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Assessment of the Effects of Heavy Rainfall on the Environment and Human Health in Eti-Osa Local Government Area, Lagos State, Nigeria

[1]Yemisi Aramide Tijani, *[2]Stephen Taiwo Ogundeji and [3]Noa Abayomi Adedokun

[1]Department of Environmental Management and Toxicology, Redeemer University, Ede, Osun State, Nigeria.
[2]Department of Water Resources Management and Agrometeorology, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
[3]Department of Environmental Management and Toxicology, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

*Corresponding authors' email: ogundejist@gmail.com
ORCID ID: https://orcid.org/0000-0003-1748-6572

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ABSTRACT
Heavy rainfall and the resulting floods are prominent manifestations of climate variability in low-lying coastal urban areas, with significant implications for environmental quality and public health. This study assessed the environmental and health effects of heavy rainfall on residents of Eti-Osa Local Government Area (LGA), Lagos State, Nigeria. A cross-sectional survey was conducted using structured questionnaires administered to 100 residents (20 per community) across five communities: Abraham Adesanya, Lekki, Sangotedo, Okun-Ajah and Ogombo. Data were analyzed using descriptive statistics in SPSS version 20 and Microsoft Excel. Most respondents (95%) perceived rainfall intensity as high. Damage to buildings and loss of property (55%) was identified as the most significant environmental impact, followed by disrupted transportation and water pollution (25%). Common cold (64%), typhoid (18%), malaria (11%), and diarrhoea (7%) were the most frequently reported health problems, while mosquito infestation (90%) and malaria-like symptoms (91%) were widely reported after rainfall events. Town hall meetings (40%) were considered the most effective awareness strategy, while clearing drainage channels (60%) and constructing durable drainage systems (51%) were the preferred mitigation measures. The study concludes that heavy rainfall poses substantial environmental and public health challenges in Eti-Osa LGA, worsened by poor drainage and indiscriminate waste disposal, and contributes community-level evidence on flood risk in Lagos's coastal LGAs. Strengthening drainage infrastructure, enforcing environmental sanitation laws, and promoting community-based awareness programmes are recommended to reduce flood-related risk.

Keywords: Heavy Rainfall, Flooding, Climate Change, Human Health, Environmental Hazard.

INTRODUCTION

Rainfall variability is among the most consistently observed indicators of climate change, with increases in the frequency and intensity of heavy rainfall events documented across both developed and developing regions over the past two decades (IPCC, 2022). While rainfall sustains agriculture and replenishes freshwater resources, heavy and prolonged rainfall can overwhelm natural and engineered drainage systems and trigger flooding, with cascading effects on infrastructure, livelihoods, ecosystems, and human health (European Union, 2007). Heavy precipitation and the resulting floods are significant consequences of climate variability in low-lying coastal cities, with detrimental implications for the environment and human health (Odubote et al., 2026).

Flooding is disproportionately distressing in developing countries such as Nigeria, where rapid and often unplanned urbanization has reduced the capacity of natural drainage systems to absorb runoff (Ndimele et al., 2024). Beyond structural damage, floods can transport terrestrial microbiological agents into drinking-water sources, precipitating outbreaks of typhoid, cholera, and other waterborne diseases (Curriero et al., 2001; Colwell, 1996), and epidemiological evidence has linked the global resurgence of cholera to environmental exposure through bathing and the use of untreated lake and coastal water (Birmingham, 1997).

In Nigeria, the human and economic costs of flood disasters have grown markedly in recent years. The country experienced its most severe flood disaster in over a decade in 2022, when extreme rainfall combined with the release of water from the Lagdo Dam in neighbouring Cameroon displaced more than 1.3 million people, destroyed over 200,000 homes and at least 340,000 hectares of farmland, and was associated with more than 600 fatalities and renewed cholera outbreaks (Abdulrahim et al., 2022). Similar dynamics have recently been reported in Borno State, where heavy rainfall and dam-related flooding produced widespread displacement and a heightened risk of water-related disease and malnutrition (Aborode et al., 2025), and climate change is increasingly recognized as a driver of the resurgence of waterborne disease across Sub-Saharan Africa more broadly (Moore and Colwell, 2025). Lagos State, and its low-lying coastal LGAs in particular, exemplifies this vulnerability: bounded by the Atlantic Ocean, the Lagos Lagoon and numerous creeks, much of the state lies less than two metres above sea level and has been ranked among the world's most exposed coastal megacities to flooding under future climate scenarios (Ndimele et al., 2024). Recent spatio-temporal analyses confirm that flooding within the metropolis is not

