

Integrating Solid Waste Management into Urban Flood Risk Reduction: A Resilience Framework for Lagos, Nigeria

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Abstract: *This study examines how solid waste management influences urban flood risk in Lagos, Nigeria, and develops an integrated resilience framework connecting waste governance, drainage management, and flood-risk reduction. An integrative evidence synthesis and comparative case-study approach was used to assess peer-reviewed studies, institutional documents, policy materials, and recent reports concerning waste disposal, drainage obstruction, flood exposure, and government and community responses. Quantitative evidence was compared descriptively, while qualitative findings were synthesized thematically. The evidence identifies improper waste disposal and drainage obstruction as important contributors to flood exposure and indicates that existing responses remain constrained by gaps in waste collection, fragmented institutional coordination, infrastructure limitations, and behavioural factors. The proposed framework integrates preventive, inclusive, sustainable, and resilience-oriented actions across institutional, infrastructural, community, economic, and regulatory dimensions. Although the study relies mainly on heterogeneous secondary evidence, it demonstrates the value of treating waste collection, waste interception, informal-sector participation, and coordinated drainage governance as components of preventive flood resilience. The framework offers a policy-oriented approach that may also inform rapidly urbanizing coastal cities facing similar waste and flood challenges.*

Keywords: solid waste management, flood-risk reduction, urban resilience, integrated governance, Lagos

1. Introduction

Urban flooding has emerged as one of the most pressing environmental challenges confronting cities in developing countries, with its frequency and intensity amplified by rapid urbanization, inadequate infrastructure and climate change (Lamond et al., 2012; Nkwunonwo et al., 2016). Among these cities, Lagos, which is Nigeria's commercial capital and one of Africa's most populous urban agglomerations, stands as a particularly vulnerable case. With an estimated population exceeding 20 million and daily municipal solid waste generation of approximately 13,000 metric tonnes, the city exemplifies the complex interplay between waste management failures and escalating flood risk (Voice of Nigeria [VON], 2025; Omole et al., 2016).

Lagos presents a unique vulnerability profile shaped by its coastal geography. The state shares 187 km of its border with the Atlantic Ocean, and about 25% of its 3,577 km² is water (The Cable, 2026). This geographic reality, combined with extensive land reclamation that has expanded the built-up footprint, creates inherent flood risks that are significantly worsened by anthropogenic factors (Abiodun, 1997; Akoni, 2025a).

The nexus between solid waste management and flooding occurs through multiple pathways. When solid waste is improperly disposed of in drainage channels, canals, and waterways, it obstructs the passage of stormwater, reduces the hydraulic capacity of drainage infrastructure, and increases the likelihood of overbank flooding during heavy rainfall events (Ojelowo & Wahab, 2017; Idris et al., 2025). In Lagos, this

phenomenon is particularly severe given the city's low-lying topography, high water table, and the prevalence of informal settlements where formal waste collection services are often absent (Echendu, 2023; Rufai & Cavazzin, 2026). Some previous studies have documented that poor waste management contributes to the blockage of streams, rivers, and drainage channels in urban centres across the country (e.g., Idris and Dantata, 2019; Omole et al., 2016).

Despite the growing recognition of the waste–flood nexus in Lagos, existing flood mitigation strategies have disproportionately emphasized structural interventions, such as drainage construction, canal dredging, and engineered flood defences, while undervaluing the critical role of effective solid waste management as a preventive measure. This oversight is particularly concerning given that approximately 70% of flooding incidents in Lagos have been attributed to blocked drainage systems (Tribune Online, 2026), a finding consistent with earlier studies that identified several locations where municipal solid waste obstructed storm drains (Ojelowo & Wahab, 2017). Furthermore, formal waste collection coverage remains limited; a baseline study in the Ajegunle-Ikorodu area found that 67% of households lack access to official Private Sector Participation (PSP) waste collection services (Ogunrinde, 2026).

This study addresses that gap by synthesizing empirical and policy evidence on the waste–flood nexus in Lagos and evaluating how current interventions address its underlying drivers. Specifically, the study (i) examines evidence linking waste disposal and drainage obstruction to flood incidence; (ii) assesses government- and community-led responses; (iii)

identifies institutional, infrastructural, and behavioural constraints; and (iv) develops an integrated waste–flood resilience framework for Lagos. The principal contribution is therefore not a new primary household survey, but the integration of fragmented evidence into a policy-oriented framework that connects municipal solid waste governance with urban flood-risk reduction and that may inform other rapidly urbanizing coastal cities facing comparable challenges.

