CHAPTER 35

Comparative Analysis of Solid Waste Management Practices in Pune and Visakhapatnam

Syed Sharukh Ali[1], *Buggarapu Malavya Sharma*[1],
Kota Lns Madhuri[2] *and Satya Vardhan Reddy Goluguri*[1]

ABSTRACT

In India, solid waste management is a problem because of rapid urbanization, increase in waste generation, and inadequate infrastructure. This analysis aims to compare solid waste management practices in two cities, Pune and Visakhapatnam, focusing on waste generating activities, segregation efficiency, collection systems, and disposal methods. Findings indicate that Pune has an organized SWM system that is complimented with efficient waste collecting practices, community participation, and centralized community processing of waste. Furthermore, although Visakhapatnam is progressive in the landfill site rehabilitation and waste to energy initiatives, challenges remain in terms of primary sorting and sustainability. The research proposes an Integrated Waste Management Framework consisting of policy, technology, finance, community participation, and education for effective sustainable management.

Keywords: Solid waste management; Waste segregation; Waste collection; Waste processing; Sustainable waste management.

1.0 Introduction

Municipal solid waste (MSW) generation has increased dramatically as an outcome of India's cities' rapid urbanization, creating serious infrastructure, health, and environmental problems. According to Central Pollution Control Board (CPCB), India generates approximately 62 million tons of waste annually, with only 43 million tons collected, 12 million tons treated, and the remaining 31 million tons disposed of in landfills (CPCB, 2021). Adopting sustainable, effective, and technologically advanced waste management practices is necessary because inefficient waste management systems contribute to pollution, resource depletion, and climate change (Gupta *et al.*, 2020). Cities must adopt integrated waste management frameworks in light of the growing population and urban density in order to improve resource recovery mechanisms and lessen the negative effects of inappropriate waste disposal (Swatch Bharat Mission, 2023).

[1]*School of Construction, NICMAR University, Pune, Maharashtra, India*
[2]*Corresponding author; School of Construction, NICMAR University, Pune, Maharashtra, India (E-mail: P2370627@student.nicmar.ac.in)*

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

Two significant Indian cities, Pune and Visakhapatnam, have different approaches to solid waste management (SWM). Pune is renowned for its strong community involvement, decentralized waste management model, and incorporation of waste-pickers into organized waste processing systems (SWaCH-Pune, 2022). Conversely, Visakhapatnam has prioritized waste-to-energy technological advancements, centralized waste processing facilities, and landfill rehabilitation (GVMC, 2021). This study intends to highlight best practices, identify obstacles, and suggest an effective framework for enhancing SWM systems in urban India by comparing these two cities. The effectiveness of the current SWM strategies in Pune and Visakhapatnam with regard to waste collection, segregation, disposal, and recycling is examined in this study. This study aims to identify the advantages and disadvantages of each city's waste management system by examining its financial models, technological interventions, and policies. Through a thorough comparison, policymakers, municipal officials, and urban planners will be able to create data driven, workable solutions to address the SWM issues in other Indian cities (World Bank, 2022).

2.0 Literature Review

Solid Waste Management (SWM) is a critical issue in urban areas, with rapid urbanization and changing consumption patterns contributing to increasing waste generation (Bholey & Mihir, 2017). India generates approximately 62 million metric tons of waste annually, ranking fourth globally in per capita waste production (Sruthi & Bhargavi, 2022). Efficient SWM requires proper waste segregation, collection efficiency, and sustainable disposal methods. However, many Indian cities struggle with inadequate infrastructure, financial constraints, and low public participation (Ramirez-Rubio *et al.*, 2019). Government regulations, such as the Solid Waste Management Rules, 2016, mandate waste segregation at source and involvement of waste pickers in formal systems. The Swachh Bharat Mission (SBM) and Service Level Benchmarking (SLB) have also improved waste collection and monitoring, but enforcement challenges exist (Ministry of Urban Development 2012, n.d.). Studies highlight Pune's success in decentralized composting and community-driven initiatives through SWaCH, while Visakhapatnam has focused on waste-to-energy projects and landfill remediation (Ghosh *et al.*, 2025) Past research suggests that public-private partnerships, policy enforcement, and financial models are essential for improving SWM (T, 2009).The integration of AI-driven monitoring, expansion of composting facilities, and strengthening of recycling initiatives can enhance waste management efficiency. (Shrestha, 2024)