evenly distributed but clusters around specific corridors, with the Victoria Island-Lekki axis, which lies within Eti-Osa LGA, identified as one of the most frequently affected flood hotspots in Lagos, alongside inland districts such as Kosofe, Ikeja and Agege (Dossa et al., 2025). A household-level assessment of the adjoining Lekki Peninsula similarly found that well over half of surveyed residents experience at least moderate social vulnerability to coastal flooding, driven chiefly by socio-economic status and unequal access to infrastructure (Akindejoye et al., 2025). Climate change is also a key determinant of public health, both directly through flood-related injury and indirectly through its effects on water quality and the transmission of vector- and water-borne disease (WHO, 2003; McMichael et al., 2006; Lafferty, 2009), while elevated humidity following heavy rainfall has also been linked to increased allergic and respiratory illness (Park, 2013). Damage to roads, drainage, and water supply following heavy rainfall in Lagos has knock-on effects across the economy and health system, with the urban poor remaining the most vulnerable (Idowu, 2011; Banire, 2011).

Despite this growing body of evidence, empirical, community-level assessments of how residents of specific Lagos coastal communities perceive and experience the environmental and health effects of heavy rainfall remain limited, particularly for Eti-Osa LGA, a rapidly urbanizing coastal LGA that combines high-value real estate with informal flood-prone settlements. While recent geospatial assessments and systematic reviews have mapped flood vulnerability and catalogued resilience strategies across Lagos Metropolis at the city scale (Orimoogunje and Aniramu, 2025; Aniramu and Orimoogunje, 2025), fine-grained evidence on how residents themselves perceive and cope with the health and environmental consequences of heavy rainfall remains comparatively scarce outside the most heavily studied flood-prone wards of the Lekki Peninsula. Understanding residents' lived experience of these risks is essential for designing locally appropriate awareness campaigns, drainage interventions and health system responses. This study therefore assessed the effect of heavy rainfall on the environment and human health of residents of Eti-Osa LGA, with specific objectives to: determine the effect of heavy rainfall on residents and their environment; assess residents' awareness of the implications of flooding and the perceived efficiency of flood control measures; evaluate the adequacy of government efforts at health-related flood awareness; and identify residents' perception of the health challenges associated with heavy rainfall, together with ways in which environmentalists and policymakers could support behaviour change for flood-risk reduction.

MATERIALS AND METHODS

Study Area

Eti-Osa LGA (Figure 1) lies on the narrow coastal lowland of south-eastern Lagos State, occupying approximately 129.5 km² of sandy beaches, swamps, mangroves and creeks along the Atlantic foreshore. The LGA is bounded to the north by the Lagos Lagoon, to the south by the Atlantic Ocean, and to the east by Ibeju-Lekki LGA. Based on the most recent national population census projections, Eti-Osa (including Victoria Island and the Lekki peninsula) has a population of approximately 283,791 persons (158,858 males and 124,933 females), and is rapidly urbanizing, with diverse economic activities spanning banking, retail and wholesale trade, commercial transportation, and residential and commercial real estate development.

