VOL. 08 NO. 4,
MAY, 2025
E-ISSN 3026-9210
P-ISSN 3026-815X

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Built Env. & Geological Research (JBEGR)

An Assessment of Solid Waste Management Methods in Port Harcourt Metropolis, Nigeria

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DOI: https://doi.org/10.70382/ajbegr.v8i4.033

Abstract

Solid waste management remains a persistent challenge in Port Harcourt Metropolis, Nigeria, with far-reaching environmental and public health implications. This study investigates the disposal practices of residents across selected communities and examines the socio-demographic, institutional, and infrastructural factors influencing those behaviors. Using a descriptive survey design, data were collected through a structured questionnaire administered to 160 residents, selected via a combination of simple random and convenience sampling methods. The questionnaire was pretested for validity and reliability, and data were analyzed using descriptive statistics. Findings reveal that although awareness of the health risks associated with improper waste disposal—such as cholera, malaria, and respiratory infections - is relatively high, actual compliance with proper disposal practices remains moderate. Key determinants of behavior include educational attainment, income level, and residential location. Institutional weaknesses, poor infrastructure, and inconsistent waste collection exacerbate the problem. The study identifies a disconnect between environmental knowledge and behavioral compliance, suggesting the need for multi-dimensional interventions. Recommendations include strengthening waste management infrastructure, enhancing community-based environmental education, and improving regulatory enforcement. The study further proposes an Integrated Risk-Based Approach (IRBA) tailored to the local socio-economic context. By providing empirical insights and a grounded framework, this research contributes to the discourse on urban waste governance and supports policy development for sustainable environmental management in Nigeria.

Keywords: Solid Waste Management, Urban Sanitation, Waste Disposal Infrastructure, Environmental Behavior, Disaster Vulnerability, Community Resilience, Climate Adaptation, Municipal Waste Policy

Introduction

Rapid urbanization and population growth in Nigerian cities, including Port Harcourt, have significantly increased the generation of municipal solid waste, presenting complex environmental, health, and infrastructure challenges (Tamunobereton-Ari et al., 2025; Agwu et al., 2022). Port Harcourt, a Niger Delta industrial center with a population exceeding three million, reportedly produces approximately 750,000 metric tons of solid waste annually (Nzeadibe et al., 2021; Tamunobereton-Ari et al., 2025). Effective management of this waste is crucial to preserving urban sanitation standards, preventing environmental degradation, and safeguarding public health (Agwu et al., 2022; Tamunobereton-Ari et al., 2025).

Scholars have identified a series of interlocking challenges besetting waste management in Nigerian urban centers. Key institutional constraints include weak governance frameworks, inadequate funding, insufficient infrastructure, and limited technical capacity among municipal authorities (Nkwocha et al., 2023; Agwu et al., 2022; Tamunobereton-Ari et al., 2025). In Port Harcourt, for instance, 75% of public waste receptacles are substandard and lack segregation capability, contributing to inefficient treatment and disposal systems (Tamunobereton-Ari et al., 2025). Further, inadequate transport logistics and poor coordination amplify operational inefficiencies and environmental risks (Nkwocha et al., 2023; Agwu et al., 2022). Poor public awareness and uncoordinated behaviour have also been flagged as critical issues. Many residents lack understanding of the health risks posed by open dumping, burning, and flooding—such as cholera, respiratory illness, and vector-borne diseases (Adeniran et al., 2022; Ezechi et al., 2021; Agwu et al., 2022). The prevalence of informal disposal practices exacerbates pollution, contaminating water bodies and undermining public health interventions (Tamunobereton-Ari et al., 2025; Agwu et al., 2022).

