

Assessing Solid Waste Management Challenges and Data-Driven Improvement Opportunities in Ahilyanagar District, Maharashtra, India

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ABSTRACT

Municipal and rural solid waste management is a multi-stage public service that depends on reliable waste data, source segregation, collection coverage, transport logistics, treatment capacity, recycling markets, institutional coordination and citizen participation. This paper develops an Ahilyanagar District-focused assessment framework informed by the integrated solid waste management perspective described by Abarca Guerrero, Maas, and Hogland (2013), but written independently and adapted to the local administrative context. Official district information lists 16 urban local bodies, while the Ahilyanagar Municipal Corporation reports daily waste generation of approximately 140–150 metric tonnes and an approximate present population of 400,000 for the city. Rahata Municipal Council is listed with a 2011 Census population of 22,335 and an area of 22.74 km². These figures provide a limited baseline, not a complete district waste inventory. The paper proposes a mixed-method approach combining official records, ward-level waste audits, household surveys, stakeholder interviews and statistical analysis. It recommends a district data dashboard, four-stream segregation, decentralised processing where feasible, formal integration of waste pickers, and performance monitoring. Since district-wide measured waste quantities and survey results were not available in the sources reviewed, no unsupported district-wide rates or empirical correlations are claimed.

Keywords: solid waste management, Ahilyanagar District, source segregation, municipal services, stakeholder participation, data-driven planning, recycling

INTRODUCTION

Solid waste management (SWM) is not simply a matter of removing refuse from streets. It is a connected system that begins with the generation of waste and continues through segregation, storage, collection, transportation, recovery, treatment and the safe handling of residues. Weakness at one stage can reduce the performance of the entire chain. For example, mixed waste can lower the value of recyclable materials, contaminate organic waste intended for composting and increase the quantity requiring final disposal.

Abarca Guerrero et al. (2013) reviewed waste-management systems in urban areas across developing countries and highlighted the interaction of technical, financial, environmental, socio-cultural, institutional and legal factors. Their study also emphasised that public authorities, service providers, households, businesses, recycling actors and informal waste

workers all influence system performance. The present paper uses that broad systems perspective as a starting point, but focuses on the administrative and service-planning needs of Ahilyanagar District.

The official district website lists 16 urban local bodies, comprising one municipal corporation, 11 municipal councils and four nagar panchayats. This institutional spread means that waste management cannot be understood through one city alone; urban centres differ in population, land area, commercial activity, tourism, collection infrastructure and access to processing facilities. The Ahilyanagar Municipal Corporation's SWM department reports 140–150 metric tonnes of waste generated per day in the city. This city-level figure should not be treated as the total for the district.

The policy context has also changed. The Government of India notified the Solid Waste Management Rules, 2026, effective from 1 April 2026, replacing the 2016

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rules. The 2026 framework mandates source segregation into wet waste, dry waste, sanitary waste and special-care waste, and strengthens monitoring and responsibilities of bulk waste generators (Press Information Bureau, 2026). Local assessment therefore needs to examine not only collection but also the separation, tracking and appropriate treatment of distinct waste streams.

2. Aim and Objectives

Aim: To develop a district-specific framework for assessing solid waste management challenges and identifying practical, data-driven improvement opportunities in Ahilyanagar District.

1. To map the principal stakeholders and responsibilities involved in urban and rural solid waste management.
2. To establish a consistent baseline for waste generation, collection, segregation, processing, recycling and residual disposal using verified records and field measurements.

3. To examine technical, financial, behavioural, environmental and institutional factors associated with service performance.
4. To assess public awareness and household/business practices related to source segregation and responsible handover of waste.
5. To propose measurable indicators and a data-driven planning framework that can support local authorities in prioritising interventions.

3. Study Area and Baseline Information

The study area is Ahilyanagar District in Maharashtra, India. The district's official municipal-administration page identifies 16 urban local bodies. For an initial local example, the same official page lists Rahata Municipal Council as a Class C council with an area of 22.74 km² and a 2011 Census population of 22,335. The Ahilyanagar Municipal Corporation website reports an area of approximately 84 km², a 2011 Census population of 350,859, an approximate current population of 400,000, and 140–150 metric tonnes of waste generated daily. The two population figures have different reference periods and should not be compared as if they were simultaneous measurements.

