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Waste Management in Malegaon: Environmental and Administrative Perspectives

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Abstract: ***This study reviews 50 published works on solid waste management (SWM), focusing on their methodological and technological foundations. The findings highlight that while research has contributed significantly to assessing the environmental impacts of poor waste management practices, developing countries continue to face unique and complex challenges. Globally, SWM is becoming an increasingly critical issue due to rapid urbanization, shifting consumption patterns, and rising health and environmental risks. In industrialized nations, systems - based approaches and engineered solutions have supported effective waste management since the 1960s. However, in developing countries, including India, the SWM sector still largely relies on collection and disposal, with minimal focus on waste segregation, recycling, or treatment. The case of Malegaon City exemplifies these issues. Here, the municipality's waste management approach is limited to basic collection and disposal. Decomposable waste is treated via vermicomposting, but non - decomposable waste is neither processed nor managed sustainably. Moreover, there is no systematic waste segregation at the source, and waste from households, industries, hospitals, and commercial establishments is disposed of at common sites. Revenue generation from waste remains an untapped opportunity. These gaps highlight the need for integrated and sustainable SWM practices tailored to the socio - economic realities of developing urban centres like Malegaon.***

Keywords: Solid Waste Management, Urban Environment, Municipal Governance, Sustainability, Developing Cities

1. Introduction

Solid Waste Management (SWM) refers to the systematic control of the generation, storage, collection, transportation, processing, and disposal of solid waste in a manner that safeguards public health and the environment. SWM practices vary depending on the source, residential, industrial, commercial, or institutional—and also differ between urban and rural areas, as well as between developed and developing countries. Waste is commonly categorized by its composition, such as organic waste, plastics, paper, metals, and glass, or by its source, including domestic, industrial, and construction waste. Effective SWM is essential to reduce environmental pollution and promote sustainable urban development.

1.1 Necessity

Solid waste management is a major challenge for Malegaon city, which has a population of around 7.31 lakh (2021) and generates approximately 168 tonnes of waste daily. This study focuses on analyzing waste generation, its physical and chemical characteristics, collection and transport systems, and current disposal practices. The city faces severe issues due to inefficient handling by the private agency responsible for waste management. At present, 28 acres of dumping land is used, which is proving insufficient. Therefore, identifying sustainable and scientific disposal methods that aim for zero waste dumping is critical. Moreover, the study explores potential revenue generation opportunities for Malegaon Municipal Corporation through two approaches: utilizing biodegradable waste for compost or biogas and recycling non - biodegradable waste like plastics and metals. Effective implementation of waste segregation, public participation, and modern technologies can significantly improve solid waste management and reduce the environmental burden on the city.

2. Objectives

Solid waste management in Malegaon city faces major challenges due to outdated systems and insufficient municipal provisions. This seminar aims to study waste generation, its physical and chemical composition, collection, transportation, and disposal methods to identify gaps and suggest sustainable solutions for improving overall waste management efficiency in the city. The basic objectives are as follows:

1) To analyze the rate of solid waste generation in Malegaon city.
2) To examine the physical and chemical characteristics of the waste produced in Malegaon.
3) To assess the existing waste collection system in the city.
4) To evaluate the transportation equipment and their capacities used by the agency appointed by the Malegaon Municipal Corporation (MMC).
5) To review the current methods employed for solid waste disposal.
6) To investigate the environmental impacts resulting from improper management of municipal solid waste.

3. Methodology

Effective waste collection and transport depend on suitable timing, road quality, and available facilities. When local leaders prioritize solid waste management, they invest in necessary infrastructure. This encourages community participation and willingness to pay, leading to improved

services and shared responsibility among stakeholders for maintaining a cleaner urban environment.

3.1 Waste Generation and Socioeconomic Link

Solid waste generation is closely linked to a region's economic status, with lower - GDP countries typically producing less waste. Data on waste quantities is gathered from various sources such as municipalities, NGOs, academic institutions, and research centers to provide an accurate understanding of waste generation patterns in cities.

