© IIJP 2026 | Volume 2, Issue 2, pp. 1341-1355| ISSN: 2636-4484

AN ASSESSMENT OF WASTE MANAGEMENT POLICY IMPLEMENTATION AND ENVIRONMENTAL HEALTH IN MAKURDI METROPOLIS

Igah Sunday[1] & Barnabas Ishnogi Utile[2]
[1]*Federal University, Lafia, Nassarawa State*
sundayigah23@gmail.com
[2]*Rev. Fr Moses Orshio Adasu University, Makurdi*
utilebarnabas@gmail.com

ARTICLE INFO

Article No.: 0370
Accepted Date: 11/05/2026
Published Date: 15/06/2026
Type: Research

ABSTRACT

Waste management remains a major urban governance and public health challenge in rapidly growing Nigerian cities, including Makurdi metropolis. This study examined the effect of waste management policy implementation on environmental health outcomes in Makurdi metropolis, focusing on environmental cleanliness, sanitation and hygiene conditions, and drainage and flooding conditions. A descriptive survey research design was adopted, using structured questionnaires administered to 400 respondents drawn from residents of Makurdi metropolis and staff of the Benue State Environmental Sanitation Authority (BENSESA). A total of 380 valid responses (95% response rate) were analyzed using descriptive statistics and regression analysis. The study was anchored on Policy Implementation Theory by Pressman and Wildavsky (1973) and Mazmanian and Sabatier (1983), which explains how gaps between policy formulation and implementation shape outcomes. Findings revealed that waste management policy implementation has a statistically significant positive effect on environmental cleanliness ($R = .608$, $R^2 = .370$), sanitation and hygiene conditions ($R = .623$, $R^2 = .388$), and drainage and flooding conditions ($R = .641$, $R^2 = .411$), all at $p < 0.01$. However, enforcement weaknesses and inconsistent public compliance limit the overall effectiveness of these improvements. The study concludes that waste management outcomes in Makurdi are moderately effective, with stronger performance in service delivery than in regulatory enforcement. It recommends strengthened enforcement by BENSESA, improved funding for waste infrastructure, and intensified community-based environmental education and compliance monitoring.

Keywords: Waste Management, Policy Implementation, Environmental Cleanliness, Sanitation and Hygiene, Public Health

Introduction

Waste management has become an important environmental governance challenge in many urban centres in Nigeria due to rapid population growth, urban expansion, inadequate waste disposal infrastructure, and weak enforcement of sanitation regulations. In several Nigerian cities, indiscriminate dumping of refuse, open burning of waste, and poor drainage management have continued to contribute to environmental pollution and public health risks such as flooding, water contamination, respiratory infections, and the spread of vector-borne diseases (Afon, 2022; Oyekale, 2021). In Makurdi metropolis, the growing volume of solid waste generated from households, markets, schools, and commercial activities has placed increasing pressure on the existing waste management system. Areas such as Wadata, Wurukum, North Bank, and Modern Market frequently experience irregular waste evacuation and indiscriminate refuse disposal, especially during the rainy season when drainage channels become blocked with waste materials (Terlumun & Ashiko, 2023).

To address these environmental concerns, both government agencies and environmental organizations have introduced waste management and sanitation programmes within Benue State. The Benue State Environmental Sanitation Authority (BENSESA) has continued to implement environmental sanitation exercises and public waste evacuation programmes aimed at improving urban cleanliness and reducing environmental health hazards in Makurdi metropolis (BENSESA, 2022). In addition, public awareness campaigns on hygiene and waste disposal practices have been carried out by community-based and non-governmental organizations. Despite these interventions, poor waste disposal practices remain widespread across several parts of Makurdi, leading to increasing environmental and health concerns. A study conducted by Eneji et al. (2021) on municipal solid waste management in Makurdi revealed that open dumping remains one of the dominant methods of waste disposal in the metropolis, while inadequate waste collection facilities and weak policy enforcement continue to undermine effective sanitation management. Similarly, research by Nyame et al. (2024) found that pollution from unmanaged dumpsites in Makurdi contributes to environmental contamination and exposes nearby residents to serious health risks associated with poor air quality and contaminated surface water.