2. Materials and Methods

2.1 Study area

Lagos State, located in Southwestern Nigeria (Fig. 1), covers an area of approximately 3,577 km², of which roughly 17–25% is aquatic (LAWMA, 2021; The Cable, 2026). The State has a tropical climate with a distinct wet season (April to October) characterized by heavy rainfall and potential flooding. The current study focuses on some Lagos communities that have experienced significant flood impacts linked to waste management challenges, including Somolu, Bariga, Ajegunle-Ikorodu, and Mushin, complemented by metropolitan-scale analyses (extracted from Ojelowo & Wahab, 2017).



Figure 1: Map of Nigeria showing Lagos State

2.2 Study design

This study uses integrative evidence-synthesis and comparative case-study design. It brings together peer-reviewed research, government and institutional documents, and recent reporting on waste management and flood-mitigation interventions in Lagos. The analysis focuses on three linked questions: how solid waste contributes to drainage obstruction and flood risk; how existing interventions address this relationship; and what institutional and policy arrangements could support a more integrated response. Evidence from selected Lagos communities is used as illustrative case material and is complemented by metropolitan-scale and wider Nigerian studies where these provide relevant comparative context.

The evidence base comprises published studies on waste management and flooding in Lagos and Nigeria; statements and

reports from the Lagos State Ministry of the Environment and Water Resources and the Lagos State Waste Management Authority (LAWMA); publications from international organizations; and recent media reports used primarily to document contemporary policy announcements and interventions. Because the source base is heterogeneous, numerical estimates are reported with their original attribution rather than treated as measurements generated by the present study. Peer-reviewed and institutional sources provide the principal analytical foundation, while media sources are used cautiously for time-sensitive developments not yet represented in academic literature.

2.3 Analytical approach

The analysis combined structured extraction of quantitative findings reported in the source literature with qualitative thematic synthesis. Reported survey statistics and administrative estimates were compared descriptively to identify recurring patterns in waste generation, collection coverage, disposal practices, drainage obstruction, and flood exposure; no new household-level statistical analysis was performed. Qualitative evidence was organized around recurrent themes: institutional coordination, infrastructure and service coverage, community participation, informal-sector activity, behavioural drivers, enforcement, and technological or nature-based interventions. Triangulation across source types was used where possible, while inconsistencies and limitations in the Nigerian evidence base were retained as interpretive constraints rather than reconciled through unsupported assumptions. This approach is consistent with evidence-mapping concerns identified by Lucas (2021), particularly the uneven quality, age, and comparability of available Nigerian urban-flood studies.

3. Results

3.1 Waste generation and disposal practices in Lagos

According to results gathered from the literature, Lagos generates approximately 13,000 metric tonnes of municipal solid waste daily (VON, 2025), with projections indicating continued growth due to population increase and changing consumption patterns (Olukanni & Oresanya, 2018). The composition of waste is dominated by plastics (Fig. 2), generated by 89% of households in surveyed communities; food scraps by 77%; paper and packaging in significant quantities; and metals and electronic waste in smaller but economically valuable fractions (Oyebode, 2013; Ogunrinde, 2026)

Formal waste collection services in Lagos, delivered through the Private Sector Participation (PSP) scheme administered by LAWMA, cover only about 63% of households (Oloniniran, 2025). Earlier studies reported even lower formal collection rates, with 27.2% of residents dumping waste directly into canals and lagoons, 29.2% patronizing cart pushers, and only 9.9% engaging registered PSP operators (Table 1). Significant disparities exist between high-income areas with regular

collection and low-income informal settlements where services are often absent. In the absence of formal services, residents adopt various coping strategies such as open dumping of waste in open spaces, roadsides, and bus stops; burning of waste in some communities, contributing to air pollution (Omole et al., 2016); informal collection by private waste pickers, often without proper disposal; and canal dumping, in which waste is disposed of directly in drainage channels and canals (Ojolowo & Wahab, 2017).