3.2 Collection, Transfer, and Transportation of Solid Waste

The study highlights that municipalities are responsible for waste collection from households, as well as for the transfer and transportation of solid waste. Efficient waste collection timing depends on the availability of transportation facilities and road quality, which directly affects user satisfaction. When local authorities prioritize solid waste management, they allocate sufficient funds for equipment and infrastructure, encouraging stakeholder willingness to pay and participate in improving services. However, waste collection providers sometimes overlook user needs, making cooperation and coordination between service users and providers essential for effective and sustainable waste management.

3.3 Treatment and Disposal of Solid Waste

a) **Vermicomposting:** Vermicomposting is the natural process of producing organic manure from earthworm excreta fed on partially decomposed organic waste. Small - scale vermicomposting plants have been established in several cities and towns across Maharashtra.
b) **Composting:** Composting is an ancient Indian technique involving the decomposition of organic matter by microorganisms in warm, moist, aerobic, or anaerobic conditions. Traditionally, farmers use compost from cow dung and agricultural waste. Compost made from urban mixed waste often has higher nutrient content compared to traditional compost.
c) **Recycling:** Successful recycling depends on community participation and the efficiency of equipment and infrastructure. Challenges include irregular collection services and inadequate collection tools. Although waste - to - energy (WTE) technologies are proven globally, their long - term viability in India remains uncertain.
d) **Disposal:** Private sector participation in waste disposal is rare in India, but the concept of tipping fees is emerging, as seen with the Bangalore Municipal Corporation. Integrated treatment and disposal facilities involving private firms are gradually developing based on technology and investment needs.

4. Results

4.1 Collection System

A private agency is appointed to collect the waste from various regions of the city and disposed it safely. The name of this agency is watergrase having administrative office in Ahmadabad Also municipal corporation appointed their system to collect the waste. Description of types of vehicles appointed by private agency and Municipal Corporation is as follows. The distribution of vehicles for collecting the waste is based on population, more dense populated area covered with the more waste carrying capacity vehicles. But this again depends on size of road on which vehicles are collected the waste. so due to narrow roads it is very important to Select vehicle for the collect. Generally some of the vehicles are not reached their last point of collection. So it is necessary to develop some waste collection equipment which can easily collect the waste to avoiding littering and nuisance. The average daily disposed quantity of waste on dumping yard is near about 170 tonnes per day. Which contain the organic matter, paper, plastic, metal, glass, leather and rubbish, textile waste etc. out of this the average organic matter collected is 65.25% which is followed by the plastic of average of 15%.

Table 1: Vehicle Description of Malegaon City

Name of Vehicle	Number of Vehicles	Capacity per Vehicle (Tonnes)	Total Capacity (Tonnes)
Tractor Trolleys	12	3.0	40.0
Dumpers	6	5.0	35.0
Trucks	8	7.0	60.0
Mini Trucks	10	2.0	25.0
Hand Carts	20	0.5	10.0
Total Capacity			170.0 Tonnes per day

4.2 Details of Dumping Yard

The primary solid waste disposal site for Malegaon city is located at Gat No.4/1, Maldeshivar**,** approximately 4.5 km from the city center**.** This 28 - acre facility has been in operation for several years but has recently faced capacity issues due to increasing waste generation and limited expansion options To address these challenges, the Malegaon Municipal Corporation (MMC) has proposed an additional 22 - acre land parcel for waste disposal, aiming to enhance the site's capacity and ensure sustainable waste management practices In recent times, the facility has experienced incidents such as a fire at the plastic waste dumping site in the Devicha Mala area, highlighting the need for improved waste segregation and management practices.

4.3 Survey on Physical Characteristics of Municipal Solid Waste in Selected Wards of Malegaon City

A detailed survey was conducted in Malegaon city to understand the physical characteristics of municipal solid waste generated in four selected wards Nehal Nagar, Aqsa Colony, Camp, and Salim Nagar. The purpose of the survey was to determine the average waste generation rate, which in India typically ranges between 200 to 879 grams per person per day. The amount and type of waste generated vary based on factors such as locality, living standards, and lifestyle habits. In Malegaon, a private agency named Watergrase, headquartered in Ahmedabad, has been appointed for waste collection and disposal. Additionally, the Malegaon Municipal Corporation operates its own waste collection system. The average quantity of waste disposed of at the city's dumping yard is approximately 170 tonnes per day. The survey covered collection methods, transportation practices,

and physical composition of waste, contributing valuable insights for improving the city's solid waste management system.

