

Living with the waters: perception, adaptation, and policy implications of flooding in Yenagoa metropolis, Nigeria

Abstract

Rationale: Yenagoa metropolis, known for its frequent and seasonal flooding, faces significant challenges due to these recurring flood events. Understanding residents' awareness, perceptions, and adaptive responses to these hazards is crucial for effective flood management and mitigation.

Objectives: The primary objectives of this study are to evaluate the level of awareness among Yenagoa residents regarding flood hazards, analyze their perceptions and adaptive responses, and assess the socio-economic and cultural factors influencing their decisions to reside in flood-prone areas.

Methods: This study employed a mixed-method approach, utilizing structured questionnaires, field observations, and interviews to gather data from 600 respondents across 18 flood-prone conurbations in Yenagoa. Respondents were selected using stratified and systematic random sampling techniques, ensuring a comprehensive representation of the population.

Results: The findings indicate a high general awareness of flood hazards among residents. However, variations in perception were observed, influenced by factors such as ethnicity, education, occupation, and resource use patterns. Despite the known risks, many residents choose to remain in Yenagoa due to perceived socio-economic benefits, cultural ties, and a favorable view of the metropolis and its surrounding suburbs. The study also found that residents employ various adaptive strategies to cope with flood risks, ranging from incidental adjustments to more purposeful actions.

Conclusion: The simplistic understanding of flood hazards has fostered an optimistic and complacent attitude among many residents, which may undermine effective risk management and mitigation efforts.

Recommendations: To address these challenges, it is recommended that targeted education and awareness campaigns be conducted to improve residents' understanding of flood risks. Additionally, policy interventions should be implemented to encourage proactive flood risk management and adaptation strategies.

Significance Statement: This study highlights the critical need for enhanced flood risk awareness and adaptive strategies in Yenagoa metropolis. The findings provide valuable insights for policymakers and stakeholders in designing more effective flood management and mitigation strategies.

Keywords: flood hazards, adjustment, response, perception, adaptation, socio-economic factors, cultural affiliations, risk management, flood mitigation, resident behavior, yenagoa metropolis

Volume 8 Issue 1 - 2025

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Introduction

Flooding is the most widespread environmental hazard globally, posing significant risks to human life, infrastructure, and economic activities. Each year, flooding claims over 20,000 lives and affects approximately 75 million people worldwide, highlighting the urgent need for comprehensive flood management strategies.¹⁻⁶ This prevalence is due to the extensive geographical distribution of rivers, floodplains, and low-lying coastal areas, which have historically attracted human settlement. For instance, Bangladesh, recognized as the most flood-prone country, accounts for nearly three-quarters of global flood-related fatalities.⁷⁻⁹ In May and June 2022, northeastern Bangladesh experienced one of the worst floods in its history, affecting 7.2 million people, including 3.5 million children.¹⁰ Although better preparedness has reduced mortality in some regions,

like the Netherlands, where 58.7% of the population remains at risk, flood-related impacts, including displacement and economic losses, continue to be severe.¹¹ In Nigeria, the September 2022 floods displaced over 1.4 million people, emphasizing the vulnerability of both developing and developed nations to flood hazards.¹¹

Flooding impacts are not confined to less developed countries, as evidenced by the historic Midwest floods in the United States during the Spring and Summer of 1993. These floods affected nine states, damaging or destroying more than 50,000 homes and causing extensive agricultural losses, including a significant reduction in national corn and soybean yields. The economic impact of these floods was staggering, with total losses estimated between \$15 and \$20 billion.¹² These examples underscore the global nature of flood hazards and their ability to cause widespread devastation. In Yenagoa

metropolis, located in the Niger Delta basin of Nigeria, floods have been a recurrent issue, causing extensive physical damage to property, particularly in residential and commercial areas.¹³ These floods not only result in tangible losses, such as the destruction of homes and businesses, but also lead to secondary effects like a temporary decline in property values.^{13,14} The agricultural sector in Yenagoa is particularly hard-hit, with over 80% of direct flood damage attributed to crop losses.¹⁴⁻¹⁷ The floods also contribute to a range of health issues, including the spread of waterborne diseases such as typhoid and malaria, and mental health challenges among affected populations.¹⁴⁻¹⁷ Additionally, environmental degradation occurs as floods erode riverbanks, submerge farmlands, and displace communities, rendering residents homeless and landless.¹⁻³