3.0 Research Gap and Need of Study

Many studies that are done in the past are mainly focused on the study of Solid Waste Management (SWM) system in a particular city of India or as complete overview of SWM on

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

country as whole, this studies lack in doing comparative analysis between cities as each study was done at different timeline and made on different parameters. To bridge that gap we would like to study about SWM practices followed by a few cities at a time, so that the information gathered on the common parameters can be compared for the detailed analysis.

4.0 Objectives

- What are the key factors influencing solid waste generation in Pune and Visakhapatnam?
- How does the waste segregation efficiency compare between Pune and Visakhapatnam?
- What policy recommendations can be made to enhance Solid Waste Management?

Scope: This research offers a comprehensive assessment of urban waste management systems, their efficiency, and potential improvements. This study contributes to multiple domains, addressing environmental, policy, technological, and operational aspects of solid waste management (SWM).

5.0 Research Methodology

A mixed-method approach was used, integrating qualitative and quantitative data collection methods. Interviews were conducted with municipal officials and waste management professionals. Secondary data was collected from government reports, previous studies, and municipal records. The Relative Score calculation method was used with weightages.

6.0 Data Analysis and Findings

6.1 Benchmarks comparison of Pune & Vishakhapatnam

Table 1 and Figure 1 shows Service level Benchmarks Reported by the Sample Cities in 2010-11, which contains 8 benchmark factors for comparison of efficiency between Pune & Vishakhapatnam.

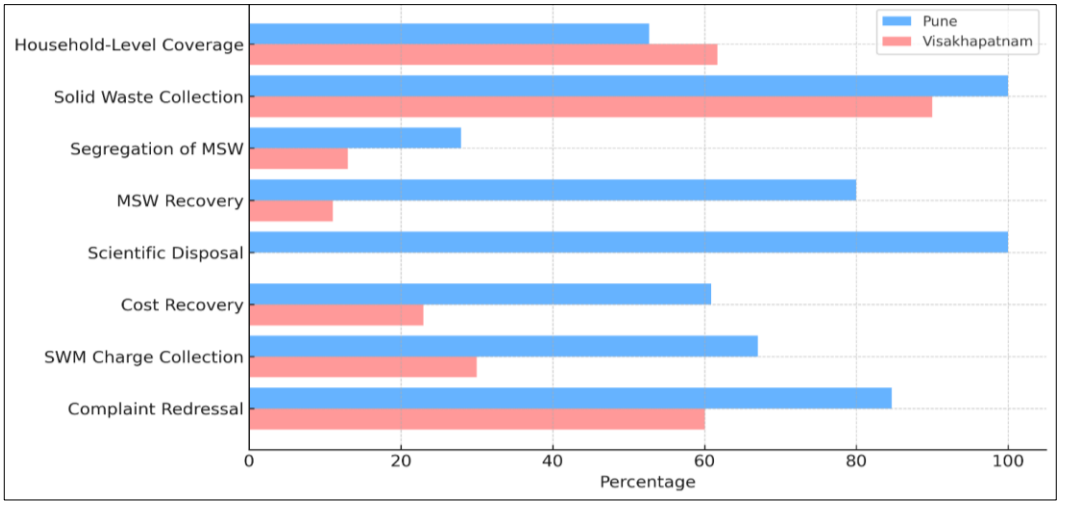
Table 1: Service level Benchmarks Reported by the Sample Cities in 2010-11

Service-level benchmarks	Benchmark	Pune	Visakhapatnam
Household-level coverage	100%	52.7%	61.7%
Efficiency in the collection of solid waste	100%	100%	90%
Extent of segregation of MSW	100%	27.9%	13%
Extent of MSW recovered	80%	80%	11%
Extent of scientific disposal of MSW	100%	100%	0%
Extent of cost recovery	100%	60.9%	23%
Efficiency in collection of SWM charges	90%	67%	30%
Efficiency in redressal of customer complaints	80%	84.7%	60%

Source: Ministry of Urban Development 2012, n.d.