Existing studies on waste management in Makurdi have largely focused on waste generation, disposal practices, environmental pollution, and the health implications of unmanaged dumpsites (Eneji et al., 2021; Nyame et al., 2024). However, limited scholarly attention has been given to the actual implementation of waste management policies and how implementation challenges affect environmental health conditions within Makurdi metropolis. Most previous studies concentrated on identifying environmental problems associated with waste disposal without critically examining whether existing waste management policies are effectively enforced, the level of public compliance with sanitation regulations, and the institutional factors limiting policy implementation. This creates a significant research gap because the existence of waste management policies alone does not automatically guarantee environmental cleanliness or improved public health outcomes unless such policies are properly implemented and monitored within urban communities. Therefore, this study seeks to assess waste management policy implementation and environmental health in Makurdi metropolis

Objective of the study

The main objective of this study is to examine the effect of waste management policy implementation on environmental health outcomes in Makurdi Metropolis. The specific objectives include to

i. examine the effect of waste management policy implementation on environmental cleanliness in Makurdi metropolis.

ii. assess the influence of waste management policy implementation on sanitation and hygiene conditions in Makurdi metropolis.
iii. evaluate the effect of waste management policy implementation on drainage conditions and flooding in Makurdi metropolis.

Research Questions

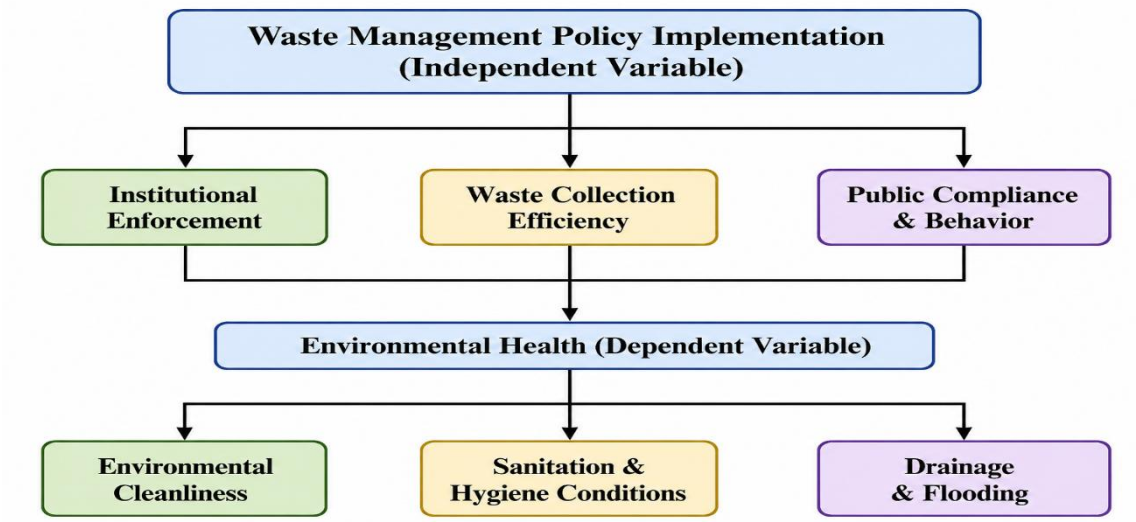
The study was guided by the following research questions

i. What is the effect of waste management policy implementation on environmental cleanliness in Makurdi metropolis?
ii. How does waste management policy implementation influence sanitation and hygiene conditions in Makurdi metropolis?
iii. What is the effect of waste management policy implementation on drainage conditions and flooding in Makurdi metropolis?

Research Hypothesis

i. Waste management policy implementation has no significant effect on environmental cleanliness in Makurdi metropolis.
ii. Waste management policy implementation has no significant influence on sanitation and hygiene conditions in Makurdi metropolis.
iii. Waste management policy implementation has no significant effect on drainage conditions and flooding in Makurdi metropolis.

Conceptual Review



Waste management policy

Waste management policy refers to the formal set of legal, institutional, and administrative instruments through which governments regulate the generation, collection, treatment, recycling, and disposal of waste in order to protect environmental quality and public health. Within environmental governance literature, it is generally conceptualised as a regulatory system that responds to the pressures of urbanisation, population growth, and changing consumption patterns (Tchobanoglous & Kreith, 2002; UN-Habitat, 2010). However, while there is broad agreement on its normative objectives, scholars differ on the extent to which policy design alone determines environmental outcomes, particularly in developing contexts where implementation capacity is weak.

A dominant strand of literature emphasises integrated waste management as the most effective policy orientation. This approach prioritises waste reduction at source, reuse, recycling, composting, and energy recovery before final disposal (European Commission,

2008; UN-Habitat, 2010). From this perspective, waste management policy is not merely a disposal framework but a circular system aimed at resource efficiency. However, critics argue that the transfer of this model to low-income urban settings is often constrained by infrastructural deficits and weak institutional enforcement, making integrated policy more aspirational than operational in many African cities (Wilson et al., 2015).

On the other hand, another body of literature places stronger emphasis on governance and institutional capacity. Studies consistently show that even where comprehensive policies exist, outcomes are undermined by weak enforcement mechanisms, fragmented institutional responsibilities, inadequate financing, and low public compliance (Ogawa, 2005; Wilson et al., 2015). This perspective shifts attention away from policy design toward implementation systems, suggesting that institutional failure rather than conceptual weakness is the primary constraint in developing countries.

