

Sustainable Waste Management in North-Eastern Nigeria: An Integrated Approach

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Abstract

Rapid urbanisation in low-income sub-Saharan African cities has aggravated solid waste management challenges, resulting in unregulated disposal, open burning, and public health risks. This study, guided by the Integrated Sustainable Waste Management (ISWM) framework and the principles of the Circular Economy (CE), examines solid waste management practices in Damaturu, Maiduguri, and Potiskum. It employs a mixed-methods approach that combines household surveys ($n = 500$), stakeholder interviews ($n = 30$), and field observations. The study addresses the research gap concerning the lack of empirical data from economically challenged Nigerian cities that integrate Integrated Sustainable Waste Management (ISWM) with Circular Economy (CE) principles, while also considering socio-political, gender, and economic factors. The statistical analyses utilised include descriptive statistics, chi-square testing, logistic regression, and cost-benefit analysis. Findings indicate that 85% of households depend on open dumping or burning, while only 15% utilise formal services; 68% were unaware of the associated health hazards, although 60% expressed a willingness to invest in improvements. Education ($OR=2.15$) and income ($OR=1.74$) were predictors of investment willingness. The cost-benefit analysis confirms that awareness activities, public-private partnerships (PPPs), and community recycling efforts are both technically feasible and socioeconomically beneficial. The paper provides unique evidence-based policy suggestions specifically designed for low-income, conflict-affected metropolitan areas in Nigeria.

Keywords: Integrated Sustainable Waste Management (ISWM), Circular Economy, Public-Private Partnerships, Urban Solid Waste.

Introduction

Rapid urbanisation has led to significant infrastructural challenges, particularly in waste management, in low-income cities worldwide, especially in Nigeria and sub-Saharan Africa (Adipah & Kwame, 2019). Numerous factors, including economic opportunities, rural-to-urban migration, and inadequate governance frameworks, contribute to this trend (Zohoori & Ghani, 2017). Many low-income cities lack the essential infrastructure for efficient waste collection and disposal, resulting in widespread unregulated dumping and pollution (Abubakar et al., 2022). Waste management often consumes a significant portion of municipal budgets (3%–15%), with the majority of funds directed toward collection rather

than sustainable waste practices (Kumari & Raghubanshi, 2023). This imbalance contributes to public health crises and environmental degradation, disproportionately affecting marginalised communities (Abubakar et al., 2022).

In these contexts, informal waste pickers play a crucial role in recycling efforts, reducing cities' carbon footprints and enhancing environmental conditions, although their contributions are often overlooked (Gutberlet, 2018). However, without adequate waste collection, transportation, and disposal infrastructure, cities often resort to open dumping and burning, practices that intensify environmental pollution and public health risks (Ferronato & Torretta, 2019). Shifting toward innovative waste recycling models presents a pathway to enhance resource recovery and reduce waste generation at the source (Xu, 2024).

Technological limitations and low community involvement further hinder effective waste management. Addressing these challenges through the adoption of appropriate technology and increased community engagement can significantly improve waste management performance (Gutberlet, 2018). Research comparing cities with varying GDP and Human Development Index (HDI) levels reveals that while wealthy cities may have more frequent waste collection, they still face significant challenges in waste management. Emerging cities can get essential lessons from studying the experiences of both high- and low-GDP cities (Sohkhlet & Nagargoje, 2020).

Nigeria faces significant challenges in municipal solid waste management due to rapid urbanisation, with waste generation projected to nearly double by 2040 (Ezeudu, Agunwamba, Ugochukwu, & Ezeudu, 2021). Poor infrastructure, insufficient funding, insufficient institutional frameworks, and lax enforcement of regulations are among the main problems (Winter & Ujoh, 2020). In northeastern cities like Maiduguri, where careless plastic waste disposal causes environmental damage and potential health hazards, these issues are particularly severe (Donuma et al., 2024). There is increasing interest in switching to a circular economy model because the existing linear economy strategy for waste management is unsustainable (Onungwe, Hunt, & Jefferson, 2023). However, a lack of strategic planning, inadequate finance, and weak laws are obstacles to execution. To address these challenges, experts recommend improving waste management infrastructure, increasing public awareness, and promoting sustainable alternatives to plastic packaging (Donuma et al., 2024; Onungwe et al., 2023).