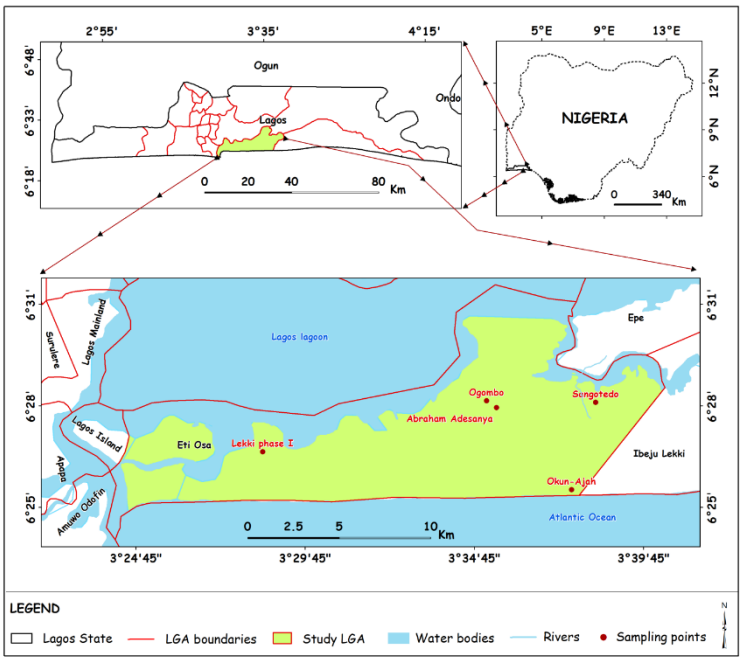


Figure 1: Map of the study area

Data Collection

Cross-sectional survey data were collected from residents on their knowledge of the causes of climate change and their perceived experience of the effects of heavy rainfall on the environment, infrastructure, livelihoods, and health. A structured questionnaire, comprising five sections covering socio-demographic characteristics, household and housing characteristics, perception of heavy rainfall, perceived health effects, and suggested solutions for flood management, was administered to residents of five communities within Eti-Osa LGA: Abraham Adesanya, Lekki, Sangotedo, Okun-Ajah and Ogombo. A total of 100 questionnaires (20 per community) were administered using a purposive sampling approach targeting household heads or adult residents with sufficient

tenure in the community to report on recurring rainfall and flood experience. Respondents participated voluntarily, were assured of anonymity, and gave informed consent prior to data collection.

Data Analysis

Data were analysed using descriptive statistics (frequency counts and percentages) to summarise responses for each of the study objectives. Statistical analysis was performed using IBM SPSS Statistics version 20 and Microsoft Excel Professional 2013.

RESULTS AND DISCUSSION

Socio-demographic and Housing Characteristics of Respondents

Most respondents were of Yoruba ethnicity (54.0%) and male (70.0%). The majority fell within the 36–45-year age bracket (61.0%) and was married (85.0%). Educational attainment was relatively high, with 58.0% of respondents having attained tertiary education, while civil servants constituted the largest occupational group (52.0%), reflecting the LGA's proximity to Lagos's commercial hub. Most respondents (69.0%) lived in cemented housing structures, and household size was fairly evenly split between fewer than five occupants (36.0%) and ten or more occupants (34.0%). A majority (67.0%) indicated no desire to relocate despite the area's flood proneness, while almost a third (33.0%) wished to relocate specifically because of recurrent flooding (Table 1).

Residents' Perception of Heavy Rainfall and its Environmental Implications

An overwhelming majority of respondents (95.0%) described rainfall intensity in Eti-Osa LGA as high, consistent with the area's proximity to the Atlantic coastline. Damage to building infrastructure and loss of property (55.0%) was identified as the leading implication of heavy rainfall, followed by disrupted transportation and polluted water bodies (25.0%). Negligence (30.0%) and low awareness among environmental agencies (29.0%) were perceived as the principal causes of rainfall-related environmental catastrophe, ahead of indiscriminate waste disposal (26.0%) and the absence of adequate drainage (15.0%) (Table 2).

Table 1: Socio-demographic and Housing Characteristics of Respondents

Variables	No. of Respondents (n= 100)	Percent (%)
Ethnic group		
Yoruba	54	54.0
Igbo	25	25.0
Hausa	21	21.0
Gender		
Male	70	70.0
Female	30	30.0
Age (years)		
Below 25	10	10.0
25–35	7	7.0
36–45	61	61.0
46 and above	22	22.0
Marital status		
Married	85	85.0
Single	12	12.0
Divorced	3	3.0
Educational status		
No formal education	5	5.0
Primary	15	15.0
Secondary	22	22.0
Tertiary	58	58.0
Occupation		
Civil servant	52	52.0
Business owner	38	38.0
Student	10	10.0
Duration of residence (years)		
Less than 1	35	35.0
Less than 3	7	7.0
Less than 5	25	25.0
5 and above	33	33.0
Number of household occupants		
Less than 5	36	36.0
5–10	30	30.0
10 and above	34	34.0
Desire to relocate		
Yes	33	33.0
No	67	67.0
House structure		

Variables	No. of Respondents (n= 100)	Percent (%)
Cemented house	69	69.0
Wood house	19	19.0
Mud house with roofing	7	7.0
Block house	5	5.0

Table 2: Residents' Perception of Heavy Rainfall and its Environmental Implications

Variables	No. of Respondents (n= 100)	Percent (%)
Description of rainfall intensity		
High	95	95.0
Moderate	2	2.0
Low	3	3.0
Frequency of heavy rainfall experience		
Often	38	38.0
Rarely	36	36.0
Occasionally	22	22.0
Always	4	4.0
Implications of heavy rainfall		
Damage to building infrastructure/loss of property	55	55.0
Disrupted transportation / polluted water bodies	25	25.0
Loss of life	13	13.0
Loss of livestock, crops and income	7	7.0
Perceived cause of rainfall-related environmental catastrophe		
Negligence	30	30.0
Low awareness by environmental agencies	29	29.0
Indiscriminate waste disposal	26	26.0
Absence of drainage	15	15.0