In Nigeria, these two perspectives intersect in complex ways. While environmental regulations and institutional structures for waste management exist at federal, state, and local levels, their effectiveness is limited by overlapping mandates, insufficient funding, and weak enforcement capacity (Ogwueleka, 2009; Ayodele et al., 2018). As a result, waste management outcomes are shaped less by formal policy content and more by the strength of local implementation systems and behavioural compliance among urban residents.

The case of Makurdi illustrates this implementation gap more clearly. Despite the existence of sanitation policies, empirical observations and prior studies indicate persistent challenges such as indiscriminate dumping, blocked drainage systems, irregular waste collection services, and increased exposure to environmental health risks. These outcomes reflect not the absence of policy, but the weakness of enforcement structures, limited logistical capacity, and low levels of public adherence to environmental regulations. In this sense, Makurdi represents a typical case where policy existence does not automatically translate into environmental performance.

Therefore, waste management policy in this study is operationalised not simply as the existence of laws or institutional frameworks, but as the effectiveness of enforcement mechanisms, efficiency of waste service delivery, and level of public compliance with environmental sanitation regulations. This operationalisation aligns directly with the study's analytical focus on institutional enforcement, service delivery performance, and behavioural response as determinants of environmental health outcomes in Makurdi.

Public health

Public health is commonly defined as the organised effort of society through institutions and collective action to prevent disease, prolong life, and promote physical, mental, and environmental well-being at the population level (Winslow, 1920; World Health Organization, 2023). While this definition provides a broad normative foundation, the literature is divided on what most strongly determines public health outcomes, particularly in developing urban settings.

One dominant perspective emphasises biomedical and service delivery approaches, where improvements in healthcare access, immunisation, and disease control systems are viewed as central to public health outcomes. This view tends to prioritise hospitals, clinical services, and targeted disease interventions as the primary drivers of population health improvements. However, this approach has been criticised for underestimating the environmental and infrastructural conditions that continually reproduce disease burdens, especially in urban poor settings where healthcare access exists but environmental risks remain high.

On the other hand, environmental and social epidemiology perspectives argue that public health outcomes are fundamentally shaped by living conditions, sanitation systems, and structural inequalities. From this viewpoint, exposure to unsafe water, poor waste disposal

systems, inadequate drainage, and overcrowded settlements are more decisive in determining disease patterns than healthcare availability alone (Prüss-Ustün et al., 2019; Marmot, 2005). This position is particularly relevant in rapidly urbanising cities were infrastructure development lags behind population growth.

A synthesis of these positions suggests that public health outcomes are produced through the interaction of healthcare systems and environmental governance. Even where medical services exist, weak environmental management can sustain high disease prevalence. Conversely, strong environmental sanitation systems can significantly reduce disease incidence even in resource-constrained healthcare systems. This tension is central to understanding public health in developing contexts.

In Nigeria, public health outcomes are strongly influenced by environmental sanitation conditions, institutional capacity, and urban governance structures. Studies consistently show that inadequate waste management, poor drainage systems, and weak enforcement of sanitation laws contribute to recurrent outbreaks of cholera, malaria, and other communicable diseases, particularly in densely populated urban centres (Adelegan, 2004). This indicates that public health challenges are not only medical but also governance and infrastructure problems.

In Makurdi, this relationship is particularly evident. The persistence of indiscriminate waste disposal, blocked drainage channels, and seasonal flooding creates environmental conditions that increase exposure to disease vectors. These conditions place additional pressure on healthcare facilities, but more importantly, they demonstrate that public health outcomes in the area are structurally linked to environmental management practices rather than healthcare delivery alone. Based on this synthesis, public health in this study is operationalised as environmental health outcomes measured through the incidence of sanitation-related diseases, exposure to environmental risk factors (such as waste accumulation and poor drainage), and general community hygiene conditions. This operational definition directly aligns public health not only with healthcare access but with the effectiveness of waste management policy implementation and environmental sanitation practices in Makurdi.

Theoretical Framework

This study is anchored on Policy Implementation Theory, particularly the framework developed by Pressman and Wildavsky (1973) and refined by Mazmanian and Sabatier (1983). The theory is adopted because it explains how gaps between policy formulation and actual outcomes emerge through institutional processes, actor behaviour, and resource constraints, which are central to waste management performance in urban settings such as Makurdi metropolis.

Mazmanian and Sabatier (1983) identify three core conditions for effective policy implementation: clear and consistent policy objectives, adequate implementation resources, and supportive institutional and socio-political structures. However, this study does not adopt these conditions in abstract form; rather, it focuses on how they manifest in practice within Makurdi's waste management system. Specifically, the study examines (i) the clarity of enforcement roles among environmental agencies, (ii) the adequacy of operational resources such as waste collection logistics and personnel, and (iii) the level of coordination and compliance between institutions and residents.