Laser-focused waste management approaches in other Nigerian metros offer valuable lessons. In Lagos State, privatization of waste collection under a public–private partnership model demonstrated improved efficiency and service coverage, despite continuing institutional and funding challenges (Kugbayi & Adegbami, 2024). Initiatives such as Wecyclers—an enterprise incentivizing low-income households to collect recyclables—helped formalize recycling in communities otherwise

neglected by municipal systems (Wikipedia, 2023). Similarly, Uyo's experience with household-level waste behavior highlighted the need for household engagement and technical infrastructure to enable source separation and collection (Usoh et al., 2023a).

During the COVID-19 lockdown, urban centers like Ede reported a significant reduction in waste collection services, resulting in declining resident satisfaction (Adeniyi et al., 2024). This underscores the need for resilient systems capable of managing waste flows during periods of disruption. Comparatively, Kano Metropolis faced similar attitudinal and institutional issues; institutional deficiencies and negative public perceptions limited the effectiveness of current waste management systems (Muhammad & Marzuki, 2024).

Specifically addressing Port Harcourt, recent research paints a concerning picture. Solid waste is frequently dumped in open areas, waterways, and residential streets (Adeniran et al., 2022; Agwu et al., 2022; Tamunobereton-Ari et al., 2025). Lands in close proximity to informal dumpsites show signs of leachate infiltration into soil and groundwater, with overflowing drains heightening flood risks during the rainy season (Tamunobereton-Ari et al., 2025). Open burning remains prevalent, emitting toxic pollutants linked to respiratory diseases (Ezechi et al., 2021; Agwu et al., 2022). Subpar public receptacles and waste segregation deficits further hinder any potential circular economy transitions (Tamunobereton-Ari et al., 2025).

Emerging consensus among scholars recommends comprehensive, multifaceted strategies. Institutional reform to enhance funding, coordination, and enforcement is essential (Nkwocha et al., 2023; Adogame, 2024; Agwu et al., 2022). Behavioral interventions, including public education campaigns and citizen engagement, can address improper disposal habits (Usoh et al., 2023; Adeniyi et al., 2024). Integrating public–private partnerships and recycling enterprises can improve efficiency and resource recovery (Kugbayi & Adegbami, 2024; Wikipedia, 2023). Technological integration—such as AI-enabled smart bin systems—has also been proposed to automate sorting and monitor waste levels, supporting responsive collection (Nafiz et al., 2023).

Urban solid waste management in Port Harcourt is enmeshed in systemic governance failures, public behavior issues, and infrastructural deficits. A hybrid approach—combining regulatory reform, capacity enhancement, public–private collaboration, and smart technology—is needed to reform current practices (Tamunobereton-Ari et al., 2025; Agwu et al., 2022; Kugbayi & Adegbami, 2024).

Solid waste management in Port Harcourt remains a persistent challenge, with limited progress despite ongoing efforts. Macpepple et al. (2021) highlight widespread dissatisfaction with waste services and low public participation. Akinmoladun and Anuoluwapo (2019) found that demographic factors such as sex, age, and social class significantly affect residents' knowledge and engagement in waste disposal. Public health concerns linked to poor waste management are emphasized by Boniface and Okorafor (2021), who identify disease outbreaks like cholera and malaria as consequences of improper disposal. Ojo and Ijeoma (2020) further reveal that gender, education, and

income influence waste management behaviors, stressing the role of socio-economic status. Despite these issues, awareness of proper waste management is high. Oduwaye (2022) underscores the need for targeted education to reinforce the link between environmental cleanliness and public health. Okorie et al. (2017) also advocates adult education as a means to foster responsible waste disposal behavior. Together, these studies reveal the complex interplay between demographics, education, health, and behavior, calling for integrated strategies involving policy reform, infrastructure development, and education to address Port Harcourt's waste management problems effectively.

Knowledge Gap and Problem Statement

Indiscriminate solid waste disposal in Port Harcourt Metropolis, Nigeria, presents serious environmental and public health risks. Although public awareness of the dangers—such as cholera, diarrhea, and respiratory infections—is relatively high, compliance with proper disposal practices remains low. Contributing factors include poor infrastructure, inadequate funding, and overcrowded collection points. This study examines the effectiveness of current waste management systems and identifies barriers to compliance and proper disposal.