Table 1: Waste Generation and Collection Coverage in Lagos State

Indicator	Value
Estimated population	>20 million*
Daily municipal solid waste generation	~13,000 metric tonnes*
Annual waste generation	~4 million tonnes**
Formal waste collection coverage (PSP)	~63% of households***
Respondents dumping waste directly into canals/lagoons	27.2%****
Respondents patronizing cart pushers	29.2%****
Respondents using registered PSP operators	9.9%****

* VON (2025)

** Olukanni & Oresanya (2018)

***Oloniran (2025)

**** Ojolowo & Wahab (2017)

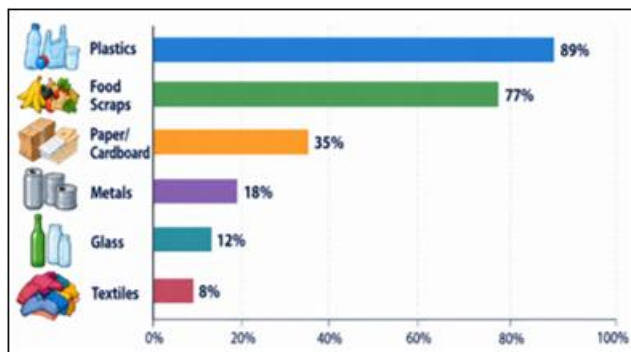


Figure 2: Household Waste Composition in Some Lagos Communities (Adapted from Ogunrinde, 2026)

Despite these challenges, Lagos has a vibrant informal waste economy that provides livelihoods for thousands of residents (Olukanni & Oresanya, 2018). In Ajegunle-Ikorodu, for example, approximately 70% of households engage with informal recyclers, with some earning ₦20,000–₦30,000 monthly from collecting and selling metals, plastics, and electronic waste (Ogunrinde, 2026). This informal sector represents an adaptive capacity that, if properly integrated into formal systems, could contribute significantly to waste management and flood mitigation (Rufai & Cavazzin, 2026).

3.2 Evidence of the waste–flood nexus in Lagos

3.2.1 Drainage blockage and flood incidence

Empirical evidence from multiple Lagos communities demonstrates a strong association between waste disposal practices and flood incidence. In Somolu Local Government

Area, only about 35% of respondents reported frequent street flooding, but a majority attributed flooding to the dumping of refuse in unsanctioned places; practices of open waste dumping into drainages in higher-elevation areas increase flood risk downslope (Daramola et al., 2024). In Ajegunle-Ikorodu, poor waste disposal practices contribute to recurrent flooding affecting nearly 80% of households, as well as blocked drainage systems (Ogunrinde, 2026). In Bariga, project organizers noted that with approximately 70% of flooding in Lagos attributed to blocked drainage systems, intercepting waste before it reaches drainage channels represents both a climate adaptation strategy and a flood prevention measure (Tribune Online, 2026).

These findings are in line with broader Nigerian research in similar contexts. For example, Ojolowo and Wahab (2017) established that waste disposal methods and frequency of collection statistically significantly predicted flooding across metropolitan Lagos, explaining about 67% of flood frequency (Table 2). Also, Echendu (2023) found in Port Harcourt that 39.2% of residents dumped waste into surrounding water bodies (rising to 70% in informal settlements) and that solid waste blockage of drains was the principal flood mechanism identified by both residents and flood risk experts. Similarly, Idris and Dantata (2019) found that poor waste management was the dominant driver of drainage obstruction in Gombe metropolis.

Table 2: Drainage Blockage Points Across Metropolitan Lagos (After Ojolowo & Wahab, 2017)

Local Government Area	Number of Blockage Points
Somolu	36
Lagos Island	20
Apapa	19
Lagos Mainland	19
Surulere	19
Total (metropolitan Lagos)	222

3.2.2 Spatial patterns of risk

Flood risk in Lagos exhibits spatial variation related to topography, drainage infrastructure, and waste management practices. In Somolu, elevation ranges from 2 m to 20 m above sea level, with low-lying areas experiencing higher flood vulnerability (Daramola et al., 2024). Public bins were found to be used mainly in high-elevation areas, while mid- and low-elevation areas relied mainly on waste vans, creating inequities in waste collection that exacerbate flood risk for vulnerable populations, which is an equity pattern mirrored in Port Harcourt's waterside informal settlements (Echendu, 2023).