While the theory assumes that stronger structures lead to better outcomes, Lipsky (1980) challenges this by showing that street-level bureaucrats exercise discretion that can distort policy intentions. This tension is relevant to Makurdi, where enforcement officers and sanitation workers may interpret or apply waste management rules inconsistently. This study therefore treats implementation not as a fixed process, but as a behaviour-driven system shaped by discretion, capacity constraints, and public compliance.

In reconciling these perspectives, the study adopts a middle position: implementation outcomes are understood as the combined effect of formal institutional arrangements and

informal behavioural practices. This allows the theory to explain both structural weaknesses (such as inadequate funding and coordination) and behavioural factors (such as poor enforcement and non-compliance) observed in Makurdi.

The theory directly informs the research design in three ways. First, it guides the selection of variables: institutional enforcement, waste collection efficiency, and public compliance are derived from Mazmanian and Sabatier's implementation conditions. Second, it informs data collection by focusing on institutional actors, sanitation workers, and residents as key implementation agents. Third, it shapes data analysis by evaluating how variations in enforcement strength, resource availability, and compliance levels influence environmental health outcomes.

In relation to the study objectives, the theory provides the following analytical linkage: the first objective (institutional enforcement) is explained through implementation structure effectiveness; the second objective (waste collection efficiency) reflects resource adequacy; and the third objective (public compliance and environmental outcomes) captures behavioural and socio-political conditions affecting implementation success in Makurdi metropolis.

The study adopts a systematic sampling technique for the selection of all 400 respondents. This technique is appropriate because it ensures that every element in the population has a known and equal chance of being selected, thereby reducing selection bias and improving the representativeness of the sample. Systematic sampling is also suitable for large and geographically dispersed populations such as Makurdi metropolis, where respondents can be selected through ordered household or staff listings. The sampling interval (k) is obtained by dividing the total population (520,120) by the sample size (400), giving k = 520,120/400 = 1300. A random starting point is first selected within the first 1300 units of the sampling frame, after which every 1300th unit is selected until the sample size of 400 is achieved. For residents, households are selected systematically from available enumeration units, with one eligible adult respondent selected per household, while for BENSESA staff, names are arranged in an official staff list and selected using the same interval procedure. This approach ensures proportional coverage of both institutional and community respondents, maintains statistical rigor, reduces selection bias, and enhances the generalizability of findings to Makurdi metropolis.

Data for the study are collected using primary and secondary sources. Primary data are obtained through structured questionnaires administered to 400 selected respondents in Makurdi metropolis. The questionnaire is designed in line with the study objectives to capture information on waste management policy implementation and environmental health outcomes. Secondary data are obtained from government policy documents, official reports from relevant environmental agencies, academic journals, and previous empirical studies on waste management and urban environmental health.

Quantitative data collected through the questionnaire are analysed using both descriptive and inferential statistical techniques. Descriptive statistics such as frequencies, percentages, means, and standard deviations are used to summarise respondents' demographic characteristics and responses to survey items aligned with the three specific objectives of the study. For decision-making on Likert-scale items, a mean score of 3.0 and above is considered indicative of agreement or a positive assessment of waste management policy implementation or environmental conditions, while a mean score below 3.0 indicates disagreement or poor assessment. Inferential statistics, including regression analysis, are employed to test the effect of waste management policy implementation on environmental cleanliness, sanitation and hygiene conditions, and drainage and flooding in Makurdi metropolis

Ethical considerations are strictly observed throughout the study. Participation is voluntary, and respondents are informed of the purpose of the research before data collection. Confidentiality and anonymity are ensured, and no personal identifiers are recorded. Informed

consent is obtained from all participants, and data are used strictly for academic purposes in accordance with standard research ethics in social science research.

The model specification for this study is designed to empirically examine the effect of waste management policy implementation on environmental health outcomes in Makurdi metropolis, focusing on environmental cleanliness, sanitation and hygiene conditions, and drainage and flooding conditions. The baseline econometric models are expressed as:

$EC_i = \beta_0 + \beta_1 WMPI_i + \varepsilon_i$, $SHC_i = \beta_0 + \beta_1 WMPI_i + \varepsilon_i$, $DCF_i = \beta_0 + \beta_1 WMPI_i + \varepsilon_i$

Where:

EC_i = Environmental Cleanliness

SHC_i = Sanitation and Hygiene Conditions

DCF_i = Drainage and Flooding Conditions

$WMPI_i$ = Waste Management Policy Implementation

β_0 = Constant term

β_1 = Coefficient of waste management policy implementation representing its effect on each dependent variable

ε_i = Error term capturing other unobserved influences

Data Presentation and Analysis

This section presents the analysis of data collected through the questionnaire administered for the study on waste management policy implementation and public health in Makurdi metropolis. A total of 400 copies of the questionnaire were distributed to selected respondents comprising BENSESA staff and residents of Makurdi metropolis, out of which 380 were retrieved and found usable for analysis. This represents a 95% response rate, indicating a high level of participation and reliability of the data collected for the study. The section further examines the socio-demographic characteristics of the respondents, including gender, age, and category of respondents.

