International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

"ASSESSMENT OF SOLID WASTE MANAGEMENT SYSTEM OF JABALPUR CITY AND USEFUL RECOMMENDATION FOR THE DEVLOPMENT OF SUSTAINABLE SWM SYSTEM"

Amit Kumar[1], R.K. Bhatia[2]

[1]Research Scholar, Department of Civil Engineering, JEC Jabalpur (India)
[2]Asso. Professor, Department of Civil Engineering, JEC Jabalpur (India)

Abstract:
Rapid urbanization, population growth, and changing consumption patterns have significantly increased the quantity and complexity of municipal solid waste (MSW) in Indian cities. Jabalpur city, an important urban center of Madhya Pradesh, generates a heterogeneous waste stream comprising municipal, hazardous, and biomedical waste, posing serious environmental and public health concerns. The present study provides a comprehensive assessment of the existing solid waste management system of Jabalpur city using an integrated approach involving field surveys, stakeholder interactions, secondary data analysis, and GIS-based spatial mapping. Waste generation rates, physical composition, collection efficiency, segregation practices, transportation logistics, processing capacity, and disposal methods were systematically evaluated. Results indicate dominance of biodegradable organic waste (≈55–60%), followed by recyclable dry waste (≈25–30%) and hazardous fractions. Despite policy provisions under Solid Waste Management Rules (2016), segregation at source remains inadequate, processing infrastructure is underutilized, and waste disposal is largely dependent on open dumping practices. GIS analysis identified major waste-generating zones and environmentally vulnerable areas associated with landfill sites. The study proposes technically feasible and sustainable interventions including decentralized composting, strengthened material recovery facilities, scientific landfill development, and institutional integration of informal waste workers. The findings highlight the urgent need for a transition from disposal-oriented to resource-oriented waste management to achieve environmental sustainability in Jabalpur city.

Keywords: Municipal Solid Waste, GIS Mapping, Sustainable Waste Management, Landfill, Hazardous Waste, Jabalpur.

1. INTRODUCTION

Municipal solid waste management (MSWM) has become a critical component of urban environmental engineering due to its direct implications on public health, ecosystem integrity, and urban sustainability. Solid waste comprises discarded materials generated from residential households, commercial establishments, industrial activities, healthcare facilities, and municipal services. In developing countries like India, ineffective MSWM systems often result in environmental degradation, groundwater contamination, air pollution, and increased disease burden.

Jabalpur city has experienced rapid urban expansion over the last two decades, accompanied by increased waste generation and diversification of waste streams. The existing waste management system is primarily collection- and disposal-centric, with limited emphasis on segregation, recovery, and scientific treatment.

Inadequate institutional capacity, lack of public participation, and insufficient infrastructure further aggravate the problem. This study aims to critically assess the current solid waste management practices in Jabalpur city and evaluate their sustainability using field-based evidence and spatial analysis tools.