Despite the significant losses associated with floods in Yenagoa, settlement in flood-prone areas continues to increase. This paradox can be partly explained by the benefits that floods bring to the region, particularly in maintaining wetland habitats, replenishing soil fertility, and supporting agriculture and fisheries, which are vital to the local economy.¹⁸⁻²² In many parts of the tropics, including Yenagoa, flood retreat agriculture, known as Fadama farming, is a common practice that capitalizes on the moist soil left behind after floods recede.²³ Given the substantial impacts of flooding in Yenagoa, there is a clear need to understand the residents' perceptions and adjustments to flood hazards. While extensive research has been conducted on the causes, frequency, and magnitude of floods in Nigeria, as well as potential mitigation strategies, there is a notable gap in the literature regarding how residents in flood-prone areas like Yenagoa perceive and adapt to these hazards. This study aims to fill this gap by examining the perceptions and adaptive behaviors of residents in Yenagoa, focusing on their awareness of flood risks, the factors influencing their decision to settle in flood-prone areas, and the range of adjustments they employ to mitigate flood impacts.

The problem of flooding in Yenagoa is particularly acute, affecting a broad spectrum of the population, especially those living in low-lying and floodplain areas.¹ The degree of the problem is substantial, with floods causing widespread displacement, property damage, and health crises.²⁴⁻²⁸ Flooding in Yenagoa has been a persistent issue, exacerbated by climate change and rapid urbanization,^{8,9} leading to increased vulnerability over time. Historically, the problem has been most severe in urban and peri-urban areas, where the combination of inadequate infrastructure and high population density amplifies the impact of floods. Different groups within Yenagoa are impacted differently by flooding. For instance, low-income households are more vulnerable due to their limited capacity to recover from flood damage and their greater likelihood of living in flood-prone areas. Women, children, and the elderly are also disproportionately affected, as they often have fewer resources and less mobility during flood events.^{2,3,29,30} Additionally, ethnic and occupational differences influence how residents perceive and respond to flood risks, with some groups more likely to engage in adaptive behaviors than others.

This study is crucial as it addresses the underexplored area of residents' perceptions and adaptive strategies in the context of flooding in Yenagoa. By filling this gap, the research will contribute to more effective flood risk management and mitigation strategies, tailored to the specific needs and behaviors of the local population. The findings will be invaluable for policymakers, urban planners, and disaster management agencies in developing targeted interventions that enhance community resilience to flooding in Yenagoa and similar flood-prone areas. Thus, this study aims to examine how the residents of Yenagoa metropolis in the Niger Delta basin perceive and adjust to floods. To achieve the aim of the study, the following objectives

were considered, that is, to: assess the level of awareness of flood hazards among residents in Yenagoa metropolis, determine the factors influencing the movement of people into flood prone areas and the resource use pattern among residents in the metropolis, determine the magnitude to which variations in perception of floods is associated with resource use and development in Yenagoa metropolis; and identify the range of adjustments open to floodplain dwellers as they act to reduce the effect of flooding in Yenagoa metropolis.

Conceptual framework

Flooding is a particularly severe issue in many traditional Nigerian cities that exhibit a blend of rural and urban characteristics. To address this challenge, this study utilizes two key conceptual frameworks: the "Excess Runoff Disposal Model"³¹ and the "Choice Tree of Adjustment Model".³² The Excess Runoff Disposal Model, which is closely linked to the process of urbanization, provides a framework for understanding the sequential stages of flood development as urban areas expand (Figure 1).