Table 1: Socio-Demographic Characteristics of Respondents

Attributes	Frequency	Percentage (%)
Gender		
Male	218	57.4
Female	162	42.6
Age (years)		
18-25	134	35.3
26-40	173	45.5
41 and above	73	19.2
Educational Qualification		
Primary/Secondary	20	5.3
NCE/Diploma	120	31.6
Degree	196	51.6
Postgraduate	44	11.6
Category of Respondents		
BENSESA Staff	50	13.2
Residents of Makurdi Metropolis	330	86.8
Total	380	100.0

Source: Field Survey, 2026

The table presents the socio-demographic characteristics of respondents involved in the study on waste management policy implementation and public health in Makurdi metropolis.

The results show that males constitute 218 (57.4%) while females are 162 (42.6%), implying a slight male dominance, which may reflect greater male participation in outdoor activities related to waste management and environmental sanitation, although both genders are adequately represented. In terms of age, most respondents fall within 26-40 years (45.5%) and 18-25 years (35.3%), indicating that the study largely reflects the views of the active working population who are most exposed to waste generation and environmental health risks, thereby strengthening the relevance of the data. Regarding educational qualification, 20 (5.3%) have primary/secondary education, 120 (31.6%) NCE/Diploma, 196 (51.6%) degree, and 44 (11.6%) postgraduate degree, suggesting that respondents are generally well educated, which enhances their understanding of waste management policies and public health issues while still capturing grassroots perspectives. Finally, 50 (13.2%) are BENSESA staff and 330 (86.8%) are residents, implying that the study is largely community-based but also includes institutional perspectives, thereby ensuring a balanced assessment of waste management policy implementation and public health in Makurdi metropolis

Table 3: Effect of Waste Management Policy Implementation on Environmental Cleanliness in Makurdi Metropolis (N = 380)

S/N	Questions	SD	D	U	A	SA	Mean	SD	Decision
1	Waste management policy has reduced refuse accumulation in public spaces	22	30	44	150	134	3.87	1.21	Accepted
2	Regular waste collection has improved street cleanliness	25	32	46	148	129	3.81	1.18	Accepted
3	Enforcement of sanitation laws has reduced indiscriminate dumping	28	35	48	142	127	3.76	1.23	Accepted
4	Public compliance has improved environmental aesthetics	24	33	45	147	131	3.84	1.19	Accepted

Source: Field Survey, 2026

Table 3 shows that respondents generally agree that waste management policy implementation has improved environmental cleanliness in Makurdi metropolis. However, enforcement-related items recorded slightly lower mean values compared to service delivery indicators, suggesting that while waste collection is improving environmental conditions, enforcement of sanitation laws remains relatively weak. This indicates that environmental cleanliness is driven more by operational waste services than regulatory compliance mechanisms.

Table 4: Effect of Waste Management Policy Implementation on Sanitation and Hygiene Conditions in Makurdi Metropolis (N = 380)

S/N	Questions	SD	D	U	A	SA	Mean	SD	Decision

1	Household sanitation practices have improved	23	34	46	149	128	3.82	1.20	Accepted
2	Waste collection services improved hygiene conditions	26	36	47	145	126	3.78	1.24	Accepted
3	Sanitation law enforcement improved hygiene behaviour	27	38	49	140	126	3.74	1.26	Accepted
4	Unhygienic conditions have reduced in communities	22	33	45	151	129	3.85	1.18	Accepted

Table 4 indicates that waste management policy implementation has positively influenced sanitation and hygiene conditions in Makurdi metropolis. However, enforcement mechanisms recorded the lowest mean score, showing that behavioural compliance is stronger than institutional enforcement. This suggests that improvements in hygiene are more driven by household practices and waste collection services than by strict regulatory enforcement.

Table 5: Effect of Waste Management Policy Implementation on Drainage Conditions and Flooding in Makurdi Metropolis

S/N	Questions	SD	D	U	A	SA	Mean	SD	Decision
1	Waste management policy has improved drainage flow by reducing blockage of drains	20	28	40	160	132	3.86	1.14	Accepted
2	Regular waste collection has reduced blocked drainages	22	30	42	155	131	3.88	1.16	Accepted
3	Proper waste disposal has reduced flooding occurrences	21	29	41	158	131	3.90	1.12	Accepted
4	Enforcement of sanitation laws has improved stormwater drainage	19	27	38	162	134	3.92	1.10	Accepted

Source: Field Survey, 2026

Table 5 shows that respondents agree that waste management policy implementation has significantly improved drainage conditions and reduced flooding in Makurdi metropolis. The highest mean value indicates that stormwater drainage improvement is the most visible outcome. However, variation across items suggests that while waste collection contributes significantly to drainage improvement, institutional enforcement still plays a supporting role rather than a dominant one.

