

Sustainable Solid Waste Management Practice in Rural Areas: A Study of Kamshet, Maharashtra

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Abstract

Kamshet is a rapidly developing town with a population of approximately 20,000 and serves as a major tourist place as well as a central workplace for nearby areas. Because of major connectivity from the national highway and railway station, increasing tourism activities, population growth, and urbanization, the town is facing significant challenges related to solid waste management. The existing scenario reveals the inadequate management and disposal of solid waste in the town. It includes illegal dumping along roadsides and open burning of waste by residents and the local authorities. The primary aim of this study is to create awareness among local communities and authorities regarding sustainable solid waste management and to recommend scientific methods for managing waste at different levels of the town. The objective involves examining current waste generation, classification, and waste management practices for the case of Kamshet, and understanding scientific, sustainable waste management methods and practices applied in similar cases at different stages, such as house, neighborhood, and town. The methodology involves primary and secondary data collection from the study of government documents and policies related to solid waste management, identification of relevant government schemes, and analysis of existing case studies of similar scale. The scope of the research deals with sustainable solid waste management, including municipal waste segregation and public awareness. The research does not introduce financial aspects of the study. The study concludes by recommending suitable scientific and sustainable solid waste management methods that can be effectively implemented in Kamshet, contributing to improved environmental conditions and securing the natural landscape of the town for sustainable rural development.

Keywords: Sustainable solid waste management, urbanization, sustainable development, waste segregation, Non-biodegradable plastics

INTRODUCTION

The rapid transformation of semi-urban regions and small towns has created a complex solid waste management crisis. While these areas experience economic growth, they often lack the infrastructure to handle the shift from organic rural waste to modern, non-biodegradable materials, such as plastic and electronics [1]. Waste generation rates are surging, yet Urban Local Bodies (ULBs) frequently struggle with limited budgets and a lack of technical expertise to manage the load.

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When formal collection systems fail, illegal dumping becomes a common but dangerous alternative, with waste accumulating in open plots and water bodies [2]. This leads to severe environmental impacts: decomposing waste produces methane, potent greenhouse gas, and leachate, a toxic liquid that infiltrates groundwater supplies.

Furthermore, the frequent open burning of these dumpsites releases carcinogens into the air [3].

Without immediate intervention focused on source segregation and empowered local governance, these transitional towns risk permanent ecological damage and public health crises. Reversing this trend requires moving beyond simple disposal towards a circular economy that treats waste as a resource rather than a burden.

Sustainable Solid Waste Management

Sustainable solid waste management focuses on reducing production, optimizing resource recovery, and minimizing environmental damage through integrated approaches. By reducing pollution, saving resources, and promoting circular economies, it promotes international objectives such as the UN Sustainable Development Goals [4].

Urbanization

India's rapid urbanization refers to the transformation of rural areas and small towns into modern urban centers, accompanied by improvements in living standards, housing and public spaces, infrastructure, connectivity, and employment opportunities.

Sustainable Development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This definition was introduced by the Brundtland Commission and subsequently endorsed multilaterally at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992.

Waste Segregation

Waste segregation is the process in which solid waste is segregated into different categories, such as biodegradable, non- biodegradable, dry, and wet waste, and hazardous waste.

Case Scenario

Kamshet serves as a critical node in the Pune district, positioned on the Old Mumbai-Pune Highway (NH 48). Its proximity to Lonavala and status as a world-renowned paragliding destination transforms its waste profile from traditional rural to commercial urban [5].

- *Connectivity hub:* Major intersections of state highways, a busy railway station, and a bus stop.
- *Topography:* Surrounded by a sensitive ecosystem, the Western Ghats, and the Indrayani River, making waste management an ecological threat.
- *Population:* Kamshet is a rapidly developing hub with a population of 25,000 that serves as a vital commercial lifeline for its residents and numerous neighboring villages.