The evolution of waste management strategies has shifted towards comprehensive approaches that integrate environmental, economic, and social dimensions, highlighting the notion of waste as a valuable resource (Arya & Shukla, 2025). The Integrated Sustainable Waste Management (ISWM) framework utilises Internet of Things (IoT) technology to enhance the efficiency of waste collection and routing, taking into account the challenges of stakeholder engagement and inherent uncertainties (Hashemi-Amiri et al., 2023). An extensive examination of global solid waste management strategies reveals

notable disparities between the Global North and South, highlighting the necessity for enhanced compliance with waste hierarchies and circular economy principles, alongside the promotion of greater stakeholder involvement and collaborative partnerships to further the United Nations Sustainable Development Goals (Awino & Apitz, 2024).

Although global academic literature increasingly supports holistic waste management models, empirical evidence from Nigeria's economically deprived cities is scarce, particularly in studies that successfully apply Integrated Sustainable Waste Management (ISWM) in conjunction with the principles of the Circular Economy. The majority of current research in Nigeria focuses on technical or policy-related aspects separately, ignoring the behavioural and socio-economic elements that are crucial for long-term, sustainable success.

This study addresses this gap by evaluating current SWM methods, identifying socio-economic determinants of willingness to pay for improved services, and assessing the feasibility of interventions such as PPPs, community recycling, and awareness campaigns.

Methodology

Location

The investigation was conducted in three urban centres located in northeastern Nigeria: Damaturu, Maiduguri, and Potiskum. These urban centres were chosen due to their heterogeneous demographic characteristics, varying levels of waste generation, and common difficulties with urban waste management. Damaturu serves as the capital of Yobe State, boasting an approximate population of 88,000. However, it suffers from inadequate waste collection services, with numerous neighbourhoods lacking regular waste collection facilities. In a similar vein, Maiduguri, recognised as the capital of Borno State and the most populous city in the region, faces significant waste management challenges due to its high population density, which is estimated to exceed 1 million. Correspondingly, Potiskum, serving as a commercial hub in Yobe State, faces waste management issues intricately linked to its bustling markets, which generate substantial quantities of plastic, organic, and textile waste.

Research Design

A mixed-methodological approach was employed, guided by the Integrated Sustainable Waste Management (ISWM) framework and the principles of the Circular Economy. This research employed quantitative household surveys, qualitative interviews with stakeholders, and direct field observations to gain a comprehensive understanding of waste management methods and the operational constraints they face.

Sampling Procedure and Sample Size Determination

Sampling Frame

The sampling frame included all households within the urban limits of the three study cities,

as delineated by the city authorities.

Stratifications

To ensure equal representation across socio-economic strata, residential areas were classified into low, middle, and high-income categories based on housing attributes, infrastructure accessibility, and typical rental prices.

Sample size determination

The sample size was determined using Cochran's formula for an unknown population at a 95% confidence level and a $\pm 5\%$ margin of error.

$$n_0 = \frac{Z^2 \cdot p(1 - p)}{e^2} \dots \dots \dots 2.3.3$$

Where

Z^2 is 1.96 (for 95% confidence)

p is the assumed proportion of households practising open dumping (0.85 based on preliminary observations).

e is 0.05

A sample size of 196 was initially obtained; however, to facilitate sub-group analysis and address potential non-responses, the sample size was increased to 500 households: Maiduguri (228), Potiskum (137), and Damaturu (135).

Collection Instruments

Household Survey

A structured questionnaire was developed in English and thereafter translated into Hausa for localised use. It consisted of four distinct sections: demographic data (age, gender, income, and education); waste management practices (disposal methods, collection frequency, and segregation habits); awareness and perceptions (knowledge of environmental issues and perceived health risks); and willingness to pay for improved services. The instrument underwent a preliminary testing phase with 30 homes located outside the specified study sites. The instrument's dependability was confirmed by Cronbach's alpha ($\alpha = 0.82$), signifying strong internal consistency.

Stakeholder Interviews

Complementing the surveys, semi-structured interviews were conducted with 30 stakeholders, including local governmental representatives, agents from waste management firms, and community leaders. The purpose of these interviews was to investigate operational impediments, financial limitations, and potential avenues for collaboration between the public and private sectors.

Field Observations

Field observations were additionally conducted at waste collection locations and dumpsites to systematically record waste composition, collection frequency, overflow conditions, waste segregation practices, and the involvement of informal waste collectors in the recycling process.