Residents' Self-reported Perceptions of Health Effects of Heavy Rainfall

Common cold (64.0%) was the most prevalent health challenge associated with heavy rainfall, followed by typhoid (18.0%), malaria (11.0%) and diarrhoea (7.0%). Mosquito infestation (90.0%) and malaria-like symptoms (91.0%) were almost universally reported as occurring 'always' after rainfall events, while most respondents also reported typhoid-like symptoms (90.0%), shortness of breath (83.0%) and cold or numbness of the extremities (89.0%) at least occasionally. Injury-related challenges were also prominent: 76.0% reported traffic-related injury, 85.0% reported falls or near-drowning, and 70.0% reported multiple traumas from loss of property or life following heavy rainfall events (Table 3).

Table 3: Self-reported Residents' Perceived Health Effects of Heavy Rainfall

Variables	No. of Respondents (n= 100)	Percent (%)
Most common health risk associated with heavy rainfall		
Common cold	64	64.0
Typhoid	18	18.0
Malaria	11	11.0
Diarrhoea	7	7.0
Experience of diarrhoea/cholera		
Occasionally	61	61.0
Rarely	21	21.0
Often	18	18.0
Mosquito infestation		
Always	90	90.0
Malaria-like symptoms		
Always	91	91.0
Typhoid-like symptoms		
Sometimes	90	90.0
Shortness of breath		
Sometimes	83	83.0
Cold / numbness of extremities		
Sometimes	89	89.0
Skin wound/infection		
Sometimes	10	10.0
Influenza / general illness		
Sometimes	7	7.0

Variables	No. of Respondents (n= 100)	Percent (%)
Traffic-related injury		
Sometimes	76	76.0
Always	10	10.0
Fall or drowning		
Sometimes	85	85.0
Always	6	6.0
Bone fracture/cuts		
Sometimes	69	69.0
Always	4	4.0
Multiple trauma (loss of property/life)		
Sometimes	70	70.0
Always	13	13.0

Residents' Suggestions for Awareness, Management and Control of Heavy Rainfall

Nearly all respondents (97.0%) reported access to some form of healthcare, although 27.0% described it as costly, and herbal medication remained the most widely used treatment option (38.0%). Most respondents (72.0%) believed awareness creation could help combat flooding, and town hall meetings (40.0%) were rated the most effective medium for raising such awareness, ahead of radio (20.0%), newspapers (17.0%), the internet (13.0%) and television (10.0%). Clearing drainage systems (60.0%) and construction of durable drainage infrastructure (51.0%) were the most favoured flood-control measures, while house-to-house education (49.0%) was considered the most effective strategy for behaviour change. Just over half of respondents (55.0%) indicated that government incentives for environmental sanitation were available, most commonly in the form of free accommodation or temporary shelter (56.0%) (Table 4).

Table 4: Residents' Suggestions for Awareness, Management and Control of Heavy Rainfall

Variables	No. of Respondents (n= 100)	Percent (%)
Access to healthcare		
Yes	97	97.0
No	3	3.0
Type of healthcare access		
Affordable	34	34.0
Costly	27	27.0
Free	21	21.0
Payment for medication only	18	18.0
Medication used		
Herbal	38	38.0
Self-medication	32	32.0
Orthodox	30	30.0
Awareness creation will help combat flooding		
Yes	72	72.0
No	28	28.0
Most effective awareness medium		
Town hall meetings	40	40.0
Radio	20	20.0
Newspaper	17	17.0
Internet	13	13.0
Television	10	10.0
Effective flood control measure		
Clearing of drainage system	60	60.0
Construction of durable drainage	51	51.0
Provision of new drainage facility by government	32	32.0
Environmental education against illegal dumping	31	31.0
Creation of canals/water channels	18	18.0
Most effective behaviour-change strategy		
House-to-house education	49	49.0
Enforcement of environmental sanitation law/fines	33	33.0
Media-based awareness (TV, radio, internet)	18	18.0
Government incentive for environmental sanitation		
Yes	55	55.0
No	45	45.0
Type of incentive received		

