## SOLID WASTE MANAGEMENT

## STUDY REPORT

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### Executive Summary: Solid Waste Management

**Overview:**  
Solid waste management (SWM) is the process of collecting, transporting, processing, recycling, or disposing of waste materials generated by human activity. Effective SWM is critical for public health, environmental sustainability, and economic growth. With urbanization, population growth, and increasing consumerism, the amount of solid waste produced globally continues to rise, making efficient waste management a top priority for governments, businesses, and communities.

**Key Challenges:**

1. **Volume of Waste:** Rapid urbanization, increased consumption, and a growing global population contribute to escalating waste production. In 2020, the world generated approximately 2.01 billion metric tons of municipal solid waste, with projections suggesting a rise to 3.4 billion metric tons by 2050.
2. **Environmental Impact:** Improper waste management leads to environmental pollution, including contamination of soil, water, and air. Plastics, electronic waste, and other non-biodegradable materials exacerbate this issue.
3. **Waste Diversion and Recycling Rates:** Many regions struggle with low recycling rates, limited infrastructure, and a lack of public awareness, leading to inefficient recycling systems and high landfill dependence.
4. **Economic Costs:** Poor waste management practices can have significant economic implications, including increased costs for landfills, waste collection, and environmental cleanup, as well as lost economic opportunities in the recycling and reuse sectors.

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### 1. **Waste Generation and Composition**

**Waste Generation:** Waste generation refers to the quantity of solid waste produced by human activities, typically measured in tons or kilograms per capita per year. The volume of waste generated varies significantly based on factors such as population size, economic activity, urbanization, and consumption patterns.

In 2020, global municipal solid waste (MSW) generation reached approximately **2.01 billion metric tons**. This figure is projected to increase by over **70%** by 2050, reaching around **3.4 billion metric tons** due to factors such as:

* **Population Growth:** The global population is expected to rise from approximately 8 billion in 2023 to over 9.7 billion by 2050, leading to higher waste production.
* **Urbanization:** As more people move to urban areas, waste generation in cities increases. Urban areas typically produce much more waste per capita compared to rural areas due to higher consumption patterns.
* **Economic Growth:** Economic development, especially in emerging economies, often leads to increased production, consumption, and consequently, more waste generation.
* **Consumerism and Disposable Goods:** Increased reliance on single-use plastics, packaging, and electronics has contributed to the growing amount of waste, particularly in high-income countries.

Waste Generation Rates:

* High-income countries: On average, 1.5 to 2.5 kg of waste per person per day.
* Middle-income countries: 0.8 to 1.5 kg per person per day.
* Low-income countries: 0.3 to 0.8 kg per person per day.

These figures highlight the disparity in waste production between wealthier nations, where consumption-driven waste is higher, and lower-income nations, where waste generation is comparatively lower due to limited purchasing power and less disposable packaging.

**Composition of Solid Waste**

The composition of municipal solid waste (MSW) refers to the different types of materials that make up the total waste stream. The composition of waste varies based on geographic region, economic conditions, and local waste management systems. However, there are common trends that are seen globally, with some variations depending on urban vs. rural settings, climate, and cultural practices.

### 2. **Current Waste Management System**

Waste management in India is a growing concern due to rapid urbanization, population growth, and increasing consumption. The waste management system in India is largely decentralized, with responsibilities shared between the central government, state governments, municipal corporations, and private entities. The system, however, faces challenges such as inadequate infrastructure, lack of awareness, inefficient segregation, and limited waste processing facilities. Here’s a broad overview of how waste management works across the country, with some insights into Pune's role:

1. **Waste Generation and Types**

India generates a significant amount of waste, which can be broadly categorized into:

* **Municipal Solid Waste (MSW)**: This includes household waste, market waste, and waste from commercial and institutional sources.
* **Industrial Waste**: Generated by manufacturing industries.
* **Biomedical Waste**: Waste from hospitals, clinics, and medical facilities.
* **E-Waste**: Waste generated from discarded electronic products.
* **Construction and Demolition Waste**: Debris from building projects.
* **Plastic Waste**: A major concern due to its non-biodegradable nature.

The average per capita waste generation varies widely between cities, but on a national scale, it's estimated that India produces around 62 million tons of solid waste annually.

1. **Waste Collection and Segregation**

In most urban areas, waste is collected through municipal or private contractors. However, the collection systems are often fragmented and lack uniformity. Some key points:

* **Door-to-Door Collection**: In cities, waste is usually collected through door-to-door services or community bins.
* **Segregation**: Segregation at source (i.e., separating dry and wet waste) is mandated in many municipalities, but this practice is not universally followed. Awareness and compliance are still low in some areas.

1. **Waste Processing and Disposal**

The waste generated in India is either processed, recycled, or disposed of in landfills or dumpsites. The level of processing varies:

* **Recycling**: India has a large informal recycling sector that processes a significant amount of waste, particularly plastic and paper. However, this sector operates without proper safety standards or oversight.
* **Waste-to-Energy (WTE)**: Some cities have implemented WTE plants to convert waste into electricity, but the capacity is limited.
* **Composting**: Organic waste (wet waste) is often composted, but large-scale composting facilities are few.
* **Landfills**: Many cities rely on landfills, which often face issues like overcapacity, environmental degradation, and leachate contamination. The closure and remediation of old landfills are also significant challenges.