Data Analysis

Stata version 17 and SPSS version 27 were used to analyse the data. Demographic and behavioural characteristics were captured using descriptive statistics, which include means, frequencies, and percentages. To examine the relationship between waste disposal practices and socio-economic position, chi-square tests were employed. To determine predictors of willingness to pay for enhanced services, binary logistic regression was utilised; odds ratios (OR) and 95% CIs were displayed. The three suggested solutions were subjected to a cost-benefit analysis (CBA), which combined capital and operating expenses, expected waste reduction, revenue generation, and possible health savings. To compare the treatments in terms of cost per percentage point decrease in open dumping, a cost-effectiveness analysis (CEA) was carried out.

Information from interviews was methodically coded using NVivo version 12 and subjected to theme analysis for the qualitative component. The codes were combined into main themes that included operational inefficiencies, institutional and legislative impediments, potential for stakeholder collaboration, and difficulties with community participation.

Ethical Considerations

Institutional ethical clearance was obtained prior to the initiation of the research. All participants were thoroughly informed of the study's objectives, the voluntary nature of their participation, and their right to withdraw at any time without facing any consequences. Before commencing data collection, informed consent was obtained both verbally and, when possible, in written form. Anonymity and confidentiality were strictly maintained; no personally identifying information, including names or residential addresses, was recorded in the dataset. Data were securely stored and employed solely for academic purposes. Cultural sensitivities were respected by conducting surveys and interviews in the locally favoured language (Hausa), followed by translation into English for analytical accuracy.

Data Triangulation

A triangulation methodology was applied to enhance the validity and reliability of the research findings. Three complementary data sources were integrated: household surveys (quantitative data on practices and willingness to pay), stakeholder interviews (qualitative insights regarding institutional and operational challenges) and field observations (direct, objective assessments of waste management practices). The triangulation of these sources

enabled the cross-verification of information and the identification of convergent and divergent trends. Household surveys recorded habits, while field observations provided empirical evidence of actual behaviours at dumpsites, and stakeholder interviews contextualised these practices within policy and physical constraints. This multi-method approach facilitated a more comprehensive and reliable understanding of the waste management system in the three cities.

Results

Field Observation Survey

Field observations conducted at waste collection sites within these urban environments indicated a significant deficiency in the establishment of designated dumping and collection zones. In cases where such facilities are present, the frequency of collection by municipal authority averages merely once every two months, which is grossly insufficient for densely populated neighbourhoods, leading to waste overflow and unsanitary conditions. Furthermore, the practice of waste segregation at the household level is virtually absent, with 96% of surveyed individuals lacking awareness of any recycling initiatives. Informal recyclers, typically comprising young people or unemployed individuals, collect plastics and metals from waste sites; however, they operate without formal support or regulatory oversight. In addition, it was noted that government personnel were observed burning refuse at collection sites every two days; nevertheless, this practice fails to adhere to environmentally sustainable principles. Collectively, these findings highlight the pressing need for enhanced waste management strategies and increased community involvement in recycling initiatives to effectively address these critical challenges.

Demographic and Behavioural Characteristics of Respondents

The demographic profile of the participants reveals that 54% were male and 46% were female, with a mean household size of 6.2 individuals ($SD = 2.1$). The age distribution was quite equitable, with 32% of respondents aged 18 to 30 years, 41% aged 31 to 50 years, and 27% aged 51 years or older. Concerning educational achievement, 28% of individuals lacked formal education, 37% had secondary education, and 35% had tertiary education. The income distribution displayed a significant bias towards the lower income category, with 52% of respondents earning below ₦20,000 monthly, 30% earning between ₦20,000 and ₦50,000, and 18% earning above ₦50,000.

Household waste segregation was nearly absent, with only 4% of respondents reporting any involvement in separating recyclable items.