3.2.3 Health and socioeconomic impacts

The waste–flood nexus has significant health and socioeconomic consequences. In Ajegunle-Ikorodu, residents reported health concerns including malaria, cholera, typhoid, and rodent infestations linked to poor waste management and flooding (Ogunrinde, 2026). These findings are consistent with wider Nigerian evidence on the public health burdens of indiscriminate dumping (Ogunrinola & Adepegba, 2012). Flood damage to property, disruption of livelihoods, and displacement further compound vulnerabilities, particularly for low-income households (Nkwunonwo et al., 2016). Figure 3

provides a conceptual model of the waste-flood nexus in Lagos State.



Figure 3: Conceptual Model of the Waste-Flood Nexus

3.3 Current interventions: government and community responses

3.3.1 Government-led initiatives

Lagos State has deployed artificial intelligence-driven systems to track water levels and waterways in real time across the state (The Cable, 2026). The system provides early warning and complements existing flood control measures, including a dedicated 'flood abatement gang' within the Ministry of Environment and Water Resources that operates 24 hours daily (Akoni, 2025a). Also, the government has established an Emergency Flood Abatement Gang and a Drainage Enforcement and Compliance Gang tasked with clearing drainage channels and ensuring free flow of water (Akoni, 2025a). In 2025, these teams were recognized for their role in flood response. The government has since issued enforcement notices against illegal structures obstructing waterways; in areas such as Lekki, Agungi, and Ajiran, buildings constructed directly on drainage channels received 72-hour demolition notices (Akoni, 2025a). The Commissioner for the Environment has emphasized that illegal structures obstructing waterways will continue to be removed and replaced with nature-based or engineered solutions (Akoni, 2025a). Furthermore, the Lagos State Government has announced plans to adopt a waste-to-energy strategy to reduce the volume of waste reaching landfill sites. A US\$400 million facility planned

for Epe is intended to convert municipal solid waste into electricity, potentially serving up to two million residents, with an estimated 12% Internal Rate of Return over a 20-year operating period (VON, 2025). An additional waste-to-energy plant, developed with a Dutch consortium, is expected to convert 3,000 tonnes of waste daily into up to 75 megawatts of electricity (Akoni, 2025b). The government has also signed an agreement with a Ghana-based company to process part of its daily waste output into compost, recyclable plastics, and fertilizers (Akoni, 2025b). Table 3 presents a summary of the government-led interventions.

After months of accumulated waste that generated significant public concern, the government revived the Monthly Environmental Sanitation Exercise, held every last Saturday of the month (This Day, 2026). Unlike previous episodes, the exercise now emphasizes community participation rather than enforcement-led compliance, with the Governor and the Commissioner for the Environment personally participating in sanitation activities in Surulere and Mushin, clearing refuse and desilting drains (This Day, 2026). Moreover, the state government convened a meeting with all 20 local government areas and 37 local council development areas to strengthen collaboration on waste management and flood mitigation (Oloniniran, 2025). Some local governments have procured tricycles for house-to-house waste collection in inner streets to improve coverage (Oloniniran, 2025). LAWMA has also expanded recycling infrastructure, growing the number of recycling companies in the state from three to 78 and engaging 16,489 street sweepers, in addition to marine waste services that remove floating refuse from blocked channels and coastal lines (LAWMA, n.d.).

3.3.2 Community-led interventions

The youth-led climate action initiative in Bariga termed 'Urban Waste to Lagoon Solutions Project' focuses on preventing waste from reaching drainage channels and waterways (Tribune Online, 2026). The project trains youth climate champions, conducts market-level sensitization exercises, and installs waste infrastructure where needed. Project organizers note that intercepting waste before it reaches drainage channels represents both a climate adaptation strategy and a flood prevention measure (Tribune Online, 2026).

Moreover, research in Ajegunle-Ikorodu revealed strong community readiness to support sustainable waste management solutions: 85% of respondents prioritized the provision of accessible waste collection points, while 65% called for more education on waste separation and recycling (Ogunrinde, 2026). The research team is working with community leaders, LAWMA, local NGOs, and private sector actors to design targeted interventions including community waste collection points, recycling education programmes, and women- and youth-led waste enterprises (Ogunrinde, 2026).