Variables	No. of Respondents (n= 100)	Percent (%)
Free accommodation / temporary shelter	56	56.0
Financial support	29	29.0
Free medical care/facilities	11	11.0
Construction of good roads and drainage	4	4.0

Discussion

The near-unanimous perception of high rainfall intensity among residents corroborates regional evidence that Lagos's coastal communities are among the most exposed in Nigeria to rainfall-induced flooding (Ndimele et al., 2024). The dominance of property damage as the leading environmental implication is consistent with national-scale assessments showing that flood-related destruction of housing, roads, and drainage infrastructure remains the most frequently reported consequence of extreme rainfall in Nigeria, including the catastrophic 2022 flood disaster (Abdulrahim et al., 2022). This pattern mirrors recent hotspot analyses of Lagos Metropolis, which identify the Victoria Island-Lekki corridor within Eti-Osa as among the most flood-affected areas of the city and attribute this to the interaction of rapid urban expansion with environmental, socio-economic, institutional, and structural vulnerability factors (Dossa et al., 2025).

The health findings align with the broader literature on climate-sensitive disease in coastal and flood-prone settings. The high prevalence of mosquito infestation and malaria-like symptoms reflects the well-established link between standing water from heavy rainfall and expanded vector breeding habitat (Lafferty, 2009; McMichael et al., 2006), while the substantial proportion of respondents reporting typhoid- and diarrhoea-related symptoms is consistent with evidence that heavy rainfall facilitates contamination of drinking water and transmission of waterborne pathogens (Curriero et al., 2001; Colwell, 1996). These risks are not unique to Eti-Osa: a recent continental review attributes the resurgence of cholera, typhoid, and other waterborne diseases across Sub-Saharan Africa directly to climate-driven changes in rainfall and flooding (Moore and Colwell, 2025), while similar flood-related disease burdens have recently been documented in northern Nigeria (Aborode et al., 2025). A systematic review of flooding-driven health risks across West Africa similarly concludes that heavy rainfall and inundation consistently precede spikes in cholera and other waterborne disease incidence, largely through overwhelmed sanitation systems and contaminated drinking-water sources, and identifies weak integration of climate data into disease surveillance as a persistent barrier to outbreak preparedness in the sub-region (Adesina et al., 2026). The relatively high proportion of respondents reporting common cold, respiratory, and injury-related complaints underscores that the health burden of heavy rainfall in Eti-Osa extends beyond classical infectious disease to direct physical hazards from flooded roads and disrupted infrastructure.

Residents' continued reliance on herbal and self-medication despite widely reported healthcare access suggests that affordability and convenience, rather than availability alone, shape health-seeking behaviour, consistent with patterns in other coastal Nigerian settlements where formal healthcare costs constrain treatment-seeking after flood-related illness (Lawanson, 2023). The finding that town hall meetings were perceived as more effective than mass media for flood-risk awareness supports earlier evidence that community-based communication channels remain particularly effective in Nigerian communities (Nwakerendu, 2016; UNESCO, 2006). Finally, residents' strong preference for drainage-focused interventions echoes a recurring theme in the Nigerian flood literature that inadequate or poorly maintained drainage, rather than rainfall volume alone, is a principal driver of urban flood risk (Ndimele et al., 2024), pointing to a clear entry point for flood-risk reduction in Eti-Osa LGA: drainage rehabilitation paired with sustained sanitation education. This finding is corroborated by a SWOT-AHP assessment of stakeholder-preferred flood solutions in a comparable Lagos coastal megacity setting, which likewise ranked drainage clearance and the construction of durable drainage infrastructure among the most strategically favoured interventions, alongside early-warning systems tailored to the seasonal rainfall peaks that drive flood risk in the metropolis (Aniramu and Orimoogunje, 2025). More broadly, a systematic review of flood-resilience strategies across Lagos Metropolis stresses that sustainable, community-anchored interventions, rather than infrastructure investment alone, are essential if flood-risk reduction efforts are to align with the 2030 Sustainable Development Agenda (Orimoogunje and Aniramu, 2025).

Conclusion

This study highlights the environmental and public health impacts of heavy rainfall in Eti-Osa LGA, Lagos State, particularly rainfall intensity, property damage, disease risks, and physical injuries, compounded by barriers to formal healthcare access. Mitigating these impacts requires sustained community-based awareness, effective waste management, enforcement of environmental laws, and investment in durable drainage infrastructure. Strengthening accessible and affordable primary healthcare services is also essential to improve disease prevention and post-flood health outcomes in Eti-Osa and similar coastal communities.

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