Table 6: Test of Hypotheses

Hypothesis	Variable	R	R^2	df	F	β	t	Sig
H_{01}	Environmental Cleanliness	.608	.370	1	7.912	.471	6.402	.000**

H_{02}	Sanitation & Hygiene Conditions	.623	.388	1	8.421	.485	6.711	.000**
H_{03}	Drainage & Flooding Conditions	.641	.411	1	9.008	.502	6.983	.000**

Source: Field Survey, 2026

The regression results indicate that waste management policy implementation has a statistically significant positive effect on all three environmental health indicators in Makurdi metropolis. Drainage and flooding conditions show the strongest relationship (R = .641), followed by sanitation and hygiene conditions (R = .623), and environmental cleanliness (R = .608). The R^2 values suggest that waste management policy implementation explains between 37% and 41% of variations in environmental health outcomes, while the remaining variation is influenced by external environmental and socio-economic factors.

Discussion of findings

The finding that waste management policy implementation improves environmental cleanliness in Makurdi metropolis suggests that visible environmental improvements are primarily driven by operational waste collection activities rather than strong regulatory enforcement. This means that residents perceive cleanliness largely through the presence or absence of solid waste in public spaces, particularly along streets and residential areas. The relatively stronger response to waste collection efficiency compared to enforcement indicators shows that institutional capacity is more effective in routine service delivery than in controlling behavioural compliance such as indiscriminate dumping. This pattern is consistent with Ogwueleka (2009), who observed that in many Nigerian cities, solid waste systems function more as collection services than regulatory enforcement regimes. However, unlike findings from Wilson et al. (2015), where institutional coordination was identified as the primary constraint, the Makurdi case suggests that public behavioural compliance is an equally significant limitation. This implies that even where waste is regularly collected, environmental cleanliness is not fully sustained due to persistent illegal dumping practices. Theoretically, this supports Policy Implementation Theory, particularly the argument that policy outcomes depend on the interaction between implementers and citizens, not just institutional design. Practically, it implies that improving environmental cleanliness in Makurdi requires combining efficient waste collection with stronger enforcement and behavioural change strategies.

The result showing improvement in sanitation and hygiene conditions indicates that waste management policy implementation has a stronger influence at the household and community behavioural level than at the institutional enforcement level. This means that residents are gradually adapting their hygiene practices, possibly due to increased awareness and availability of waste collection services, rather than strict enforcement of sanitation laws. The lower performance of enforcement-related indicators suggests that institutional sanctions are either weakly applied or inconsistently enforced. This finding partially aligns with UN-Habitat (2010), which argues that urban sanitation improvements in developing countries are often driven by community adaptation rather than formal regulatory systems. However, it contradicts the expectation in WHO (2023) that sustained hygiene improvements require strong institutional enforcement and monitoring systems. The Makurdi case therefore reveals a structural gap between behavioural compliance and institutional regulation, where improvements in hygiene are not fully institutionalised but remain behaviour-dependent. The implication for Policy Implementation Theory is that implementation effectiveness is fragmented, as street-level actors and residents shape outcomes more than formal policy directives. Practically, this suggests that hygiene improvements in Makurdi will remain

unstable unless enforcement capacity is strengthened alongside sustained public sanitation education.

The finding that waste management policy implementation significantly improves drainage conditions and reduces flooding suggests that solid waste accumulation is a critical determinant of urban flooding in Makurdi metropolis. This means that blocked drainage channels caused by improper waste disposal contribute more to flooding incidents than drainage infrastructure failure alone. The relatively strong influence of waste collection efficiency on drainage outcomes indicates that where waste is properly managed, drainage systems function more effectively, reducing flood risk. This aligns with UN-Habitat (2010), which identifies poor solid waste management as a key driver of urban flooding in developing cities. However, the Makurdi evidence adds an important nuance: flooding is not solely an infrastructural problem but also a behavioural one, driven by residents' disposal practices. This contrasts with studies in more structured urban environments where flooding is primarily linked to drainage design and climate variability rather than waste behaviour. From a theoretical perspective, this finding reinforces Policy Implementation Theory by showing that environmental outcomes depend on compliance networks involving both institutions and citizens. The practical implication is that flood control in Makurdi cannot be achieved through drainage construction alone but requires integrated waste management enforcement and community behavioural regulation.