1. **Government Policies and Regulations**

The Indian government has introduced various policies to manage waste more effectively:

* **Swachh Bharat Mission (SBM)**: Launched in 2014, SBM aims to clean urban and rural areas, improve waste management, and reduce open defecation.
* **Plastic Waste Management Rules (2016)**: These rules aim to phase out single-use plastics, encourage recycling, and set standards for plastic waste management.
* **Solid Waste Management Rules (2016)**: These rules lay down guidelines for waste segregation, collection, processing, and disposal.

The enforcement of these regulations, however, is often inconsistent across regions.

1. **Challenges in Waste Management**

Several challenges hinder effective waste management in India:

* **Lack of Infrastructure**: Many cities lack adequate waste processing facilities, waste segregation infrastructure, and recycling plants.
* **Public Awareness**: Public awareness about waste segregation and responsible disposal is still low, especially in smaller towns and rural areas.
* **Informal Sector**: A large proportion of waste is handled by informal workers who lack proper training, safety measures, and integration into formal systems.
* **Inadequate Funding**: Municipalities often struggle with limited funding for waste management programs.
* **Landfill Overflow**: Many cities, including major ones like Delhi, Mumbai, and Bengaluru, face overflowing landfills, which create environmental and health hazards.

### 3. **Key Challenges**

Despite significant efforts, Pune faces several challenges in managing its solid waste effectively:

* **Insufficient Segregation**: A significant portion of waste is still not segregated at source, which complicates recycling and composting efforts.
* **Overburdened Landfills**: The existing landfills in Uruli Devachi and Phursungi are reaching their capacity, leading to environmental concerns, including leachate and methane gas emissions. The lack of space for new landfills is a growing challenge.
* **Lack of Public Awareness**: Despite campaigns, awareness around the importance of segregation and reducing waste remains limited in many parts of the city.
* **Inadequate Infrastructure**: Pune's waste processing infrastructure (for composting, recycling, and waste-to-energy) is still underdeveloped, limiting the city's ability to handle the growing waste stream efficiently.
* **Informal Sector Dependence**: The informal waste sector, including ragpickers, plays a crucial role in waste segregation and recycling. However, they lack recognition, protection, and training, which limits the efficiency and safety of their work.

### 4. **Ongoing Initiatives and Solutions**

 **Swachh Bharat Mission (SBM)**: Promotes cleanliness, waste segregation, and sanitation through awareness campaigns and door-to-door collection.

 **Solid Waste Management Rules (2016)**: Mandates waste segregation, recycling, and processing to reduce landfilling, with an emphasis on source separation.

 **Plastic Waste Management Rules**: Bans single-use plastics and promotes recycling and producer responsibility to reduce plastic waste.

 **Waste-to-Energy (WTE) Projects**: Converts non-recyclable waste into energy to reduce landfill waste and generate power.

 **Decentralized Waste Processing**: Encourages local composting and recycling initiatives to process waste at the community level, especially organic waste.

 **Extended Producer Responsibility (EPR)**: Holds producers accountable for managing waste from their products, especially plastics and electronics.

 **Awareness Campaigns**: Initiatives like “I Clean India” and local workshops to increase public participation in waste segregation.

 **Recycling Initiatives**: Focus on improving recycling rates by formalizing the informal sector and promoting waste segregation for recycling.

### 5. **Future Recommendations**

 **Strengthen Segregation at Source**: Enforce stricter segregation rules and provide better incentives for citizens to separate wet, dry, and hazardous waste from the outset.

 **Expand Recycling Infrastructure**: Invest in more recycling plants and formalize the informal recycling sector to increase recycling rates, especially for plastics and e-waste.

 **Enhance Waste-to-Energy Projects**: Scale up waste-to-energy plants and explore more efficient technologies for converting waste into usable energy.

 **Promote Public-Private Partnerships**: Encourage collaboration between municipalities, private companies, and NGOs to improve waste collection, processing, and recycling infrastructure.

 **Increase Producer Responsibility (EPR)**: Strengthen EPR regulations to make manufacturers accountable for managing the waste generated from their products, especially plastics.

 **Boost Awareness and Education**: Continue public education campaigns to foster better waste management practices and increase community participation.

 **Improve Landfill Management**: Focus on reducing landfills, improving waste processing, and ensuring proper closure and remediation of existing landfills.

 **Innovate with Technology**: Invest in smart waste management solutions like sensor-based bins, data analytics for waste tracking, and AI-based recycling technologies.

### 6. **Conclusion**

Pune's solid waste management system is evolving, but significant challenges remain, especially with regard to waste segregation, landfill management, and infrastructure capacity. However, the city has made strides in promoting waste reduction, recycling, and composting initiatives. By continuing to invest in waste processing technologies, expanding public awareness, and enhancing stakeholder collaboration, Pune can build a more sustainable and efficient waste management system that can cope with its growing urban population.

Effective solid waste management will not only improve public health and environmental conditions but will also contribute to Pune's goal of becoming a more sustainable and livable city.