PERIOD	SPATIAL CHARACTERISTICS OF RUNOFF DRAINAGE IN A HYPOTHETICAL AREA	HYDROGRAPH CHARACTERISTICS	INDEX
T: PRE-URBAN PERIOD			CMP= Centre of Mass of Precipitation CMR= Centre of Mass of Runoff Y = Hypothetical stream = Surface Runoff
T = 1: Initial urbanization period with adequate provision for modern artificial drainage			
T = 2: Post urbanization period without provisions for adequate modern drainage			
T = 3: Post organization period with provision for adequate modern artificial drainage			

Figure 1 Sequential Development of Surface Runoff Drainage in an Expanding Urban Environment in a Developing Country.³¹

The urban geo-hydrologic environment is notably more diverse and complex than that of a pre-urban water catchment due to the introduction of impervious surfaces and modified drainage systems, such as drains and retention basins, resulting from urban development.³¹ As urbanization progresses, these changes can introduce further complications, particularly when expanding impervious areas are not adequately serviced by runoff disposal systems. Consequently, runoff often accumulates on street surfaces, leading to significant inconveniences and costly damage. To address these challenges, many cities are compelled to seek expensive post-construction solutions. The urban flood challenges faced by expanding Nigerian cities can be understood through a series of sequential development stages (Figure 1). In the pre-urban period (t), a hypothetical area that will eventually be urbanized typically features natural vegetation and an absence of man-made structures. At this stage, the surface maintains its natural infiltration characteristics, and the runoff drainage systems are considered "natural" or "normal." The lag time of runoff, defined as the interval between the center of mass of storm precipitation and the center of mass of the resulting hydrograph, is also considered "normal".³¹

As the initial urbanization period (t+1) begins, most urban structures are concentrated in a core area, while the surrounding areas remain in a natural or semi-natural state. Urbanization reduces the infiltration capacity of the basin surface, resulting in a significant increase in surface runoff. However, without the implementation of modern artificial drainage facilities, the runoff takes longer to reach the natural drainage system, leading to considerable surface pondage and an increased lag time. This lag time becomes increasingly pronounced as urban structures continue to expand (t+2) without the simultaneous development of artificial drainage systems. At this stage, the streets are severely affected by flooding, highlighting the need for improved infrastructure.

In the post-urbanization period (t+3), the construction of adequate modern drainage systems significantly reduces the flow time for runoff, thereby shortening the lag time. Although this alleviates flooding on city streets, it may also lead to increased flood peaks in natural streams due to the accelerated urban runoff. This model is particularly applicable to many urban cities in Nigeria. For instance, in Yenagoa, the process of urbanization began in the 1980s, representing the initial urbanization period (t+1). During this time, the city experienced minimal flood issues, with only isolated incidents of surface pondage in the metropolis. However, by 1981, the metropolis had expanded significantly, corresponding to stage (t+2), when widespread street flooding became prevalent. It is anticipated that a post-urbanization period will follow, during which more attention will be given to the planning and development of the city's basic layout. Hence, all urban and semi-urban flood problems and their corresponding alleviation strategies in Nigeria can be sequentially interpreted through the lens of the Excess Runoff Disposal Model, which is intrinsically linked to the process of increasing urbanization.

The choice tree of adjustment model

The Choice Tree of Adjustment model, in contrast to other frameworks, conceptualizes the array of options available to individuals or agencies when confronting hazards that impact a specific area. This model is particularly relevant for individuals and small groups, as it focuses on fundamental decisions related to livelihood and location. The selection of a particular activity at a given location is significantly influenced by one's understanding of potential hazard processes and the extent to which technological resources can be applied to mitigate these risks. Within any chosen location, a variety of livelihood choices or adjustments may be available, allowing for either minor or major shifts in resource use patterns.³² Moreover, once an individual commits to a specific resource use in a particular location, they tend to employ a range of personal and social strategies to navigate the associated risks. Firstly, they may seek to modify the loss burden by balancing it with other costs related to their chosen location. This often involves reducing losses by adapting the damaging events to better suit the people affected. While most natural hazards are not yet fully understood and thus cannot be entirely controlled at their source through environmental engineering, individuals and communities can still take steps to mitigate their impact.