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

Figure 1: Comparison of Waste Management Factors – Pune vs Vishakhapatnam



Source: Compiled by authors

Additionally, it contains benchmark percentages of 8 factors. In which, Pune beats Vishakhapatnam in 7 factors where as Vishkhapatnam beats only in 1 factor i.e., Household level coverage in 2011.

6.2 Cross comparison between Pune & Vishakhapatnam

Table 2 contains seven parameters which will define efficiency of both cities. Data is collected from PMC and GVMC.

Table 2: 7 Key Factors Considered for Both Cities

Parameter	Pune (%)	Vishakhapatnam (%)	Assigned Weight
Household coverage	90	93	20% (0.2)
Waste Segregation	95	80	20% (0.2)
Collection frequency (everyday)	100	70	15% (0.15)
Door-to-door collection	95	80	15% (0.15)
Use of community bins	5	26	5% (0.05)
Non-payment of service charges (inverse impact)	(100-20) = 80	(100-40) = 60	10% (0.1)
Willingness to pay	80	50	10% (0.1)

Source: compiled by authors

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

Table 3 shows justification for 7 parameters considered including weightages.

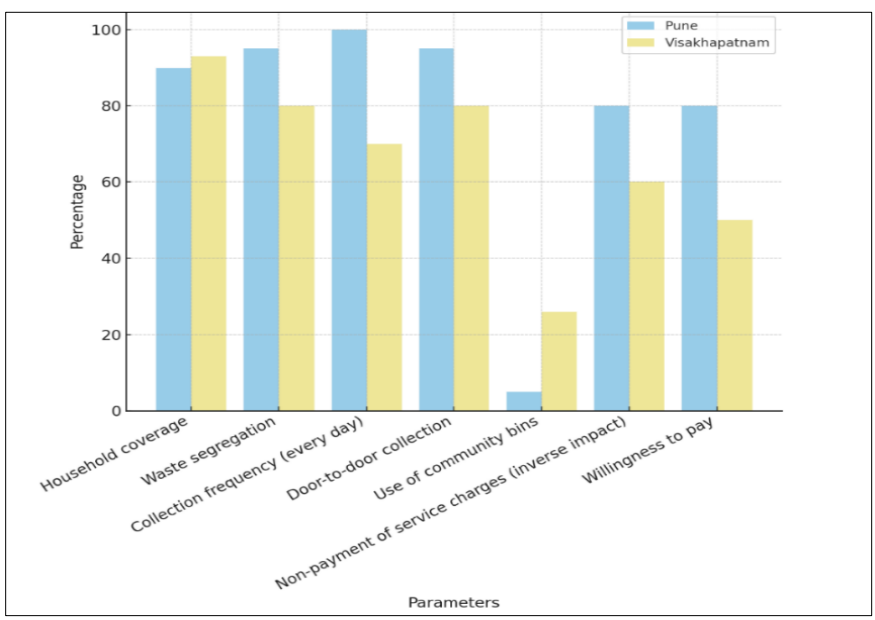
Table 3: Assumption of Weightages

Parameter	Weightage (%)	Justification
Household Coverage	20% (0.2)	Higher coverage ensures effective waste collection and minimal littering.
Waste Segregation	20% (0.2)	Essential for efficient recycling and reducing landfill burden.
Collection Frequency (Every Day)	15% (0.15)	Regular waste collection prevents accumulation and health hazards.
Door-to-Door Collection	15% (0.15)	Increases efficiency and minimizes community bin overflow.
Use of Community-Bins	5% (0.05)	Lower weightage since bins are supplementary to door-to-door collection.
Non-Payment of Service-Charges (Inverse Impact)	10% (0.1)	Financial sustainability is crucial for long-term waste management success.
Willingness to Pay	10% (0.1)	Indicates public participation and the feasibility of waste management funding.