The town's economy is a diverse mix of traditional agriculture, a sprawling retail sector including textile and grocery markets, and small-scale industrial operations. Additionally, its position along the highway has fostered a busy hospitality sector of hotels and restaurants. However, this varied economic activity generates a massive and complex stream of daily waste that currently lacks a formal management system, leading to significant environmental challenges for the region [6].

Existing Scenario of Solid Waste Management of Kamshet

Kamshet, a strategically located town within the ecologically sensitive Western Ghats, is currently undergoing a volatile transition from a rural society to a rapidly urbanizing center. This shift has triggered a "waste-infrastructure gap," where the current population of 25,000 is projected to surge to 35,000 by 2030, out-pacing the local government's capacity to manage its metabolic output. Currently, the town generates 10 tons of municipal solid waste (MSW) daily and lacks a scientific disposal mechanism. Although door-to-door collection is active, the absence of source segregation renders the process inefficient, as high-moisture organic waste is integrated with non-biodegradable plastics and construction and demolition (C&D) debris [7].

The environmental consequences are severe, as waste is subjected to uncontrolled open dumping due to a critical lack of designated land and processing facilities. This crisis is compounded by a low level of civic awareness, leading to illegal disposal on roadsides and sensitive riverbanks, threatening the local watershed. Historically, Kamshet's waste was predominantly biodegradable and manageable; however, increased connectivity and inward migration have introduced modern consumption patterns that the current system cannot sustain. Without immediate intervention in the form of decentralized processing and a strategic waste management policy, Kamshet faces an imminent environmental breakdown that could compromise the biodiversity of the surrounding highland ecosystem [8].

DATA COLLECTION

Solid Waste Management Government Initiatives

Swachh Bharat Mission (SBM) 2.0

Rural/Grameen (SBM-G Phase II): Aimed at achieving *open defecation free (ODF) Plus (explain)* status for all villages. This involves establishing community compost pits and plastic waste management units at the block level.

Swachh Survekshan

SSG is the world's largest rural sanitation survey, conducted by the Department of Drinking Water and Sanitation (DDWS), Ministry of Jal Shakti [9].

The ranking of Districts and States is determined by four main components:

Compost Banao, Compost Apnao

Compost Banao, Compost Apnao (Make Compost, Adopt Compost) is a multimedia awareness campaign launched under the Swachh Bharat Mission to promote the conversion of kitchen waste into organic manure. While the campaign originated in the urban sector, it has become a central pillar of SBM-Grameen Phase II (2020–2026) as part of the push for solid waste management in villages.

Promotion of Waste-to-Energy

Galvanizing Organic Bio-Agro Resources Dhan (GOBARdhan) is the flagship program for rural wet-to-energy. It converts cattle dung, agricultural residue, and kitchen waste into energy.

CASE STUDY

Vengurla, Maharashtra

Process of waste management in Vengurla:

1. *Generation:* Vengurla generates seven tons of waste every day. While 2-2.5 tons are wet waste, the rest is dry. An additional 4-5 tons are generated by a nearby village daily.
2. *Segregation:* Every household segregates waste into wet, dry, and hazardous; some even separate the dry waste into different categories. Public dustbins have four components.
3. *Transportation:* Five vehicles from the municipality collect waste every day from the entire town and transport it to the Swachh Bharat Park for processing.
4. *Processing:* Energy is generated from wet waste through a biogas plant. Approximately 100 cum of biogas is produced and used to run machines to process the waste on-site.
5. Dry waste is segregated into 19 categories and recycled.
6. 100 kg of slurry is produced, which is used to make compost.
7. Water is recycled on-site.
8. Low-grade plastic is shredded and used to build roads. 12 km of roads in Vengurla are made from this plastic.
9. Disposal of non-biodegradable, non-recyclable waste is co-processed in a cement company.
10. A small fraction of waste is stored at a designated site in the facility as it is inert.

The Ambikapur Model (Chhattisgarh)

Ambikapur is the benchmark for decentralized waste management in India. While the city has grown,

its core "SLRM" model was designed to be replicable for small municipal councils. Solid Liquid Resource Management (SLRM) Centers. Instead of one massive dumping ground, the town is divided into small sectors, each with its own SLRM center.