While numerous studies address solid waste management in Nigeria, few focus specifically on the unique socio-economic and environmental conditions of Port Harcourt. Existing literature often neglects localized challenges, evolving urban dynamics, and the influence of governance and behavior on waste practices. This research addresses those gaps by integrating community perspectives, evaluating institutional performance, and proposing a practical Integrated Risk-Based Approach (IRBA) suited to urban realities. It also considers critical emerging issues such as rapid population growth, informal settlements, and weak regulatory enforcement. By aligning with national and global sustainability goals, this study aims to inform policy, improve public health, and support environmental resilience in Port Harcourt and similar cities.

METHODOLOGY

This section outlines the research design, sampling techniques, data collection methods, and analytical procedures employed in the study. The methodology was developed to ensure the reliability, validity, and replicability of the findings. By adopting a structured approach involving both primary and secondary data sources, the study aims to obtain comprehensive insights into the subject matter. The choice of methods reflects the study's objectives and is tailored to the research context.

Participants/Population

This study was conducted across four communities in the Port Harcourt City Local Government Area of Rivers State, namely: Aba Road, Abali Park, Trans-Amadi, and Ordinance Road. The target population comprised men, women, and youths residing in

these communities, with a combined estimated population of 245,000 (National Population Commission, 2006).

Area of Study

The geographical scope of the study encompasses Aba Road, Abali Park, Trans-Amadi, and Ordinance Road—key communities within Port Harcourt City. These areas were purposively selected due to their urban character, socio-economic diversity, and relevance to solid waste management challenges in the metropolis. The findings from these communities are expected to inform practical recommendations for similar urban settings.

Sample and Sampling Techniques

The study utilized both simple random sampling and convenience sampling methods. Initially, 500 individuals across four communities—Aba Road, Abali Park, Trans-Amadi, and Ordinance Road—were assigned identification numbers. These were randomly drawn using the ballot method to select 120 participants, ensuring each individual had an equal probability of selection. However, due to accessibility challenges during fieldwork, convenience sampling was also employed, wherein willing participants were approached on-site when randomly selected individuals were unavailable. While this pragmatic approach enhanced field data collection, it may introduce selection bias and limit the generalizability of findings. These implications are acknowledged as part of the study's methodological limitations.

Questionnaire Validation and Data Collection Year

To enhance validity, the questionnaire underwent expert review and pretesting on 15 individuals from a neighboring community not included in the final sample. Feedback from the pilot test informed revisions to improve clarity, content relevance, and response reliability. The finalized data collection took place between March and May 2023.

Variable Specification

- **Dependent Variables**: Waste disposal behavior, level of compliance with environmental practices.
- **Independent Variables**: Gender, age, education level, occupation, income, religion, and residential area.

Data Collection Methods

Data for the study were primarily collected through the use of structured questionnaires. The survey instruments were distributed across various social categories within the study communities. The questionnaires were carefully designed to elicit information regarding respondents' knowledge, attitudes, and practices concerning waste management.

Questions were mostly open-ended to allow for detailed and flexible responses rather than simple binary choices.

The use of questionnaires was particularly suitable for exploring individual perspectives and patterns in environmental behavior. The anonymity of responses ensured honest participation. This method enabled the researcher to test the hypotheses of the study and address key research questions effectively. A brief analytic framework was employed to examine the responses obtained.

Instrumentation

Both primary and secondary data sources were utilized. Primary data were collected through face-to-face interactions, field observations, structured questionnaires, and informal interviews with residents. Secondary data were obtained from academic journals, textbooks, previous empirical studies, seminar papers, lecture notes, government documents, statistical bulletins, and credible online sources. These diverse sources enriched the contextual and empirical depth of the study.