Table 1: Demographic and Behavioural Characteristics of Respondents (N = 500)

Variable	Category	Frequency (n)	Percentage (%)	Mean (SD)
Gender	Male	270	54.0	–
	Female	230	46.0	–
Age	18–30 years	160	32.0	
	31–50 years	205	41.0	
	Above 50 years	135	27.0	
Household size	–	–	–	6.2 (±2.1)
Education	None	140	28.0	–
	Secondary	185	37.0	–
	Tertiary	175	35.0	–
Income	< ₦20,000	260	52.0	–
	₦20,000–₦50,000	150	30.0	–
	> ₦50,000	90	18.0	–
Segregation practices	Yes	20	4.0	–
	No	480	96.0	–

Household Waste Management Practices

Table 2: Household Waste Disposal Methods by City

Disposal Method	Maiduguri (n=228)	Potiskum (n=137)	Damaturu (n=135)	Total (%)
Open dumping/burning	180	100	120	85.0
Formal collection service	40	28	17	15.0
Informal collectors	8	9	3	5.0

The study results, illustrated in Table 2, reveal that open dumping and burning remain the primary waste disposal techniques in all three cities, with 85% of households utilising these practices. Only 15% of respondents reported access to formal waste collection services, while 5% utilised informal collectors (note, several families employed various disposal methods).

Awareness of Environmental and Health Impacts

Survey data further revealed that 68% of survey respondents were unaware of the environmental and public health risks associated with inappropriate waste disposal. The degree of awareness exhibited a significant association with educational attainment ($\chi^2 = 39.4$, $df = 4$, $p < 0.001$) and household income ($\chi^2 = 28.6$, $df = 4$, $p < 0.001$).

Table 3: Awareness Levels and Barriers to Sustainable Waste Practices

Indicator	% of Respondents	Statistical Association	Significance
Unaware of health/environmental risks	68%	Education ($\chi^2 = 39.4$, $df = 4$)	$p < 0.001$
		Income ($\chi^2 = 28.6$, $df = 4$)	$p < 0.001$
Reported barriers: Lack of awareness	78%	–	–
Reported barriers: Inconvenience	69%	–	–

Furthermore, 78% and 69% of respondents identified "lack of awareness" and "inconvenience" as the primary barriers to adopting environmentally efficient waste management procedures, respectively.

Willingness to Pay for Improved Waste Services

Table 4: Predictors of Willingness to Pay for Improved Waste Management (Binary Logistic Regression)

Predictor	Odds Ratio (OR)	95% CI	p-value
Education (Tertiary vs None)	2.15	1.33–3.49	0.002
Income (>₦50k vs <₦20k)	1.74	1.14–2.64	0.010
Awareness (Yes vs No)	1.89	1.21–2.94	0.005

60% of survey respondents expressed a willingness to pay a nominal monthly charge, typically between ₦200 and ₦500, for enhanced waste disposal services. The regression analysis clarified the societal and economic factors that support this willingness. Households with university-level education demonstrated over double the likelihood (odds ratio = 2.15, $p = 0.002$) of expressing willingness compared to those without formal educational qualifications, highlighting the impact of education on environmental accountability and service value assessment. Similarly, households with monthly incomes higher than ₦50,000 exhibited a significantly greater likelihood (odds ratio = 1.74, $p = 0.010$) of paying than low-income households earning below ₦20,000, indicating that financial capacity directly affects support for improvements in service provision. A heightened level of environmental awareness emerged as a crucial predictor, with respondents exhibiting greater knowledge being nearly twice as likely (odds ratio = 1.89, $p = 0.005$) to support a fee, thereby highlighting the essential role of risk perception in driving behavioural change.

Operational Efficiency Gaps

Field observations revealed that waste collection in most residential areas occurred just once every two months. The municipal collection vehicles were often over ten years old, frequently had technical malfunctions, and operated without the application of optimum

routing strategies. Informal recyclers were common at numerous disposal sites; nevertheless, they lacked protective equipment and were not legally integrated into the municipal waste management system.

These operational inefficiencies led to persistent waste overflow, offensive odours, and open burning at collection locations, which are in direct contradiction to recognised environmental best practices.

Cost–Benefit and Cost-Effectiveness of Proposed Interventions

Table 5: Comparative Cost–Benefit of Proposed Interventions

Intervention	Cost (₦ million)	% Impact (reduction or adoption)	ROI (years)	Cost-effectiveness (₦ per % point)
Community Recycling	20.0	30% waste reduction	2.0	666,667
PPP	15/month	40% dumping reduction	1.5	375,000
Awareness + Incentives	20.0	45% segregation adoption	1.0	444,444

Community-Based Recycling

In this proposed scheme, bins, transportation, and community training are all included in the ₦20 million initial setup expenditures for the waste management program. Through efficient recycling and reuse techniques, this effort is expected to cut waste volume by 30%. Furthermore, the predicted two-year return on investment is fuelled by lower disposal costs and money from recyclable materials. This program's sustainable methods not only improve waste management but also yield financial gains, with a Cost-effectiveness of ₦666,667 per percentage point reduction in open dumping.