3.3.3 Public perception and response

Public perception of government initiatives has been mixed. In response to the evacuation of accumulated waste, residents expressed appreciation and hoped that the government would

make it a continuous exercise (News Agency of Nigeria [NAN], 2026). Some residents called for more frequent household waste collection to discourage illegal dumping, while others advocated stricter enforcement against environmental offenders (NAN, 2026). Residents have demonstrated awareness of their own role: one noted that 'whenever it rains, the drains overflow. If refuse is left too long, it blocks the drainage and worsens

flooding,' while another resident emphasized that they also have a role to play as some people still dump refuse on road medians at night (NAN, 2026). This awareness-without-action pattern mirrors Echendu's (2023) finding that Nigerian residents understand the waste–flood link yet lack accessible alternatives, indicating that awareness alone is insufficient to change behaviour

Table 3: Government-Led Interventions Addressing the Waste-Flood Nexus

S/N	Intervention	Description
1.	AI-driven flood monitoring	Real-time tracking of water levels and waterways
2.	Flood Abatement Gang	24-hour drainage clearance operations
3.	Drainage Enforcement and Compliance Team	Enforcement against illegal structures obstructing waterways
4.	Waste-to-energy (Epe)	US\$400 million facility; 3,000 tonnes/day; 75 MW; serves ~2 million residents; 12% IRR over 20 years
5.	Waste-to-energy (Dutch consortium)	3,000 tonnes/day → 75 MW
6.	Compost/recycling agreement (Ghana-based company)	Processing waste into compost, recyclable plastics, fertilizers
7.	Monthly Environmental Sanitation Exercise	Revived; last Saturday monthly; community participation emphasis
8.	Local government collaboration	20 LGAs + 37 LCDAs; tricycles for house-to-house collection
9.	Recycling infrastructure expansion	Recycling companies increased from 3 to 78; 16,489 street sweepers; marine waste services*

3.4 Challenges and Constraints

3.4.1 Institutional and governance challenges

Despite recent collaboration efforts, coordination among government agencies, local governments, and community organizations remains fragmented (Lucas, 2021; Oloniran, 2025). Limited funding also constrains the scale and reach of interventions; for example, the proposed US\$400 million waste-to-energy facility depends on substantial private-sector participation (VON, 2025). Weak and uneven enforcement of environmental regulations further contributes to continued indiscriminate dumping (Rufai & Cavazzin, 2026). These constraints indicate that technical interventions alone are unlikely to produce sustained reductions in waste-related flood risk without stronger institutional coordination and implementation capacity.

3.4.2 Infrastructure deficits

The Olusosun and Solous 3 landfills have outlived their lifespan, necessitating decommissioning and development of alternatives (Akoni, 2025b; Olukanni & Oresanya, 2018). Also, the existing drainage systems are frequently inadequate, narrow, and poorly maintained (Olajuyigbe et al., 2012; Akoni, 2025a). The government acknowledges that effective drainage management could address up to 50% of flooding challenges (Akoni, 2025a). Likewise, with only about 63% formal collection coverage, significant portions of the city remain underserved (Oloniran, 2025).

3.4.3 Behavioural and social challenges

Despite awareness campaigns, some residents continue to dispose of waste improperly, including during rainfall events (The Cable, 2026). While awareness of the waste–flood link exists, behaviour change has been slow (Daramola et al., 2024). Lastly, low-income communities often lack access to formal waste services and bear disproportionate flood risk (Echendu, 2023; Ogunrinde, 2026).

4. Discussion

4.1 Evaluating the effectiveness of current interventions

The evidence reviewed in this study indicates that Lagos is increasingly treating waste management and flood control as interconnected policy challenges, although the degree of integration varies across interventions. AI-supported flood monitoring can strengthen preparedness and early warning (The Cable, 2026), but monitoring does not prevent solid waste from entering drainage systems. Its value therefore depends on complementary upstream measures that reduce obstruction, improve collection coverage, and maintain drainage capacity (Jha et al., 2012). This distinction between preparedness and prevention is central to evaluating the current intervention portfolio.

Waste-to-energy initiatives potentially provide two benefits: diversion of waste from disposal sites and generation of energy. The planned scale reported for Lagos suggests the potential for material waste diversion (Akoni, 2025b; VON, 2025). However, capital intensity, feedstock reliability, environmental safeguards, and long-term operational capacity are important implementation considerations. Waste-to-energy should therefore be treated as one component of an integrated waste hierarchy rather than as a substitute for collection, source reduction, recycling, and drainage protection.