Table 2: Composition and Physical Characteristics of Solid Waste in Malegaon City

Type of Waste	Nehal Nagar (%)	Aqsa Colony (%)	Camp (%)	Salim Nagar (%)	Average in %
Organic	58	58	54	60	57.5
Paper	6	5	6	8	6.25
Plastic	11	14	12	11	9.6
Metal	2	2	3	2	2.25
Glass	3	2	3	4	3
Leather & Rubber	4	4	4	2	4.6
Textile	8	5	4	5	5.5
Inert Miscellaneous	8	10	14	8	10

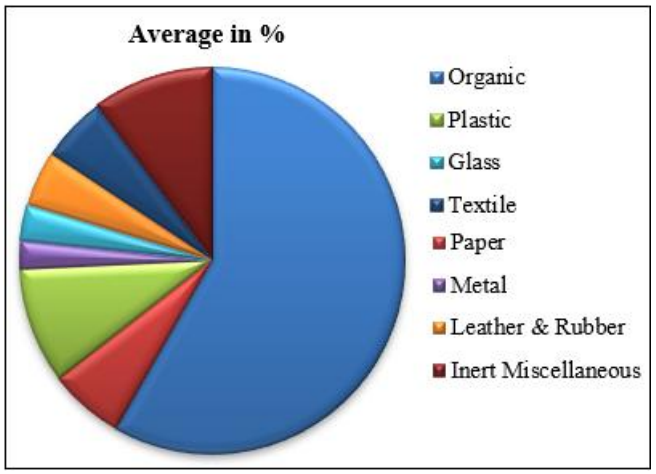

Figure 1: Graphical Representation of Household Waste Composition by Ward in Malegaon City

The data reveals that organic waste is the most dominant component of household waste across all four areas, consistently accounting for more than 50% of the total waste. This highlights the significant presence of biodegradable material in the overall waste composition. Plastic and paper together form a notable proportion, suggesting a potential need for improved recycling practices in these localities. Among the four areas, Camp exhibits the highest amount of inert waste, which could be indicative of increased non - biodegradable or construction - related debris in that locality. On the other hand, Salim Nagar presents a relatively balanced waste distribution, with slightly higher proportions of organic and glass waste compared to the other areas.

Table 3: Ward - wise Percentage Distribution of Solid Waste Composition in Malegaon (Basic Demographics and Waste Data)

Ward Name	Ward No.	Population	Waste Generated	Per Capita Waste (kg/day)
Nehal Nagar	12	11, 554	4, 044 kg	0.350 kg
Aqsa Nagar	21	12, 563	4, 397 kg	0.349 kg
Camp	12	12, 200	3, 909 kg	0.320 kg
Salim Nagar	16	12, 444	4, 480 kg	0.360 kg
Average	–	12, 190	4, 207 kg	0.345 kg

The data indicates that each of the four wards, Nehal Nagar, Aqsa Nagar, Camp, and Salim Nagar—has a population ranging between approximately 11, 500 and 12, 500 individuals. The total waste generated per day in these wards varies from 3, 909 kilograms to 4, 480 kilograms. When this is calculated on a per - person basis, the average waste generation comes to around 0.345 kilograms per person per day. This figure suggests a moderate level of waste production per resident, reflecting typical urban household waste output in medium - sized Indian cities like Malegaon. The values highlight the need for an efficient waste management system to handle the consistent and sizable volume of daily waste.

Table 4: Waste Composition (By Percentage and Weight in kg per Person)

Waste Type	Nehal Nagar	Aqsa Nagar	Camp	Salim Nagar	Average
Organic	63% (0.220 kg)	59% (0.205 kg)	57% (0.182 kg)	61% (0.219 kg)	60% (0.207 kg)
Paper	5% (0.017 kg)	8% (0.027 kg)	7% (0.022 kg)	9% (0.032 kg)	7.25% (0.025 kg)

In all four wards surveyed, organic waste forms the largest proportion of household waste, comprising between 57% and 63% of the total. This indicates that the majority of waste generated by households in these areas is biodegradable in nature. On an average, each person produces about 0.207 kilograms of organic waste per day, reflecting typical food and garden waste patterns in residential zones.