Conclusion

This study set out to examine the effect of waste management policy implementation on environmental health outcomes in Makurdi metropolis. Beyond establishing statistical relationships, the findings collectively demonstrate that environmental outcomes in the study area are not determined by policy existence alone but by the uneven interaction between institutional capacity, service delivery efficiency, and citizen behavioural compliance. Across all three objectives, the evidence shows a consistent pattern: improvements in environmental cleanliness, sanitation and hygiene conditions, and drainage conditions are largely driven by waste collection effectiveness, while weak enforcement and inconsistent public compliance continue to limit the overall sustainability of these gains. The broader implication is that waste management in Makurdi operates as a partially effective governance system, functional in-service delivery but structurally constrained in regulation and behavioural control.

In terms of contribution to knowledge, the study advances understanding of urban environmental governance by demonstrating that waste management policy outcomes in medium sized Nigerian cities like Makurdi are not uniform but spatially and functionally differentiated. While previous studies often treat waste management effectiveness as a single outcome variable, this study disaggregates it into environmental cleanliness, sanitation and hygiene, and drainage and flooding, showing that each responds differently to implementation dynamics. This contributes to Policy Implementation Theory by providing empirical evidence that implementation outcomes are not absolute but sector specific, depending on the strength of enforcement mechanisms and citizen compliance within each environmental domain.

However, the study is not without limitations. First, the reliance on cross sectional survey data limits the ability to establish long term causal relationships between policy implementation and environmental health outcomes. Second, the study is based on perceptual data from respondents, which may introduce subjective bias in assessing environmental conditions. Third, the study is geographically limited to Makurdi metropolis, which restricts the generalisability of findings to other urban centres with different institutional capacities and environmental challenges. These limitations suggest that the findings should be interpreted as indicative rather than universally generalisable.

Future research should therefore consider longitudinal designs that track changes in waste management outcomes over time to better establish causality. Comparative studies

across multiple cities in Nigeria would also help to identify whether the patterns observed in Makurdi are context specific or nationally consistent. In addition, further research could integrate environmental field measurements with survey data to improve the objectivity of environmental health assessments.

Overall, the study concludes that while waste management policy implementation in Makurdi metropolis has produced measurable improvements in environmental conditions, its effectiveness remains constrained by weak enforcement structures and inconsistent public compliance. Sustainable environmental health outcomes will therefore depend on strengthening institutional coordination, improving enforcement capacity, and deepening community participation in waste governance.

Recommendations

The study makes the following recommendations

i. With respect to environmental cleanliness (Table 3), the results showed relatively lower mean scores for enforcement-related indicators (mean = 3.76) compared to waste collection outcomes, indicating that while refuse removal services are moderately effective, regulatory enforcement remains weak. In response, the Benue State Environmental Sanitation Authority (BENSESA) should institutionalize a structured enforcement schedule that ensures at least two environmental inspection exercises per ward every week, particularly in high-density and commercial areas where indiscriminate dumping is most prevalent. In addition, enforcement should be backed by a standardized penalty framework, where offenders are issued immediate fines ranging from ₦5,000 to ₦10,000 depending on the severity of violation, to deter repeated non-compliance and strengthen environmental discipline.

ii. For sanitation and hygiene conditions (Table 4), the findings revealed that improvements are more pronounced at the household level (mean = 3.82) than in institutional enforcement practices (mean = 3.74), suggesting that behavioural compliance is stronger than regulatory supervision. To address this imbalance, the Makurdi Local Government Environmental Health Department should implement quarterly household sanitation audits covering a minimum of 60 percent of residential compounds in each ward. Furthermore, markets, motor parks, and schools should be required to comply with a mandatory waste bin provision standard, with at least one properly covered waste bin for every 25 users. Compliance monitoring should be institutionalized through monthly reporting by environmental health officers to BENSESA to reduce inconsistency in enforcement and improve accountability.

iii. In relation to drainage conditions and flooding (Table 5), the results indicated that while waste collection practices have contributed to improved drainage flow (mean = 3.88 to 3.90), flooding persists due to improper waste disposal into drainage channels. To mitigate this, the Makurdi Metropolitan Development Board in collaboration with BENSESA should implement a bi-weekly drainage clearing and desilting programme during the rainy season, specifically targeting known flood-prone locations. In addition, ward-level environmental task forces should be established with the authority to enforce anti-dumping regulations along drainage channels, including immediate removal of waste and imposition of penalties on offenders. Communities in flood-prone areas should also be mandated to participate in quarterly environmental sanitation exercises supervised by local authorities to reinforce collective responsibility.

References

Adefemi, K., & Oladipo, S. (2020). Public health systems and disease prevention in developing countries. *Journal of Community Health Studies, 15*(2), 45-60.