The entire system is managed by women's self-help groups (SHGs). They handle door-to-door collection using battery-operated tricycles.

- *Zero landfill*: Waste is sorted into a staggering 156 categories.
- *Organic*: Composted or used for biogas.
- *Inorganic*: Sold to recyclers.
- *Garbage cafe*: A unique initiative where the municipal corporation provides free meals to the poor/ragpickers in exchange for plastic waste [10].

The Alappuzha Model (Kerala)

Alappuzha (Alleppey) shifted to a 100% decentralized model after its central landfill was shut down due to public protests.

Processing at Source

The municipality discourages the centralized collection of wet waste. Instead, they provide subsidized pipe-composting units and biogas plants to individual households.

For those without space (apartments/shops), "Thumburmuzhi" aerobic composting bins are placed at street corners. These are aesthetically designed and do not smell, making them socially acceptable. By not transporting wet waste (which is 70% of the weight), the town saved massive amounts on fuel and vehicle maintenance [11].

ANALYSIS

Issues and Challenges Observed Related to Solid Waste Management in the Case of Kamshet

The main issue with how waste is handled right now is that the systems for picking up, sorting, and recycling trash are simply not good enough. Because the infrastructure is so weak, people end up dumping household, business, and construction waste in places they should not. This creates a huge mess and wastes materials that could have been reused. This poor disposal does not just look bad; it is dangerous. It pollutes our air, soil, and water. When we use open or dirty landfills, they can poison our drinking water and spread serious diseases.

- Illegal dumping of solid waste in nearby areas, roadsides, riverbanks, and open ground.
- Lack of awareness of solid waste management (SWM) in both the community and local authorities.
- Lack of sustainable SWM technologies and policies.
- The system suffers from a deficiency in monitoring waste (Figure 1) collection, material recovery, and electronic waste disposal.
- No segregation of waste at household, neighborhood, and town levels. Inadequate segregation techniques.
- No composting systems are being used at household level.
- Migration of laborers is due to scope for construction-related job opportunities.
- More amount of single-use plastic waste from shops, and households.

RECOMMENDATIONS

Sustainable Solid Waste Management Techniques and Strategies for the Case of Kamshet

Study of Sustainable Solid Waste Management

- Identify different types of waste and determine suitable locations for waste treatment and disposal facilities.
- Adopt sustainable technologies for waste treatment, recovery, and recycling.

- Promote sustainable solid waste management (SWM) practices at the individual and household levels, such as home composting of biodegradable waste using techniques including vermicomposting, aerobic composting through the pit method, chamber method, and NADEP method (Figure 2).
- Explore and implement waste-to-energy technologies for the conversion of suitable waste streams into useful energy.
- Rehabilitate, manage, and scientifically assess existing dumpsites.
- Ensure strict compliance with applicable waste management rules and regulations, with appropriate enforcement actions against non-compliance.
- Promote public awareness of sustainable SWM practices.
- Increase public awareness of the health, environmental, and economic impacts associated with improper SWM (Figure 3).

Illegal Waste Dumping Areas

Awareness-Government Initiatives

- Swachh Bharat Mission (Gramin)
- Swachh Survekshan
- Compost Banao, Compost Apnao Campaign
- Promotion of Waste-to-Energy