Flood-abatement gangs provide a rapid mechanism for clearing drainage blockages, and their 24-hour operational model reflects institutional attention to recurrent flood risk (Akoni, 2025a). Nevertheless, clearance is primarily reactive: it removes obstructions after waste has entered the drainage network. A more preventive model would combine routine maintenance with reliable household collection, interception of waste before it reaches waterways, enforcement against dumping, and targeted service expansion in flood-prone communities. This interpretation is consistent with Ojelowo

and Wahab (2017), who linked waste-management practices and collection frequency with flooding across metropolitan Lagos.

Community initiatives in Bariga and Ajegunle-Ikorodu illustrate the complementary role of bottom-up action. Youth mobilization, market sensitization, local collection points, and recycling education can improve the social infrastructure needed for prevention (Tribune Online, 2026; Ogunrinde, 2026). However, community participation is unlikely to be durable where residents lack affordable and reliable disposal alternatives. Engagement should therefore be paired with service provision and institutional accountability rather than treated as a substitute for them.

4.2 Integrating the informal waste economy

One of the most promising but underexploited opportunities in Lagos is the integration of the informal waste economy into formal waste management systems. The finding that about 70% of households in Ajegunle-Ikorodu engage with informal recyclers (Ogunrinde, 2026) indicates that informal networks already perform essential waste management functions. Rufai and Cavazzin (2026) observe that infrastructural deficits and weak enforcement limit proper disposal, 'yet a highly active informal sector provides adaptive capacity that formal institutions have not harnessed.' Ojolowo and Wahab (2017) similarly recommended integrating cart pushers, who enjoyed greater patronage than LAWMA and PSP operators, into the formal system. Integrating informal waste workers could improve collection coverage, increased recycling rates, economic empowerment, and reduced waste entering drainage channels.

4.3 Addressing the behavioural dimension

A critical factor in the waste–flood nexus is why residents dispose of waste improperly despite awareness of the consequences. Research from Somolu found that while residents are aware of flood risk, this awareness does not always translate into appropriate disposal practices (Daramola et al., 2024). Echendu (2023) attributes this gap in Nigerian big cities to the lack of a sense of belonging, weakly integrated urban waste management systems, and the absence of disincentives for offenders. Contributing factors include limited alternatives in communities without regular collection, cost considerations, normalized dumping behaviour, and weak enforcement (Rufai & Cavazzin, 2026). Effective interventions must therefore combine infrastructure provision, economic incentives, social mobilization, and enforcement, which is consistent with the 'behavioural turn' literature on flood risk management (Kuhlicke et al., 2020; Echendu, 2023).

4.4 An integrated framework for Lagos

Drawing on the evidence synthesized above, this study proposes an integrated waste–flood resilience framework for Lagos. The framework builds on prior work on integrated solid waste and flood-risk management (Idris et al., 2025),

behavioural and institutional dimensions of urban waste systems (Rufai & Cavazzin, 2026; Echendu, 2023), and metropolitan Lagos evidence on drainage obstruction (Ojolowo and Wahab, 2017). Its distinctive contribution is to organize these strands into five mutually reinforcing principles—Integration, Prevention, Inclusivity, Sustainability, and Resilience—and to connect them to implementable institutional, infrastructural, community, economic, regulatory, and nature-based actions. The framework is intended as a policy architecture rather than a validated predictive model. Its value lies in identifying where interventions must interact: collection expansion reduces leakage into drains; community participation and incentives influence disposal behaviour; formalization can harness informal recovery networks; drainage management protects hydraulic capacity; and coordinated governance aligns these activities with flood-risk planning. Table 4 translates these principles into components and phased implementation pathways.