Public-Private Partnerships (PPP)

The monthly contractual obligation for this initiative is projected to amount to ₦15 million in collaboration with a private waste management firm. The objective of the proposed plan is to augment the frequency of waste collection to biweekly intervals, thereby substantially mitigating litter accumulation and the burning of refuse. The anticipated return on investment encompasses a favourable revenue effect, primarily fuelled by enhanced operational efficiency. Furthermore, the initiative has the capacity to extend its services to adjacent communities, which could subsequently bolster its profitability and improve environmental conditions. The Cost-effectiveness stands at ₦375,000 per percentage point reduction in open dumping.

Awareness Campaign and Community Incentives:

The financial implications of the campaign were projected to reach ₦20 million, encompassing expenditures on materials and incentives designed to enhance the

initiative's viability. This program was designed to enhance community engagement, aiming for a target of 45% of households implementing waste segregation methodologies. The expected return on investment is anticipated to manifest in the form of improved environmental health outcomes and a decrease in healthcare expenditures attributable to waste-related health complications. The cost-effectiveness stands at ₦444,444 per percentage point increase in adoption of segregation.

Discussions

Interpretation of Findings through the ISWM Framework

The findings highlight that waste management in the surveyed North-eastern Nigerian cities is mainly characterised by unregulated disposal practices, notably open dumping and burning, which corresponds with ISWM's acknowledgement of deficient "physical elements" in numerous low-income environments (Wilson, Velis, & Rodic, 2013). The bi-monthly collection frequency, coupled with outdated trucks and a lack of trash segregation, exemplifies operational inefficiency.

From the ISWM standpoint, two governing factors are significantly neglected. Stakeholder inclusion is deficient, as informal recyclers actively participate yet are marginalised from the formal waste management system. Financial sustainability is lacking, as municipal income generation for trash services is nearly non-existent and primarily reliant on constrained public finances.

Cultural and gender dynamics, in addition to infrastructure and financial, influence waste habits. Social norms frequently emphasise convenience (e.g., roadside disposal), but stigma associated with waste management constrains household-level segregation. Women predominantly manage waste at home, yet are inadequately represented in decision-making, resulting in a dissonance between reality and policy. Governance deficiencies, including inadequate enforcement of regulations, constrained municipal capabilities, and political interference, exacerbate these issues.

The identified shortcomings suggest that a comprehensive strategy, combining infrastructure investments, inclusive stakeholder frameworks, and diverse financial mechanisms, is essential to alter the current trajectory.

Circular Economy Opportunities and Constraints

Embracing a Circular Economy (CE) framework redefines waste as a valuable asset. Our research suggests that waste segregation occurs when awareness and incentives are sufficiently offered, indicating considerable potential for resource recovery. The cost-benefit study indicated that community-driven recycling activities could reduce waste volumes by 30%, thereby aligning with the circular economy's aims of closing material loops. However, the shift towards a circular economy is hindered by:

- The lack of a localised market for recycling

- Insufficient technical capability for efficient waste segregation and processing
- A lack of supportive legislative frameworks that enforce segregation rules and promote the recycling sector.

Opportunities within the circular economy exhibit gender disparities: women predominantly engage in domestic sorting and low-value recycling, whereas men typically manage more lucrative items, such as scrap metal. In the absence of specific support, women continue to be marginalised from economic benefits. Waste is frequently perceived as "dirty" rather than a resource, which hinders engagement in recycling efforts. Mitigating these views by community-based awareness efforts could augment participation.

Without tackling these systemic hurdles, the implementation of CE risks being cosmetic, focusing on minor pilot initiatives rather than facilitating systemic reform.

Global Comparisons

The occurrence of open dumping in our study aligns with the conditions recorded in Nairobi County, Kenya (Muiruri, Wahome, & Karatu, 2020) and a low-income neighbourhood of Komani, South Africa (Ngalo & Thondhlana, 2023). In both instances, the application of Public-Private Partnership (PPP) models was found to improve service reliability and coverage scope.