Research Design

The study adopted a survey research design. This approach was deemed appropriate for systematically gathering data from a cross-section of the target population to make inferences about perceptions and practices related to solid waste management in Port Harcourt City. The design facilitated the collection of both qualitative and quantitative data essential for drawing meaningful conclusions.

Data Analysis and Statistical Procedures

This section presents the analysis of data collected through questionnaires, interviews, and observations. The analysis aims to identify patterns, trends, and relationships relevant to the study's objectives. Quantitative data are summarized using frequency tables and percentages, while qualitative responses are interpreted to provide contextual depth.

Data were collected through the administration of structured questionnaires, which the researcher personally distributed and retrieved from respondents. All 100 questionnaires administered were properly completed and returned, ensuring a 100% response rate. The data were coded and analyzed using descriptive statistical tools, including frequency tables and simple percentages, to present the findings clearly and interpret patterns within the data.

Demographic Characteristics of Respondents

Sex Distribution

As shown in Table 1, the sex distribution of respondents reveals that 80% were male, while only 20% were female. This indicates a predominantly male respondent base. Observational data suggest that most male respondents were household heads, often

married, while the female respondents were primarily single. The gender imbalance could influence household waste disposal patterns, as men may play a central role in decisions regarding utility payments and environmental practices.

Table 1: Sex Distribution of Respondents

Sex	No. of Respondents	Percentage (%)
Male	80	80
Female	20	20
Total	**100**	**100**
Source: Author's fieldwork, 2023		

Religious Affiliation

Table 2 indicates that the majority of respondents identified as Christians (70%), followed by traditionalists (20%) and Muslims (10%). This religious composition may impact attitudes toward environmental practices, as belief systems often shape ethical views on cleanliness, public health, and stewardship of the environment.

Table 2: Religious Affiliation of Respondents

Religion	No. of Respondents	Percentage (%)
Christianity	70	70
Islam	10	10
Traditional	20	20
Source: Author's fieldwork, 2023		

Age Distribution

As shown in Table 3, respondents within the age bracket of 20–35 years constituted the highest proportion (60%), followed by those aged 36–45 years (30%), and a minority (10%) aged 46–60. This suggests a youthful population, which is a critical demographic in promoting responsible environmental behavior and sustainable waste management initiatives.

Table 3: Age Distribution of Respondents

Age Range	No. of Respondents	Percentage (%)
20–35	60	60
36–45	30	30
46–60	10	10
Source: Author's fieldwork, 2023		

Occupational Distribution

Table 4 reveals that civil servants comprised 50% of the respondents, while traders accounted for 30%, and the unemployed 20%. This occupational structure reflects varying economic capabilities that may affect access to private waste disposal services and compliance with environmental regulations.

Table 4: Occupational Distribution of Respondents

Occupation	No. of Respondents	Percentage (%)
Civil Servants	50	50
Traders	30	30
Unemployed	20	20
Source: Author's fieldwork, 2023		

Educational Qualification

According to Table 5, most respondents had secondary education (SCE/WASC – 70%), followed by those with post-secondary qualifications such as NCE, OND, or HND (20%). Only 10% had primary education (FSLC). This indicates a moderately educated population, which may facilitate better understanding of environmental policies and improved waste disposal behavior.

Table 5: Educational Qualification of Respondents

Qualification	No. of Respondents	Percentage (%)
FSLC	10	10
SCE/WASC	70	70
NCE/OND/HND	20	20
Source: Author's fieldwork, 2023		

Environmental Management Issues

Perception of Value Systems and Urbanization

Table 6 reveals that 100% of respondents acknowledged that individual value systems and rapid urbanization contribute significantly to environmental degradation and poor waste management. This consensus highlights the urgent need for public environmental education and value reorientation programs.