Source: compiled by authors

Figure 3 shows visual aid of Comparison of Waste Management parameters -Pune vs Vishakhapatnam. In which x axis contains Percentages and y axis contains 7 parameters.

Figure 1: Comparison of Waste Management Parameters – Pune vs Vishakhapatnam



Source: compiled by authors

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

City	Weighted Score	Final Rating (out of 5)
Pune	0.903	4.515
Visakhapatnam	0.7869	3.9345

6.3 Key observations

Waste management performance of Pune and Visakhapatnam stands at 4.515 out of 5 and 3.9345 out of 5 respectively. As compared to Visakhapatnam, Pune has a better score showcasing a more effective and sustainable waste management system.

Key Observations by Parameter:

- *Household Coverage:* With Visakhapatanam (93%) slightly outperforming Pune (90%) it retains a small edge.
- *Waste Segregation:* Aside from segregation, Pune (95%) does much better than Visakhapatnam (80%). Poorer segregation outcomes in Visakhapatnam can translate to more difficulties in managing recycling as well as landfill sites.
- *Collection Frequency:* Pune does daily waste collection for its clients 100% of the time, while Visakhapatnam only manages to do it 70% of the time. This can cause build-up of waste and health concerns for Visakhapatnam.
- *Door-to-Door Collection:* Pune (95%) makes use of a public bin collection system the most, hence needing the least effort to deposit waste in public bins. Visakhapatnam (80%) is more dependent on community bins which lowers efficiency.
- *Use of Community Bins:* Visakhapatnam (26%) has a bigger percentage of people using community bins than Pune (5%), which indicates that there is a problem with direct collection.
- *Non-Payment of Service Charges:* Compliance level for payment in Pune currently stands at 80%, while Visakhapatnam serves at 60%. These figures are bound to affect the financial health of the system, and waste management performance.
- *Willingness to Pay:* In contrast to Visakhapatam (50%), Pune (80%) shows markedly increased support and payment for waste management services. Public cooperation and financial sustainability look much better in Pune.

6.4 Challenges identified

Despite the improvements in both cities, several challenges persist:

- The high dependence on landfills stems from the low segregation rates observed in Visakhapatnam.
- Problematic financial sustainability, especially in Visakhapatnam, stems from inadequate revenue collection through waste management service fee compliance.
- Inefficient recycling and waste-to-energy processes are a consequence of insufficient technological sophistication in waste processing.
- Insufficient active participation of the public in the segregation and recycling of waste.

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

7.0 Conclusion

This study illustrates specific challenges and prospects related to Solid Waste Management (SWM) in Indian cities, with particular attention to Pune and Visakhapatnam. Each city has made improvements in their waste management systems; however, notable distinctions still exist. Pune has adopted a community-based model which includes decentralized waste processing, waste-picker cooperatives, and public participation. On the other hand, Visakhapatnam has implemented waste-to-energy methods along with landfill remediation; however, they still have not mastered source segregation and financial self-sufficiency. When comparing the years from 2011 to 2024, these two cities have significantly progressed. A comparative assessment of the two cities suggests that waste segregation, financial hardship, and civic participation are the major issues in both cities. The effectiveness of decentralized strategies in Pune suggests that municipal corporations must focus on source segregation, scientific waste disposal, and community involvement if they want long-term sustainability.