Indicator	Officially reported value	Interpretation / limitation
Urban local bodies in district	16: 1 municipal corporation, 11 municipal councils, 4 nagar panchayats	Administrative coverage; not a waste quantity
Ahilyanagar city area	About 84 km ²	Reported by the Municipal Corporation SWM department
Ahilyanagar city population	350,859 (2011 Census); approximately 400,000 currently	Current figure is an approximate municipal estimate
Ahilyanagar city waste generation	140–150 metric tonnes/day	City-level reported figure; district total is not established
Rahata Municipal Council area	22.74 km ²	Official district municipal-administration listing
Rahata population	22,335 (2011 Census)	Historical census value; not a current population estimate

A rough arithmetic comparison of 140–150 tonnes/day against the Municipal Corporation's approximate population of 400,000 gives 0.35–0.375 kg/person/day. This is only an implied indicative ratio, not a measured per-capita generation rate: the population is approximate, the waste quantity is a range, and daily visitors or other non-resident generators may contribute. It must not be used as a district-wide estimate.

4. Conceptual Framework

The proposed framework examines three connected dimensions: (i) the waste-service chain, (ii) the stakeholders responsible for or affected by each stage, and (iii) enabling conditions that influence performance. This adapts the systems logic of Abarca Guerrero et al. (2013) without copying their wording or transferring their results to Ahilyanagar.

Dimension	Elements to assess in Ahilyanagar
Waste-service chain	Generation and composition; household/business segregation; primary collection; secondary storage and transport; transfer; composting/biomethanation; material recovery; residual disposal
Stakeholders	Urban local bodies, gram panchayats, households, shops, hotels, markets, institutions, contractors, self-help groups, waste pickers, recyclers, NGOs and educational institutions
Enabling conditions	Vehicles and bins; worker training and safety; budget and cost recovery; public awareness; data quality; coordination; market access; land and processing capacity; compliance with current rules

The central proposition to be tested is that performance is influenced by the combination of infrastructure, operational management, public participation, institutional coordination and reliable information. These relationships are hypotheses for local investigation, not established findings for the district.

RESEARCH METHODOLOGY

5.1 Research design

A descriptive and analytical mixed-method design is proposed. Secondary data should first be compiled from the district administration, municipal corporations and councils, gram panchayats, Maharashtra Pollution Control Board (MPCB), and relevant national reporting portals. Primary data should then validate service conditions and explain differences between locations. The study should distinguish verified administrative records, direct field measurements, respondent perceptions and estimates.

5.2 Sampling and field data

A feasible design is stratified sampling across selected urban local bodies and rural settlements, with sites

selected to represent large and small population centres, commercial areas, residential neighbourhoods and peri-urban/rural conditions. A final sample size should be calculated from the study objectives, available resources and expected variability rather than chosen arbitrarily. Household surveys may record household size, waste separation practices, collection frequency, satisfaction, awareness and barriers. Interviews should include municipal officers, sanitation supervisors, collection workers, waste pickers, recyclers and community representatives.

5.3 Waste audit and indicators

At sampled sites, waste should be weighed and classified over a defined number of consecutive days, including weekday/weekend variation where practical. Each audit should record location, date, sample source, gross weight, category weights, rejected contamination, collection status and the weighing method. The proposed four-stream classification is wet, dry, sanitary and special-care waste, consistent with the 2026 rules. Dry waste can be further separated for analysis into paper/cardboard, plastics, metals, glass, textiles, composites and residual dry material.