Table 4: Proposed Integrated Framework for Lagos

a) Core Principles

Principle	Description
Integration	Treat waste management and flood mitigation as interconnected challenges
Prevention	Prioritize interception of waste before entering drainage systems
Inclusivity	Account for needs of informal settlements
Sustainability	Ensure economic, social, and environmental viability
Resilience	Design systems to withstand and recover from flood events

b) Components

Component	Key Actions
Institutional coordination	Inter-agency taskforce (Ministry of Environment, LAWMA, LGAs/LCDAs, community orgs)
Infrastructure development	Expanded PSP coverage; improved drainage; transfer stations; sanitary landfills; nature-based solutions
Community engagement	School/community education; waste champions; participatory planning; multi-channel campaigns
Economic incentives	Pay-as-you-throw; deposit-refund; waste-to-energy financing; formalization of informal workers
Enforcement and regulation	Prohibitions on drainage dumping; AI/CCTV monitoring; meaningful penalties; paired with disposal alternatives

c) Phased Implementation Pathways

Phase	Timeline	Key Actions
Short-term	0–2 years	Expand collection coverage in flood-prone areas; intensify drainage clearance; community education; establish taskforce
Medium-term	2–5 years	Construct transfer stations; commission waste-to-energy; strengthen enforcement; formalize informal workers
Long-term	5+ years	Comprehensive drainage master plans; climate-adaptive urban planning; institutional capacity building

4.5 Limitations of the study

This study has several limitations. First, it relies primarily on secondary evidence from published studies, institutional documents, government statements, and selected media reports; it therefore cannot establish causal effects with the precision of a longitudinal or primary-data study. Second, the underlying studies differ in geographic coverage, sampling, measurement, and publication date, limiting direct comparison of some quantitative estimates. Third, evidence from selected communities cannot be assumed to represent all of Lagos State. Fourth, media sources were necessary for several recent policy developments but may not provide the methodological detail available in peer-reviewed research. Finally, the proposed integrated framework is conceptually derived from the synthesized evidence and should be tested through implementation studies, primary data collection, and rigorous impact evaluation. These limitations are consistent with Lucas's (2021) observation that the Nigerian urban-flood evidence base remains uneven in quality and comparability.

5. Conclusion and Recommendations

5.1 Conclusion

This study demonstrates that solid waste management is an important component of urban flood-risk reduction in Lagos. The reviewed evidence consistently indicates that improper waste disposal, inadequate collection coverage, drainage obstruction, infrastructure deficits, and fragmented governance interact to increase flood exposure. Existing initiatives, including drainage clearance, monitoring technologies, recycling programmes, waste-processing investments, sanitation campaigns, and community interventions, address important elements of the problem but are likely to achieve greater impact when implemented as a coordinated system. The proposed integrated resilience framework therefore combines institutional coordination, improved waste services, drainage protection, community participation, informal-sector integration, economic measures, enforcement, and nature-based interventions. For Lagos and comparable rapidly urbanizing coastal cities, effective flood resilience requires both downstream flood-control measures and upstream actions that prevent solid waste from entering drainage and waterway systems.

5.2 Recommendations

5.2.1 For government and policymakers:

- 1) Establish an integrated waste and flood management taskforce with representation from all relevant agencies and community organizations;
- 2) Expand waste collection coverage to underserved communities, with particular attention to low-income informal settlements where flood vulnerability is highest;
- 3) Accelerate waste-to-energy and recycling initiatives to reduce the volume of waste reaching drainage channels and landfills;

- 4) Strengthen enforcement of environmental regulations through monitoring technology, meaningful penalties, and consistent application, paired with accessible disposal alternatives;
- 5) Integrate solid waste management into urban planning and flood risk assessments;
- 6) Invest in nature-based solutions, including wetland restoration, mangrove planting, and green infrastructure, alongside engineered drainage; and
- 7) Implement a comprehensive public awareness campaign on the waste–flood link across multiple channels.

5.2.2 For Community Organizations and Civil Society:

- 1) Support community-led waste management initiatives that empower residents to take ownership of their environment;
- 2) Facilitate partnerships between communities and government agencies;
- 3) Promote waste reduction and recycling through education and practical support; and
- 4) Advocate for policy changes addressing systemic barriers to effective waste management and flood mitigation.

5.2.3 For Further Research

- 1) Quantify the economic costs of the waste–flood nexus and the benefits of improved waste management;
- 2) Investigate the social dynamics of waste disposal behaviour and effective behaviour-change strategies;
- 3) Evaluate current interventions through rigorous impact assessment;
- 4) Develop flood risk models incorporating waste-related variables; and
- 5) Study barriers and opportunities for integrating the informal waste economy into formal systems.

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Data availability statement

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