8.0 Recommendations

To address these challenges, an Integrated Waste Management Framework (IWMF) is

- *Policy Changes:* Implement the Extended Producer Responsibility (EPR) policy where industries are answerable for the waste produced and recyclability of their products is promoted. Apply the Polluter Pays Principle where generators of massive waste bear the costs of its disposal. Augment segregation policies through heightened penalties for noncompliance.
- *Improvement in Technology:* Employ AI-powered waste tracking systems to enhance route collection efficiency. Construct mobile applications through which residents can monitor waste collection dates or report if waste has not been collected and provide lower rewards for improper segregation of waste. Improve Material Recovery Facilities (MRFs) by integrating automated sorting of waste for better recycling processes.
- *Financial Plans for Achieving Sustainable Waste Management:* Raise the level of compliance to SWM service charge collection especially in Visakhapatnam through awareness campaigns and rewarding those who pay on time. Grant tax incentives to firms that use a zero-waste approach. Foster Public Private Partnership (PPP) for development aid for investment in waste collection or processing facilities.
- *Public Participation and Civic Education Programs:* Sponsor initiatives dubbed, “Zero Waste Neighbourhood” aimed at mobilizing residents to minimize waste at the community level. Create contests on waste segregation for the citizens in order to enhance participation. Introduce waste-oriented teaching programs to primary schools to promote relevant behavioral change

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

By adopting these measures, Indian cities can transition towards a more efficient, financially sustainable, and environmentally responsible SWM system, ensuring cleaner urban environments and improved public health.

9.0 Future Scope

- *Lack of Standardized Evaluation Frameworks:* Current research lacks a uniform methodology for assessing operational efficiency, financial sustainability, and technological adoption in SWM.
- *Insufficient Evaluation of Technological Interventions:* It is still unclear how waste-to-energy technologies, automated sorting, the Internet of Things and artificial intelligence (AI) can improve SWM till what extent in percentage.
- *Limited Comparative Studies:* Although Pune and Visakhapatnam use different SWM strategies, there isn't a thorough comparison to assess how effective they are.

References

Bholey, M. (2017). Smart cities and sustainable urbanism: A study from policy and design perspective. *Chollege International Journal of Multidisciplinary & Allied Studies, 4*, 36.

Central Pollution Control Board. (2021). *Annual report*. https://cpcb.nic.in

Diwat Kumar Shrestha, & P. B. M. (2024). Policies and practices for the conservation of natural resources during infrastructure development in Nepal. *NPRC Journal of Multidisciplinary Research, 1*(7), 1–19.

Greater Visakhapatnam Municipal Corporation. (2021). *GVMC annual report*. https://gvmc.gov.in

Gupta, A., Kumar, R., & Singh, N. (2020). Urban solid waste management in India: Challenges and policy recommendations. *Journal of Environmental Management, 258*, 110015. https://doi.org/10.1016/j.jenvman.2019.110015 (add DOI if available)

K. G. Sruthi, & Bhargavi. (2022). Solid waste management in India – Current trends. *Acta Scientific Medical Sciences, 6*(7), 30–35. https://www.actascientific.com/ASMS

Ministry of Urban Development. (2012). *Annual report 2013–14*. https://mohua.gov.in/upload/uploadfiles/files/Annual-Report-2013-14.pdf

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*

Oriana Ramirez-Rubio, Daher, C., Fanjul, G., Gascon, M., Mueller, N., Pajín, L., … Nieuwenhuijsen, M. J. (2019). Urban health: An example of a 'health in all policies' approach in the context of SDGs implementation. *Globalization and Health, 15*, 1–6. https://doi.org/10.1186/s12992-019-0491-8

Poulomee Arun Ghosh, Bobba, E. R., Dodda, S. S., Jasti, V. K., Meka, S., & Vanga, H. R. (2025). Scenario of solid waste management in Indian cities. *Ecology, Economy and Society–The INSEE Journal, 8*(1), 55–76. https://doi.org/10.37773/ees.v8i1.976

SWaCH Pune. (2022). *Annual performance report*. https://swachcoop.com

Swachh Bharat Mission. (2023). *Program overview*. https://swachhbharatmission.gov.in

T, N. (2009). Municipal solid waste management in India: From waste disposal to recovery of resources. *Waste Management, 29*(3), 1163–1166. https://doi.org/10.1016/j.wasman.2008.06.038

World Bank. (2022). *Solid waste management and service delivery*. https://www.worldbank.org

DOI: 10.17492/JPI/NICMAR/2507035 *ISBN: 978-93-49790-54-4*