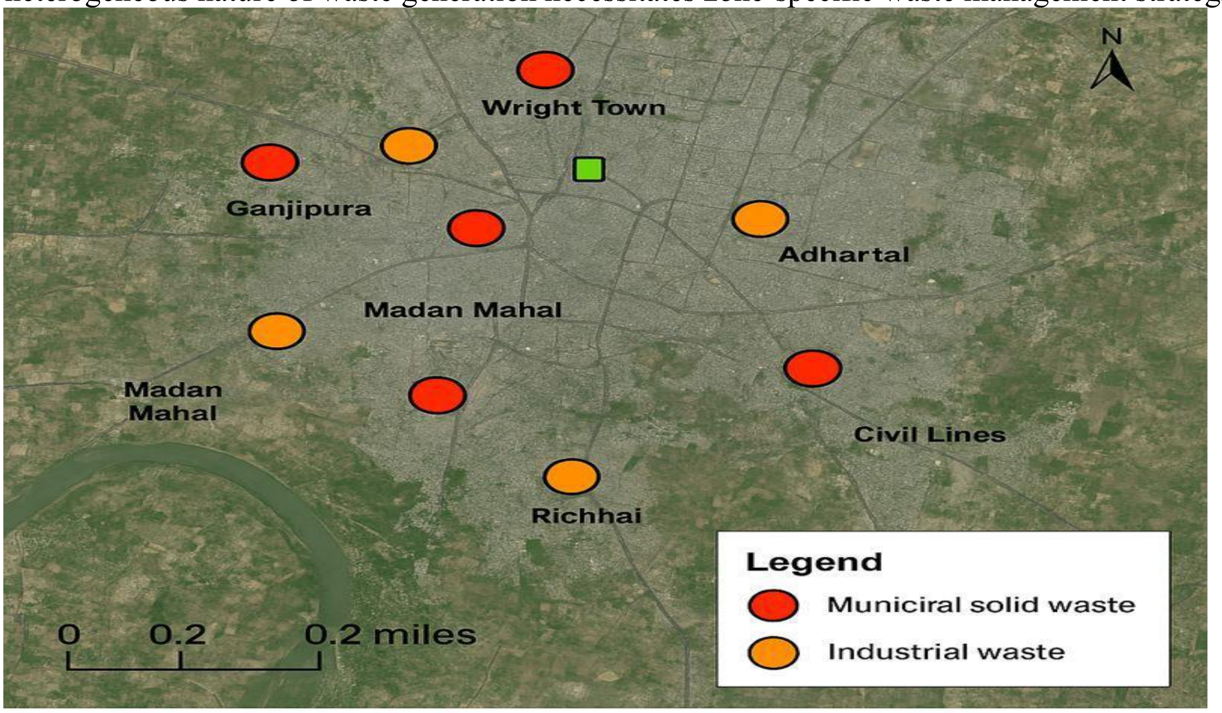
2. STUDY AREA DESCRIPTION

Jabalpur city is located in the central part of Madhya Pradesh and serves as a major administrative, commercial, and industrial hub. The city consists of mixed land-use patterns including dense residential zones, commercial markets, small- and medium-scale industrial areas, healthcare institutions, and peri-urban agricultural zones.

Based on municipal zoning and land-use characteristics, the city was categorized into functional waste-generating zones:

- Residential household zones (≈80–85% contribution)
- Commercial and market areas
- Industrial and workshop clusters
- Healthcare institutions generating biomedical waste
- Construction and demolition activity zones

The heterogeneous nature of waste generation necessitates zone-specific waste management strategies.



Spatial distribution of major solid waste generating

3. OBJECTIVES AND SCOPE OF THE STUDY

3.1 Objectives of the Study

The specific objectives of the present research work are as follows:

1. To assess the existing municipal solid waste management system of Jabalpur city.
2. To identify major municipal, hazardous, and biomedical waste generating zones within the city.
3. To characterize municipal solid waste based on physical composition and moisture content.
4. To evaluate waste collection, segregation, transportation, processing, and disposal practices.
5. To analyse spatial distribution of waste generation and disposal sites using GIS techniques.

6. To identify environmental and public health impacts associated with existing waste management practices.
7. To propose technically feasible and sustainable measures for improving the solid waste management system of Jabalpur city.

3.2 Scope of the Study

The scope of the study is limited to the municipal limits of Jabalpur city. The study focuses on municipal solid waste along with hazardous and biomedical waste generated from residential, commercial, industrial, and healthcare sources. Detailed chemical analysis of waste was not undertaken; instead, emphasis was placed on physical characterization and system-level assessment. The research evaluates present operational practices and infrastructure without undertaking pilot-scale treatment experiments. The findings are intended to support urban local bodies in planning sustainable and integrated solid waste management strategies.

4. MATERIALS AND METHODOLOGY

4.1 Research Design

A **case study methodology** was adopted to analyse the MSWM system of Jabalpur city. The approach integrates qualitative and quantitative techniques to capture technical, institutional, and social dimensions of waste management.

4.2 Data Collection Methods

- **Primary Data:** Field surveys, site inspections at landfill and processing facilities, direct observation of collection and transportation systems, and semi-structured interviews with municipal officials, sanitation workers, and residents.
- **Secondary Data:** Waste generation statistics, reports from Jabalpur Municipal Corporation (JMC), Madhya Pradesh Pollution Control Board (MPPCB), and published literature.

4.3 Waste Characterization

Municipal solid waste was characterized based on:

- Physical composition (wet basis)
- Moisture content
- Presence of recyclable and hazardous fractions

The waste stream was classified into biodegradable, non-biodegradable, recyclable, and hazardous components to assess treatment suitability.

4.4 GIS-Based Spatial Analysis

GIS techniques were employed to:

- Map waste generation hotspots
- Identify high MSW, hazardous waste, and biomedical waste producing zones
- Analyze spatial relationship between landfill sites and sensitive land-use areas

The integration of field data with spatial mapping provided a robust assessment of environmental vulnerability associated with waste disposal practices.

5. RESULTS AND DISCUSSION

5.1 Municipal Solid Waste Generation and Composition

The study estimated that Jabalpur generates approximately **330–360 tonnes per day** of municipal solid waste. Biodegradable organic waste constitutes the largest fraction, primarily originating from households and vegetable markets. The high moisture content (~44%) and organic carbon concentration indicate strong suitability for biological treatment methods such as composting and biomethanation.

However, improper segregation leads to contamination of recyclable and compostable waste, reducing processing efficiency.

5.2 Segregation Practices at Source

Although segregation into biodegradable and non-biodegradable waste has been mandated, field observations revealed low compliance. In many wards, waste is stored in mixed form, and color-coded bin systems are inconsistently implemented. Lack of awareness, inadequate monitoring, and weak enforcement mechanisms are key limiting factors.

5.3 Collection and Transportation System

Door-to-door collection covers major parts of the city; however, collection frequency and vehicle availability vary across zones. Mixing of segregated waste during transportation was frequently observed due to lack of compartmentalized vehicles. This results in loss of segregation integrity and reduces the effectiveness of downstream processing facilities.