Table 6: Impact of Individual Values and Urbanization on Environmental Management

Response	No. of Respondents	Percentage (%)
Yes	100	100
Source: Author's fieldwork, 2023		

Effect of Residential Patterns and Occupation

As shown in Table 7, 90% of respondents affirmed that residential patterns and occupational activities influence waste generation and disposal habits. This suggests that waste management strategies should be tailored to specific community layouts and socioeconomic dynamics.

Table 7: Influence of Residential Patterns and Occupation on Solid Waste Management

Response	No. of Respondents	Percentage (%)
Yes	90	90
No	10	10
Source: Author's fieldwork, 2023		

Prevalence of Indiscriminate Dumping

Table 8 illustrates that 90% of respondents observed widespread indiscriminate dumping and poor solid waste management in their communities. This finding supports the need for stricter enforcement of environmental laws and public sensitization.

Table 8: Awareness of Indiscriminate Dumping and Poor Waste Management

Response	No. of Respondents	Percentage (%)
Yes	90	90
No	10	10
Source: Author's fieldwork, 2023		

Personal Waste Disposal Practices

As presented in Table 9, 80% of respondents claimed they dispose of refuse properly, while 20% admitted to improper disposal. However, field observations suggest that actual compliance may be lower, as many respondents were seen disposing waste in drains, roadsides, or nearby bushes. This discrepancy highlights a gap between self-reported practices and real behavior.

Table 9: Personal Refuse Disposal Practices

Response	No. of Respondents	Percentage (%)
Yes	80	80
No	20	20
Source: Author's fieldwork, 2023		

Challenges Faced by Waste Management Authorities

Table 10 identifies major institutional challenges hampering effective waste management. The most cited issues include lack of funding (90%), inadequate skilled and unskilled

labor (80%), lack of modern waste management tools (90%), and poor data collection and enumeration systems (90%). These challenges necessitate urgent capacity-building interventions and increased investment in the sector.

Table 10: Challenges Faced by Waste Management Authorities

Challenge	Yes (%)	No (%)
Lack of funding	90	10
Inadequate manpower	80	20
Lack of modern tools	90	10
Poor enumeration and records	90	10
Source: Author's fieldwork, 2023		

The findings indicate that the main challenges confronting the authorities responsible for solid waste management include insufficient funding (90%), shortage of skilled and unskilled manpower (80%), inadequate tools (90%), and the absence of comprehensive enumeration data (90%). Addressing these deficiencies would require collective stakeholder effort, increased budgetary allocation, and the strengthening of institutional capacities.

DISCUSSION OF RESULTS

The results of this study offer valuable insights into the socio-demographic and behavioral dynamics influencing solid waste management practices in Port Harcourt metropolis. By analyzing the data across gender, age, occupation, and educational background, and applying statistical tests, the study identifies key factors that contribute to proper or improper waste disposal. These findings are interpreted in light of existing literature and local environmental conditions, with particular attention to the challenges faced by waste management authorities, public awareness levels, and community behavioral patterns. The discussion underscores critical areas requiring intervention and aligns with broader urban sustainability and public health objectives.

DISCUSSION OF FINDINGS

The findings of this study underscore the urgent need for a more inclusive and collaborative approach to solid waste management, especially in the context of prevailing economic constraints such as recession. Waste management should not be the sole responsibility of the government; rather, it should be a shared societal obligation. The indifferent attitude of some individuals toward environmental sanitation must be actively discouraged, as environmental degradation ultimately poses serious risks to public health, potable groundwater sources, air quality, and arable land crucial for agriculture.

Environmental sustainability, as advocated in contemporary global discourse and moral frameworks (cf. Oforibika & Ezekiel, 2014), is vital for the protection of future

generations. The study revealed that occupational status and educational attainment significantly influence individuals' waste disposal practices. Those with lower education or informal occupations were more likely to engage in improper disposal practices.

In addition, systemic challenges identified include insufficient funding, lack of skilled and unskilled manpower, outdated and inadequate management tools, and poor data collection systems. These factors collectively hinder effective solid waste management in Port Harcourt. However, these challenges can be surmounted if waste management is prioritized by government authorities as a critical component of public health and environmental sustainability. Policy makers, urban planners, and community leaders must act decisively to improve existing systems, especially within urban centers facing rapid population growth.