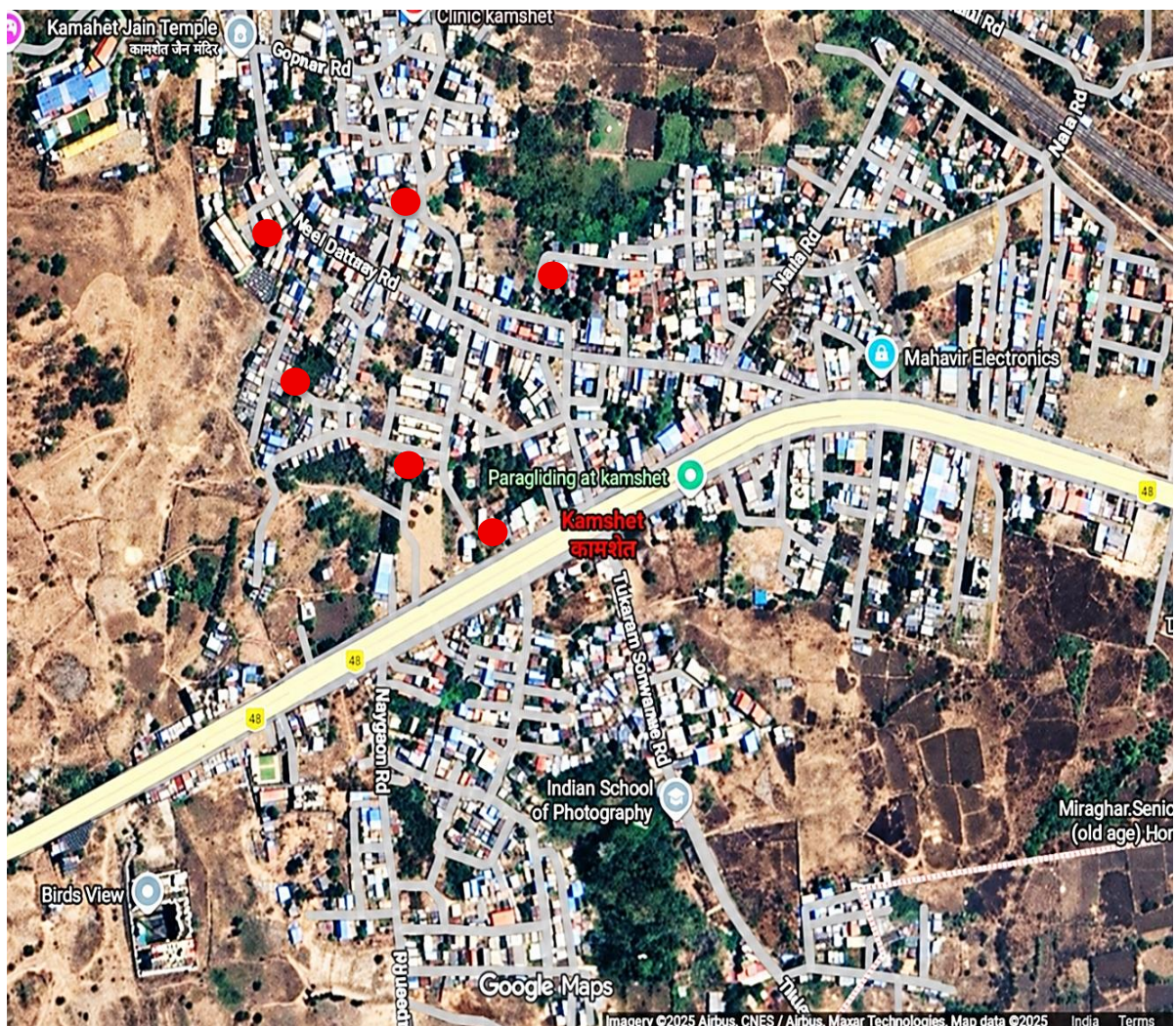


Figure 1. Locations of illegal dumping of waste.



Figure 2. Illegal waste dumping.



Figure 3. Illegal waste dumping.

CONCLUSION

Kamshet's rapid urbanization, growing tourism, and improved connectivity have intensified solid waste generation beyond the capacity of its existing management system. The absence of source segregation, scientific processing, and public awareness has led to illegal dumping, open burning, and environmental degradation, particularly in ecologically sensitive areas. This study highlights the urgent need for sustainable and decentralized SWM practices. By adopting household level composting, community-based treatment systems, strict rule enforcement, and awareness programs supported by government initiatives such as Swachh Bharat Mission, Kamshet can move toward a zero-waste approach. Implementing these measures will improve environmental quality, public health, and ensure the sustainable development of the town.

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