In addition to these efforts, modifying human vulnerability is another critical component of the model. This involves implementing measures designed to reduce hazard losses by adjusting people's behaviors and responses to damaging events. Such measures can include hazard preparedness programs aimed at changing how people interact with their environment, accepting and distributing losses among resource users, and installing forecasting and warning systems. Furthermore, strategic land use planning can encourage more

appropriate allocations, thereby reducing vulnerability. As population growth continues to drive increased occupancy in hazard-prone zones, the necessity of choosing between changing land use practices in place or migrating to safer locations becomes increasingly apparent. Purposeful adjustments, such as insurance or engineering projects, are most effective when initiated well in advance of a hazardous event. On the other hand, short-term responses, such as emergency evacuations, also depend heavily on prior planning and preparedness to ensure their effectiveness. The Choice Tree of Adjustment model illustrates how these strategies are often aligned along a time scale, with their success largely contingent on the timing and occurrence of extreme events (Figure 2).

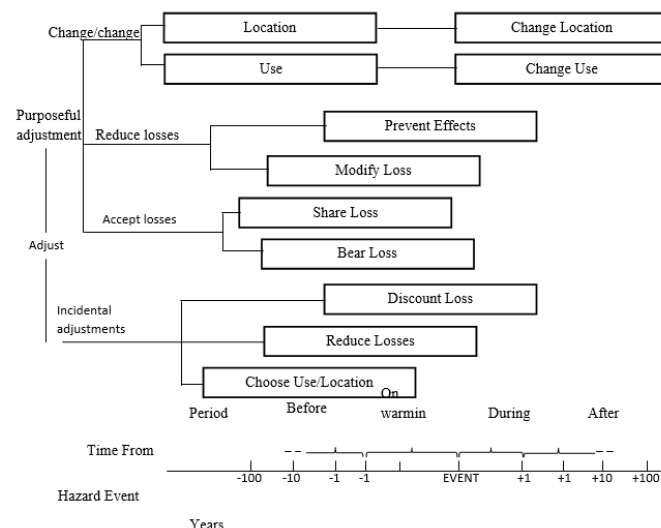


Figure 2 A Choice Tree of Adjustment Burton et al.,³² Adjustment begins with an initial choice of a resource use, livelihood system, and location. For the choice, various incidental and purposeful adjustments are available, at somewhat different time scales for initiation. The most radical choice is to change the original use or location.

Materials and methods

Study area

Yenagoa metropolis, the administrative headquarters of Bayelsa State, Nigeria, is strategically situated between Latitudes 4°49' N and 5°23' N, and Longitudes 6°10' E and 6°40' E, along the banks of the Ekoli Creek in the Niger Delta Basin. This location is intersected by the Epie Creek, as well as numerous streams and wetlands, which are vital to sustaining the local ecosystem and supporting the socioeconomic and cultural lives of the residents. The metropolis experiences an Equatorial climate, characterized by consistently high daily temperatures averaging around 27°C, with a narrow annual temperature range of 2°C to 3°C, and a small diurnal range of 1°C to 8°C. Relative humidity remains high, consistently exceeding 80%. The area receives substantial rainfall, ranging from 3,000 mm to 4,050 mm annually, with December often experiencing no recorded rainfall. In terms of relief and drainage, the terrain of Yenagoa is predominantly flat, sloping gently toward the coast. This results in the entire area lying below 15.25 meters above sea level, making it particularly susceptible to flooding.¹⁴ Geologically, the metropolis is underlain by sedimentary rock formations that date back to the Cretaceous era, approximately 120 million years ago. These formations include deposits of continental, marine, lacustrine, and alluvial origins, contributing to the area's rich mineral resources.³³

Study design

This study employed a cross-sectional survey design, which is suitable for capturing a snapshot of the population’s awareness, perceptions, and adjustments to flood hazards in Yenagoa metropolis. The survey method was chosen to allow for the collection of a wide range of data sets pertinent to understanding the complex dynamics of flood risk perception and management among residents.

Study population

The study population comprised household heads residing in 18 conurbations within Yenagoa metropolis. This population was chosen due to their direct exposure to flood hazards and their role in making decisions regarding household adjustments to flooding. The population characteristics included a mix of socio-economic backgrounds, education levels, and ethnicities, reflecting the diversity of the metropolis.