5.4 Waste Processing Infrastructure

Existing composting facilities operate below their design capacity due to poor quality of incoming waste. Decentralized processing units are largely absent, despite high organic waste generation. Material recovery facilities (MRFs) are limited and heavily dependent on informal waste pickers.

5.5 Disposal Practices and Environmental Impacts

Final disposal is primarily through open dumping at low-lying landfill sites. Scientific landfill features such as liners, leachate collection systems, and landfill gas management are inadequate. During monsoon periods, leachate generation poses a serious risk to groundwater quality. Open burning of waste contributes to air pollution and greenhouse gas emissions.

5.6 Hazardous and Biomedical Waste Management

Hazardous waste is generated from automobile workshops, e-waste sources, small industries, and healthcare facilities. Biomedical waste is treated through common biomedical waste treatment facilities; however, improper segregation at source and unsafe handling practices increase occupational and environmental risks.

6. SUSTAINABILITY ASSESSMENT

The assessment indicates that Jabalpur’s solid waste management system lacks environmental, economic, and institutional sustainability. High landfill dependency, low resource recovery, and operational inefficiencies increase long-term environmental costs. Integration of informal waste workers, decentralized waste processing, and enforcement of segregation norms are critical for improving system sustainability.

7. CONCLUSIONS

The study concludes that the existing MSWM system in Jabalpur city is technically inadequate and environmentally unsustainable. Despite availability of policy frameworks and technical guidelines, implementation gaps persist at multiple levels. Adoption of integrated, decentralized, and resource-oriented waste management strategies is essential for improving environmental performance and urban resilience.

8. RECOMMENDATIONS

- Mandatory source segregation with real-time monitoring
- Decentralized composting for organic waste

- Expansion of material recovery facilities
- Scientific sanitary landfill development
- Integration and safety training of informal waste pickers
- Public awareness and institutional capacity building

REFERENCES:

1. Central Pollution Control Board (CPCB). *Status of Municipal Solid Waste Management in India*. New Delhi, India.
2. CPHEEO (2016). *Manual on Municipal Solid Waste Management*. Ministry of Housing and Urban Affairs, Government of India.
3. Ministry of Environment, Forest and Climate Change (MoEFCC) (2016). *Solid Waste Management Rules*. Government of India.
4. Sharholy, M., Ahmad, K., Mahmood, G., & Trivedi, R. C. (2008). Municipal solid waste management in Indian cities – A review. *Waste Management*, 28(2), 459–467.
5. Ogwueleka, T. C. (2009). Municipal solid waste characteristics and management in Nigeria. *Iranian Journal of Environmental Health Science & Engineering*, 6(3), 173–180.
6. Zeng, G., Yu, M., Huang, H., et al. (2005). Integrated solid waste management in urban areas. *Environmental Management*, 36(4), 534–545.
7. World Bank (1999). *What a Waste: Solid Waste Management in Asia*. World Bank Publications, Washington DC.
8. World Bank (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. Washington DC.
9. Kumar, S., Smith, S. R., Fowler, G., et al. (2017). Challenges and opportunities associated with waste management in India. *Royal Society Open Science*, 4(3), 160764.
10. Gupta, S., Mohan, K., Prasad, R., Gupta, S., & Kansal, A. (1998). Solid waste management in India: options and opportunities. *Resources, Conservation and Recycling*, 24(2), 137–154.
11. Rajput, R., Prasad, G., & Chopra, A. K. (2009). Scenario of solid waste management in present Indian context. *Caspiian Journal of Environmental Sciences*, 7(1), 45–53.
12. Batool, S. A., & Ch, M. N. (2009). Municipal solid waste management in Lahore city district, Pakistan. *Waste Management*, 29(6), 1971–1981.
13. Siddiqui, A. A., & Khan, M. A. (2015). Urban solid waste management in India: Issues and challenges. *International Journal of Environmental Engineering*, 7(3), 222–236.
14. Deshpande, V. P., & Rathod, M. (2006). Assessment of municipal solid waste management system. *Indian Journal of Environmental Protection*, 26(7), 604–610.
15. Ramesh Babu, B., Parande, A. K., & Kumar, T. P. (2009). Management of biomedical waste in India. *Journal of Environmental Health Science & Engineering*, 6(4), 239–244.
16. Sharma, S., Chauhan, S. V. S., & Goyal, R. (2008). Biomedical waste management in hospitals of Agra city. *Journal of Environmental Biology*, 29(2), 159–162.
17. Tchobanoglous, G., Theisen, H., & Vigil, S. (1993). *Integrated Solid Waste Management: Engineering Principles and Management Issues*. McGraw-Hill, New York.
18. IS 10500 (2012). *Drinking Water – Specification*. Bureau of Indian Standards, New Delhi.
19. Jabalpur Municipal Corporation (JMC). *Solid Waste Management Records and Annual Reports*. Jabalpur, India.
20. Madhya Pradesh Pollution Control