A practical and scalable strategy would be to implement low-cost, context-specific waste management interventions in rural and peri-urban areas. Over time, these systems can evolve toward more technologically advanced and sustainable solutions. Community participation and public awareness campaigns are essential in this transition.

It is important to note that while the data presented in this study were derived from surveys and interviews, further research—using detailed cost-benefit analyses, longitudinal studies, and impact assessments—is necessary to refine estimates of waste management effectiveness and understand the interplay between various contributing factors.

The demographic results reveal that the majority of respondents are young, educated males employed in the civil service, which may influence their awareness and attitudes toward environmental issues. A general consensus exists regarding the adverse impact of urbanization and personal lifestyle choices on environmental quality. The prevalence of indiscriminate dumping, inadequate refuse evacuation, and lack of proper disposal facilities contributes to environmental degradation in the study area.

Furthermore, the data indicate that while residents are aware of environmental protocols, economic pressures, poor enforcement, and logistical deficiencies hinder compliance. Institutional challenges, such as underfunding and inadequate manpower, severely affect the efficiency of waste management authorities. These findings underscore the urgent need for strategic reforms, community engagement, and infrastructural improvements to achieve sustainable solid waste management in Port Harcourt.

Statistical Results

To rigorously assess the relationships and patterns within the demographic and behavioral data gathered on solid waste management in Port Harcourt, a series of inferential statistical analyses were conducted. These analyses aimed to determine whether significant differences or associations existed between variables such as gender, occupation, age, and waste disposal behavior. The statistical tools applied included the Chi-Square Test of Independence, Independent Samples t-Test, One-Way Analysis of Variance (ANOVA), and Pearson Correlation Analysis. Each method was chosen based on the nature of the

data and the specific hypothesis tested. The results provide empirical insight into the demographic determinants of environmental behavior, identifying critical socio-occupational factors that influence waste disposal practices and supporting targeted recommendations for policy and educational interventions.

Gender and Waste Disposal Practices

A chi-square test of independence was conducted to assess whether there was a significant relationship between gender and self-reported waste disposal practices. The result yielded a χ^2 statistic of **0.0** with a p-value of 1.00, indicating no statistically significant association between gender and proper waste disposal. This implies that both male and female respondents demonstrated similar patterns in waste disposal behavior.

Occupation and Waste Disposal Attitudes

An independent samples t-test was used to compare the waste disposal ratings between civil servants and traders. The result ($t = -4.51, p = 0.0$) suggests a statistically significant difference in how the two occupational groups rated their waste disposal behavior. Civil servants were more likely to report better disposal practices compared to traders.

Occupational Group Differences in Waste Disposal

A one-way ANOVA test was performed to compare the average waste disposal ratings across civil servants, traders, and the unemployed. The test returned a highly significant result ($F = 83.20, p < 0.0001$), confirming that occupation significantly influences waste disposal behavior. This finding supports the hypothesis that economic status and job type affect environmental responsibility.

Age and Waste Disposal Behavior

Pearson correlation analysis revealed a moderate negative relationship between respondents' age and their waste disposal rating ($r = -0.25, p = 0.013$). The result is statistically significant, suggesting that as age increases, reported compliance with proper waste disposal slightly declines. This may indicate generational differences in environmental consciousness or physical ability to manage waste properly

Chi-Square Test of Independence

- Tested Variables: Gender vs. Waste Disposal Practice
- Chi-Square Statistic (χ^2): 0.000
- p-value: 1.000
- Interpretation: There is no significant relationship between gender and proper waste disposal practices among respondents. Both males and females appear equally likely to dispose of waste properly or improperly.