Indicator	Suggested calculation
Per-capita generation	Measured daily waste (kg) ÷ population served; report denominator and coverage
Segregation rate	Waste handed over in correctly separated streams ÷ total waste sampled × 100
Collection coverage	Households receiving the defined collection service ÷ households surveyed × 100
Material recovery rate	Quantity recovered for reuse/recycling ÷ total waste received × 100
Processing rate	Quantity processed through verified treatment facilities ÷ total waste generated or collected × 100; specify denominator
Service reliability	Scheduled collections completed ÷ scheduled collections × 100

5.4 Analysis plan

Descriptive statistics should summarise waste quantities, composition, service frequency and survey responses. Cross-tabulations can compare segregation practices by settlement type, household characteristics and awareness. Spearman correlation may be used for ordinal measures if assumptions and sample size are suitable. Regression or classification models should only be applied when sufficient, well-documented observations are available. Missing values, measurement dates, units and population denominators must be documented. Any model should be validated on held-out data and reported with suitable metrics.

5.5 Ethics and data quality

Participation in surveys should be voluntary and based on informed consent. Personal identifiers should not be published. Field teams should use a common questionnaire, calibrated weighing scales, consistent waste categories and a documented data dictionary. Municipal estimates should be cross-checked against weighbridge records, collection logs and processing-facility records wherever possible.

6. Preliminary Secondary-Source Assessment

The available official sources establish the administrative scale of the district and provide one city-level waste-generation range, but they do not provide a complete, comparable dataset for all 16 urban local bodies and rural areas. As a result, the evidence supports a baseline and a research plan rather than a claim that the district's full waste system has already been quantitatively evaluated.

Three practical implications follow. First, city-level waste quantities should be kept separate from district-wide totals. Second, population values must carry their reference year or estimation status. Third, performance indicators should use common definitions across local bodies. For example, a reported collection percentage is not comparable across two councils unless both use the same definition of households covered, the same reporting period and a consistent denominator.

The main evidence gap is the absence, in the reviewed sources, of a harmonised district dataset showing daily waste generated, collected, processed, recycled and disposed of by each local body, together with

composition and seasonal variation. The study should request monthly and ward-level records from local bodies and MPCB, then validate them with field audits. Results should not be inferred from the 140–150 tonnes/day figure for Ahilyanagar city alone.

7. Discussion and Recommended Interventions

A district-level approach should focus on coordination and measurement before selecting expensive technologies. A common reporting template can make waste quantities, service coverage, processing outcomes and expenditure comparable across local bodies. A dashboard should display daily or monthly generation, collection performance, stream-wise processing, complaints, vehicle availability, facility downtime and residual quantities sent for disposal. Records should be timestamped and linked to a named reporting authority.

Source segregation is a prerequisite for higher-quality composting and recycling. Awareness activities should be paired with reliable separate collection; messaging alone is unlikely to sustain participation if segregated waste is later mixed. Bulk generators such as markets, hotels, institutions and large residential premises should be assessed separately because their waste volumes and management options may differ from those of individual households.

Organic waste should be assessed for decentralised composting or biomethanation where composition, land, operating capacity and end-use markets support it. Dry recyclables should be channelled through material recovery and authorised recycling routes. Sanitary and special-care waste requires separate handling under applicable requirements. Only processing residues and appropriate inert material should proceed to final disposal. The selection of technology must follow waste audits and operational feasibility rather than assumed composition.

Waste pickers and small recycling businesses should be included in system design, training and safety planning. Their role can improve material recovery, but formal integration should protect livelihoods and occupational health. Inter-municipal cooperation may also be useful where smaller councils lack sufficient scale to operate specialised facilities independently.

CONCLUSION

This paper translates a systems-based solid waste management perspective into a district-specific research framework for Ahilyanagar. Official sources confirm a network of 16 urban local bodies, a reported city-level waste generation of 140–150 metric tonnes per day for Ahilyanagar Municipal Corporation, and baseline administrative details for Rahata Municipal Council. These facts demonstrate the need for careful spatial and temporal boundaries; they do not establish the total waste generated across the district.

The recommended next step is a verified district baseline built from common local-body records, representative waste audits and stakeholder surveys. A data-driven framework can then identify where source segregation, collection reliability, processing capacity, recycling markets, worker safety and institutional coordination require priority attention. Quantitative conclusions about correlations or district-wide performance should be published only after the primary and administrative data have been collected and analysed.

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