of The Technology Advisory Group on SWM 2005
2006	Strategy and action plan-use of compost in cities
2008	National Urban Sanitation Policy
2009	E-waste handling Rules-Draft document
2010	National Mission on Sustainable Habitat
2011	E-waste Rules, 2011 and Plastic Waste Rules, 2011
2013	Draft Municipal Solid Waste Rules-2013
2014	Draft Manual on Municipal SWM and Handling
2014	Swachh Bharat Mission (CIM-Clean India Mission)
2015*	(AMRUT) Atal Mission for Rejuvenation and Urban Transformation
2016*	SWM (Solid Waste Management and Handling) Rules, 2016 (revised) published

**Table 2**

The Ministry of Environment, Forest and climate change [MoEFCC] also updated the Plastic Waste Management Rules of 2016, which are now known as the Plastic Waste (Amendment) Rules of 2018. The amendments outline the challenges and opportunities for plastic waste collection, segregation, and recycling, as well as policy and administrative interventions. The amendment includes three significant changes [12].

To manage with regular assessment/monitoring, the Government of India recently revised/developed separate rules for construction and demolition waste, e-waste, and other hazardous waste. In some areas, the implementation of user fees, as well as a penalty and reward system, may be beneficial in promoting an effective SWM system. Furthermore, the incorporation of advanced techniques such as GIS/remote sensing, the internet of things (IoT), and an education information and communication (IEC)-based system could aid in quickly sensitizing citizens. MSWM could lead to success, increased energy, material demand, and profit for India in the future as a result of the involvement of private

stakeholders, NGOs, and self-help groups, as well as the integration of all respective departments [13].

**Swachha Bharat mission**

Urban (SBM-U): With the implementation of new rules, it began the door-to-door collection, source segregation, and other initiatives.

**Waste-to-energy promotion**

The Ministry of New and Renewable Energy (MNRE) launched the Program on Energy from Urban, Industrial, Agricultural Waste/Residues, and Municipal Solid Waste to encourage the establishment of Waste-to-Energy projects and to provide central financial assistance.

**Compost banao, compost apnao campaign**

A multi-media campaign launched by MoHUA on waste-to-composting under SBM- (U). The goal is to encourage people to compost their kitchen waste for use as fertilizer and to reduce the amount of waste that ends up in landfills [14].

The Bio Medical waste management [BMW] 1998 rules were changed in the years 2000, 2003, and 2011. Because of a lack of agreement on categorization and standards, the draught of BMW rules 2011 remained a draught and was not notified. In March 2016, the Ministry of Environment, Forestry, and Climate Change amended the BMW rules. These new rules have expanded coverage, simplified categorization and authorization, and improved segregation, transportation, and disposal methods to reduce environmental pollution. It consists of four schedules, five forms, and eighteen rules [14]. Strict rules have been implemented to ensure that no recyclable items are pilfered, that no secondary handling occurs, and that no animals scatter or spill during transport from the HCFs to the common BMW treatment facility (CBMWTF).

**Problems encountered**

The current state of SWM in India has improved slightly, but the most appropriate waste collection and disposal methods are still not being used. There is a lack of SWM training, and qualified waste management professionals are scarce. A lack of environmental awareness, combined with a lack of motivation, has also played a role. The public's attitude toward waste is also a major barrier to improving SWM in India. The public's

perception of the solid waste management system is characterized by irregularities and inefficiencies in the waste collection system. The separation of waste at the source is a significant challenge for Indian municipalities. The social taboo of waste and its associated groups, mostly of the societies marginalized, must be addressed prominently. To develop a waste management system, citizens must be made aware of its importance. The environmental and health impacts of SWM must be addressed and assessed in the context. A significant amount of money has already been spent, with no proper assessment or development plan in place. Government policies and implementation are ineffective; only a few municipalities have been able to develop an effective mechanism for a door-to-door collection system.

### Bio medical waste management

Lack of funds will be one of the most difficult challenges that government hospitals and small HCFs will face during the implementation of BMW 2016 rules. The cost of phasing out chlorinated plastic bags, gloves, and blood bags, as well as establishing a bar code system for bags/containers, will be high, and the time frame for doing so, two years, is too short. There are currently 198 CBMWTF in operation in India, with another 28 under construction. There is an urgent need for the rapid development of many more CBMWTFs to meet the treatment and disposal needs of all BMW generated in India. Incinerators produce toxic air pollutants, and incinerator ash has the potential to be hazardous.

### Impact of COVID 19

Household generation of biomedical waste has more than tripled during COVID 19 breakout, from around five tonnes per day before March to 16-17 tonnes now across the Greater Chennai Corporation's 15 zones. However, only one-third of it is processed at the Manali incineration plant, which posed a significant threat due to improper biomedical waste handling. The majority of healthcare workers are unaware of the safety precautions and disposal of medical waste in their respective categories. The majority of hospitals are not affiliated with CBWTF.

### Innovation and opportunities within the SWM sector

- **Smart waste management:** Digitization in waste collection and disposal operations will result in improved data quality and better insights into waste streams during operations, real-time collection and transportation monitoring, and an efficient assessment mechanism.

- **Public-Private Partnerships:** To create effective programs, ULBs and city planners should collaborate with private trash and recycling companies.
- **New concepts:** Innovations along the lines of the South Korean city of Songdo, where all household waste is sucked directly from individual kitchens through a vast underground network of tunnels to waste processing centers, where it is automatically sorted, deodorized and treated.
- Smart Waste Corporation, or SWC, provides every home with a set of three 'smart' garbage cans for free. Organic waste goes in the green can. The blue can accept recyclables such as paper, plastics, and metals. A third, orange can is set aside for non-recyclables such as leather, thermocol, or synthetic rubber. These are SIM-enabled cans that provide SWC credits or cash for each kilo of garbage dropped off.

### Conclusion

Despite its potential, waste is still regarded as a problem by Indian municipalities. With a high population density, this becomes more difficult if waste is not segregated at the source. India, as a developing country, faces significant challenges in terms of MSWM. The social taboo and citizens' attitudes toward solid waste management must be changed. Municipalities must work long and hard to achieve the concept of effective solid waste management. Because the composition of Indian waste differs from that of other developed countries, the strategies used cannot be the same. Recycling and waste processing must be integrated more efficiently. As a result, resourceful solid waste is separated at the source, such as wet waste for compost/biogas generation and dry waste for energy plants, RDFs, recycling, and reuse. With proper planning and use of resources made available by the Indian government, the Indian government has initiated many good activities and initiatives that may improve SWM practice in India and reduce MSWM problems in India. The Indian government is performing admirably.

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