Independent Samples t-Test

- Tested Groups: Civil Servants vs. Traders
- t-statistic: -4.51
- p-value: 0.0000225 (highly significant)
- Interpretation: There is a statistically significant difference between civil servants and traders in their average waste disposal ratings. Civil servants rate their practices more positively than traders.

One-Way ANOVA

- Tested Groups: Civil Servants, Traders, and Unemployed
- F-statistic: 83.20
- p-value: 9.08e-22 (extremely significant)
- Interpretation: The average waste disposal ratings differ significantly across the three occupational groups. Further post-hoc analysis would reveal which groups differ the most, but the overall variance is highly significant.

Pearson Correlation Analysis

- Tested Variables: Age and Waste Disposal Rating
- Correlation Coefficient (r): -0.248
- p-value: 0.0127
- Interpretation: There is a moderate negative correlation between age and waste disposal rating, statistically significant at the 5% level. This suggests that as age increases, proper waste disposal practices slightly decrease among respondents.

Key Findings

1. Policy Intervention Needed: Waste management challenges in Port Harcourt require urgent policy reforms and government-led programs to mitigate associated environmental and health risks.
2. Weak Institutional Oversight: Inadequate monitoring and enforcement by regulatory agencies contribute significantly to poor waste management practices.
3. Outdated Sanitation Laws: Current legislation is insufficient to deter indiscriminate dumping and must be revised to ensure effective deterrence and accountability.
4. Government Neglect: Insufficient public sector engagement and investment remain major barriers to sustainable waste management.
5. Impact of Urbanization: Rapid urban growth has intensified the waste management crisis, exacerbated environmental pollution and strained municipal infrastructure.

Policy and Research Implications

For Policy: The findings underscore an urgent need for integrated waste management policies that combine stricter enforcement with community engagement—particularly targeted education campaigns to bridge the awareness-compliance gap. Investments in decentralized infrastructure (e.g., neighborhood collection points) and public-private partnerships (modeled after Lagos' LAWMA) could address systemic failures in funding and logistics.

CONCLUSION

This study assessed solid waste disposal practices and the socio-demographic factors influencing them in selected communities within Port Harcourt Metropolis. Despite relatively high awareness of proper waste management, actual compliance was found to be moderate, suggesting a disconnect between knowledge and behavior. Key determinants of waste disposal practices included education level, income, occupation, and residential location. Infrastructural deficiencies, irregular waste collection, and limited public engagement further exacerbate poor disposal habits. Moreover, the combination of random and convenience sampling, though necessary under field conditions, introduces a potential for selection bias, which is acknowledged as a methodological limitation. Nonetheless, the findings contribute valuable localized insights into the behavioral and structural dynamics of waste management in urban Nigeria.

RECOMMENDATIONS

1. **Strengthen Waste Management Infrastructure**: Government and municipal agencies should prioritize regular waste collection, provide adequate bins, and expand coverage to underserved areas.
2. **Targeted Environmental Education**: Develop and implement community-based programs focused on translating waste awareness into responsible disposal behavior, especially in lower-income and densely populated neighborhoods.
3. **Policy Enforcement**: Strengthen regulatory enforcement on illegal dumping and incentivize compliance through community reward schemes.
4. **Community Engagement**: Incorporate residents into waste planning and monitoring processes to increase ownership and accountability.
5. **Further Research**: Future studies should apply longitudinal or mixed-methods designs to capture behavioral changes over time and include geospatial analysis of disposal hotspots.

FUTURE RESEARCH

Future studies should prioritize longitudinal behavioral analyses to identify drivers of non-compliance, cost-benefit assessments of proposed interventions, and scalable models for informal settlement inclusion. Additionally, integrating climate resilience into waste

management frameworks remains a critical gap for Niger Delta cities facing flooding and erosion.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

ACKNOWLEDGMENT

The authors sincerely express their gratitude to the anonymous reviewers and editorial team for their insightful feedback and constructive recommendations, which significantly enhanced the quality of this manuscript.

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