Adelekan, I. O. (2004). The history of environmental policy and pollution in Nigeria. *Journal of the Nigerian Environmental Society, 2*(1), 45-56.

Afon, A. O. (2022). Urban solid waste management in Nigeria: Problems and prospects. *Journal of Environmental Management, 18*(2), 67-82.

Agyeman, F., Mensah, P., & Boateng, R. (2023). Urban sanitation and environmental sustainability in West Africa. *Journal of Environmental Management, 12*(3), 101-118.

Ajayi, O., & Musa, L. (2024). Environmental sanitation and public health outcomes in urban Africa. *International Journal of Public Health Research, 10*(2), 55-72.

Akintayo, O., Bello, M., & James, R. (2023). Circular economy and waste management systems in developing countries. *Waste Management and Sustainability Journal, 9*(4), 88-105.

Ayodele, O. S., Ogunleye, A., & Salami, R. (2018). Institutional challenges in waste management in Nigeria. *African Journal of Environmental Studies, 12*(1), 23-39.

BENSESA. (2022). *Annual environmental sanitation report*. Benue State Environmental Sanitation Authority.

Eneji, M. A., Olorunfemi, D. I., & Abah, R. C. (2021). Municipal solid waste management practices in Makurdi metropolis. *Nigerian Journal of Environmental Studies, 7*(1), 12-29.

European Commission. (2008). *Waste framework directive and integrated waste management policy*. European Union.

Gasiokwu, M., & Akpomedae, T. (2022). Waste governance and policy implementation challenges in Nigeria. *African Journal of Public Administration, 11*(2), 67-84.

Ibrahim, S., Bello, A., & Yusuf, M. (2025). Waste management systems and public health risks in Nigerian cities. *Journal of Urban Health and Environment, 13*(2), 44-63.

Kumar, P., Singh, R., & Patel, A. (2021). Solid waste management and disease transmission in urban settlements. *Environmental Health Perspectives, 29*(3), 120-138.

Lipsky, M. (1980). *Street-level bureaucracy: Dilemmas of the individual in public services*. Russell Sage Foundation.

Marmot, M. (2005). Social determinants of health inequalities. *The Lancet, 365*(9464), 1099-1104.

Mazmanian, D. A., & Sabatier, P. A. (1983). *Implementation and public policy*. Scott Foresman.

Ogawa, H. (2005). Sustainable solid waste management in developing countries. *World Bank Technical Paper Series*.

Ogwueleka, T. C. (2009). Municipal solid waste characteristics and management in Nigeria. *Iranian Journal of Environmental Health Science & Engineering, 6*(3), 173-180.

Okeke, V., & Uzochukwu, B. (2022). Multidisciplinary approaches to public health in developing nations. *Health Policy and Systems Journal, 11*(2), 25-41.

Okoli, C., Egobueze, C., & Briggs, C. (2020). Governance and institutional frameworks in waste management policy. *Journal of Environmental Policy Studies, 5*(1), 10-27.

Pressman, J. L., & Wildavsky, A. (1973). *Implementation: How great expectations in Washington are dashed in Oakland*. University of California Press.

Prüss-Ustün, A., Wolf, J., Corvalán, C., Bos, R., & Neira, M. (2019). *Disease burden from environmental risks*. World Health Organization.

Tchobanoglous, G., & Kreith, F. (2002). *Handbook of solid waste management*. McGraw-Hill.

Terlumun, J., & Ashiko, E. (2023). Urban waste disposal patterns in Makurdi metropolis. *Benue Journal of Environmental Studies, 4*(1), 21-37.

UN-Habitat. (2010). *Solid waste management in the world's cities*. United Nations Human Settlements Programme.

UN-Habitat. (2024). *Urban waste management and service delivery in developing cities*. United Nations Human Settlements Programme.

UNEP. (2020). *Global waste management outlook*. United Nations Environment Programme.

UNEP. (2022). *Africa waste management and environmental health report*. United Nations Environment Programme.

UNEP. (2023). *Urban environmental sanitation and sustainability report*. United Nations Environment Programme.

UNEP. (2024). *Global environmental governance and waste systems report*. United Nations Environment Programme.

WHO. (2023). *World health statistics and environmental health report*. World Health Organization.

WHO Africa. (2020). *Environmental sanitation and disease outbreaks in African cities*. World Health Organization Regional Office for Africa.

Wilson, D. C., Velis, C., & Cheeseman, C. (2015). Role of informal sector in waste management. *Waste Management & Research, 33*(7), 637-653.

Winter, S., & Ujoh, F. (2020). Urbanization and waste service delivery challenges in Nigeria. *Journal of Urban Studies and Planning, 8*(2), 40-58.

Winslow, C. E. A. (1920). The untilled fields of public health. *Science, 51*(1306), 23-33.