The recorded 1.89-fold increase in the willingness to pay among environmentally conscious respondents aligns with findings from Dodoma Urban District, Tanzania (Mushi, 2024), where awareness was found to be statistically significant and positively affects willingness to pay for improved solid waste management techniques at 1% significance level ($p = 0.002$).

Success stories regarding community-based recycling initiatives from Brazil (Miranda, Fidelis, de Souza Fidelis, Pilatti, & Picinin, 2020) and Kenya (Nyongesa & Van Der Westhuizen, 2025) demonstrate that, when provided with sufficient training and infrastructure, local cooperatives can achieve diversion rates exceeding our expected reduction of 30%. In contrast to Brazil and Kenya, where cooperatives and PPPs incorporate informal participants, governance in Northeastern Nigeria remains fragmented. Inadequate accountability and centralised decision-making hinder the efficacy of changes, highlighting the necessity for community-state co-production.

This suggests that enhancing the intervention and strengthening institutional support may yield significantly greater benefits in Northeastern Nigeria.

Policy and Practice Implications

Institutional Reform

Municipal institutions must create legal agreements with informal recycling organisations, granting them operational legitimacy, access to necessary protective equipment, and incorporation into existing collection routes.

The formal acknowledgement of informal recyclers must incorporate gender-sensitive policies that empower women via cooperative membership and training initiatives.

Financing Models

PPPs can help address infrastructure gaps, but they require transparent contracts, performance-based incentives, and safeguards to ensure affordability for low-income individuals.

Infrastructure for Behavioural Change

Continuous awareness campaigns should be conducted in local languages and linked to readily accessible waste segregation locations. Incentives, such as fee reductions or awards for recyclers, enhance ongoing participation.

Awareness programs must be linguistically tailored and culturally grounded, leveraging community and religious leaders to transform norms regarding waste and recycling.

Legislation on Circular Economy

The enactment of mandatory segregation laws, landfill taxes, and initiatives to cultivate recycling markets can promote the growth of the Circular Economy in metropolitan regions of Nigeria.

Limitations and Future Research

The cross-sectional design utilised in this study limits the ability to draw causal inferences about behavioural change. Longitudinal research is essential for evaluating the long-term effects of interventions. Furthermore, subsequent research should examine the life-cycle environmental impact of the proposed interventions and assess the gender-specific aspects of participation in waste management, given the established evidence that women often bear the primary responsibilities related to household waste management in African contexts.

Conclusions

This study examined solid waste management techniques in the economically challenged cities of Maiduguri, Damaturu, and Potiskum, utilising the principles of Integrated Sustainable Waste Management and Circular Economy. The unique contribution lies in the integration of quantitative household data, stakeholder perspectives, and empirical observations to clarify how cultural norms, gender roles, and governance deficiencies intersect with infrastructural limitations, thereby influencing waste management practices in Northeastern Nigeria, a region often overlooked in scholarly discussions.

The research demonstrated strong relationships among socio-economic status, educational attainment, and waste disposal methods. Logistic regression analysis

confirmed that environmental awareness is a key predictor of the willingness to pay for improved services. The cost–benefit analysis revealed that awareness initiatives combined with incentives are the most economically viable strategies for behavioural change, while public-private partnerships (PPPs) and community-focused recycling programs provide significant benefits in waste reduction and operational efficiency.

The policy consequences are clear. Local government agencies should formalise informal waste recyclers, particularly focusing on female participants, by creating cooperative structures and offering pertinent training to facilitate their incorporation into waste management systems. Secondly, funding structures ought to prioritise public-private partnerships (PPPs) that include transparency measures and protections for affordability. Thirdly, activities designed to modify consumer behaviour require the execution of culturally pertinent awareness campaigns, delivered in local languages and supported by endorsements from traditional and religious leaders. Ultimately, both national and state governments should enact binding legislation regarding the circular economy, including mandatory waste segregation and the development of recycling markets, to go beyond temporary pilot programs.

This study recommends:

- Institutional integration through officially assimilating informal recyclers into municipal trash management systems, providing training and protective equipment.
- Expanding the framework of open, performance-oriented Public–Private Partnerships (PPPs) to improve service accessibility in underserved areas.
- Awareness and incentives through implementing continuous, multilingual awareness campaigns along with concrete incentives for waste segregation.
- Regulatory reforms by mandating compulsory source segregation and executing complementary circular economy policies.
- Infrastructure investment through modernising waste collection fleets and implementing decentralised sorting and processing facilities.

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