Paper waste, though significantly less than organic waste, still represents a noticeable fraction, varying between 5% and 9% across the wards. The average daily per capita generation of paper waste stands at approximately 0.025 kilograms. Among the four wards, Aqsa Nagar and Salim Nagar tend to generate slightly higher amounts of paper waste compared to the other two areas, possibly due to differences in lifestyle, consumption habits, or access to paper - based goods.

Nehal Nagar stands out with the highest percentage of organic waste at 63%, suggesting that a significant portion of its household waste is biodegradable—likely from food scraps,

kitchen waste, or garden refuse. In comparison to other wards, Salim Nagar records the highest per capita waste generation rate at 0.360 kilograms per person per day. This slight increase may point to differences in consumption patterns, lifestyle, or population behavior. Interestingly, Salim Nagar also leads in paper waste generation, with 9% of its total household waste being paper. This may be attributed to greater use of packaging materials, a higher presence of educational institutions, or commercial activity in the area.

When considering the overall waste composition across the four wards, the data clearly highlights the dominance of organic and paper waste. This insight is valuable for designing effective waste management strategies—such as promoting composting of organic materials and encouraging paper recycling programs—to reduce landfill burden and enhance sustainability efforts.

4.4 Leachate Characteristics and Environmental Impact from Unengineered Landfill Sites in Malegaon City:

In Malegaon city, leachate generated from municipal solid waste is primarily coming from three non - engineered, low - lying open dumping sites. These sites lack essential environmental safeguards such as bottom liners, leachate collection systems, or treatment facilities. As a result, the leachate freely seeps into the surrounding soil and water bodies, posing serious environmental risks. To understand the extent of this pollution, leachate samples were collected and tested for various chemical parameters. The analysis revealed that the leachate contains a high concentration of both organic and inorganic pollutants, with values exceeding the standard permissible limits. This indicates that the waste is undergoing uncontrolled decomposition, producing highly contaminated liquid effluent.

However, since the waste is mainly domestic in origin, the concentration of heavy metals was found to be minimal or present only in trace amounts. Despite this, the overall composition of the leachate shows a high pollution potential. The findings underline the urgent need for proper leachate management solutions, such as engineered landfill designs and treatment systems, to reduce the environmental damage caused by unregulated waste disposal in Malegaon.

Table 5: Chemical Properties of Leachate from Malegaon Landfill Sites

Parameter	Concentration
Color and Odour	dark brown/ Foul smell
pH	8.8 mg/l
TS, SS and TDS	5972 mg/l, 619 mg/l, 5361 mg/l
Turbidity	79 NTU
Hardness	575 mg/l
BOD5	326 mg/l
COD	825 mg/l
Chlorides	1446 mg/l
Nitrate	12.5 mg/l
Total Phosphorus	52.8 mg/l
Sulphate	48.8 mg/l

5. Conclusion

The analysis of solid waste management in Malegaon city reveals several critical challenges and areas for improvement. The per capita waste generation rate stands at approximately 349 grams, influenced by varying income levels and lifestyles. Islampura ward records the highest waste generation per capita, while Camp ward generates the least. Notably, the city produces a relatively higher percentage of plastic waste compared to other Indian cities, and the organic waste content is also substantial due to the inclusion of slaughterhouse waste.

Unlike many Indian cities that follow a centralized waste collection model, Malegaon lacks such a system, leading to inefficiencies in waste handling. Although the municipal corporation has achieved near parity between the waste generated (approximately 175 tonnes per day) and its daily collection capacity, the problem of final disposal remains severe. The existing dumping sites have exceeded their capacity, emphasizing the urgent need for a new landfill location.

Furthermore, the corporation's current approach to waste management focuses only on collection and disposal. There is no system in place for treating non - biodegradable waste, and the only treatment process employed—vermicomposting—is limited to organic waste. The absence of waste segregation at the source, along with the unscientific disposal of waste from industrial, medical, commercial, and institutional sources at a common site, poses serious environmental and public health risks.

To ensure sustainable waste management, Malegaon must adopt a more integrated and strategic approach—emphasizing segregation, recycling, treatment of non - decomposable waste, and exploring avenues for revenue generation through resource recovery.

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