Inclusion criteria

The study included household heads who had been residents of Yenagoa metropolis for at least one year. This criterion ensured that the respondents had adequate experience and exposure to the flood events in the area, allowing them to provide informed responses regarding their awareness, perceptions, and adjustments to flood hazards.

Exclusion criteria

Household heads who had recently relocated to Yenagoa metropolis, specifically those with less than one year of residency, were excluded from the study. Additionally, respondents who were unavailable or unwilling to provide informed consent were not included in the survey.

Sample size

The sample size was determined using the Cochran formula³⁴ for an infinite population, which was then adjusted for the finite population of Yenagoa metropolis. Thus, to determine the sample size using the Cochran formula for a finite population, the following steps were followed:

$$n_0 = \frac{Z^2 * P * (1 - P)}{E^2}$$

Where:

n_0 = Sample size for infinite population

Z = Z-value (e.g., 1.96 for a 95% confidence level)

p = Estimated proportion of the population (commonly 0.5 if unknown)

E = Margin of error (e.g., 0.05 for 5%)

Assuming a 95% confidence level, $Z=1.96$, $p=0.5$, and $E=0.05$.

$$\text{Sample Size } (n_0):$$

$$n_0 = \frac{(1.96)^2 * 0.5 * (1 - 0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 * 0.25}{0.0025}$$

$$n_0 = \frac{0.9604}{0.0025}$$

Sample Size (n_0): 384.16

So, for an infinite population, the sample size is approximately 384.

For a finite population, we use the finite population correction formula:

$$nf = \frac{no}{1 + no - \frac{1}{N}}$$

Where:

- o nf = Adjusted sample size for finite population
- o N = Finite population size (385,442 in this case)

Hence,

$$nf = \frac{384.16}{1 + 384.16 - 385442}$$

$$nf = \frac{384.16}{1 + 384.16 / 385442}$$

$$nf = \frac{384.16}{1.000994}$$

$$nf = \frac{384.16}{1 + 0.000994}$$

$$nf = 383.3$$

To account for the response rate, we calculate:

$$\text{Total questionnaires needed} = \frac{\text{Desired Valid Responses}}{\text{Response Rate}}$$

$$\text{Total questionnaires needed} = \frac{600}{0.95}$$

$$\text{Total questionnaire needed} = 632$$

Thus, a total of 632 questionnaires were administered, and 600 valid responses were retrieved, resulting in a response rate of 95%. This sample size provided sufficient statistical power to generalize the findings to the broader population of the metropolis.

Sampling techniques

The study employed a stratified and systematic sampling technique to ensure that the selected respondents were representative of the diverse population within Yenagoa metropolis. The stratified sampling technique was used to divide the metropolis into 18 conurbations based on geographic and socio-economic characteristics. Within each stratum, systematic sampling was used to select household heads at regular intervals, ensuring that the sample was not biased towards any particular group.

Data collection tool

The primary data collection tool was a structured questionnaire, designed to gather detailed information on respondents’ demographics, awareness of flood hazards, perceptions of flood risks, and the adjustments they have made to mitigate flood impacts. The questionnaire was composed of close-ended questions to facilitate quantitative analysis and ensure consistency in responses.

Pretesting of research instruments

Before the main data collection, the questionnaire was pretested on a small sample of respondents who were similar to the study population but not part of the main survey. This pretesting helped to identify any ambiguities in the questions and to assess the reliability and validity of the instrument. Adjustments were made based on

feedback from the pretest to enhance the clarity and effectiveness of the questionnaire.

Validity/reliability of instrument

To ensure the validity of the research instrument, content validity was established through expert review. The questionnaire was evaluated by professionals in the fields of environmental science and urban planning to ensure that it adequately covered the research objectives. Reliability was tested using the test-retest method, where the questionnaire was administered to the same group of respondents at two different times. A high correlation coefficient indicated strong reliability of the instrument.

Data sources

Data for this study were collected from both primary and secondary sources. Primary data were obtained through direct field methods, including observation, interviews, and the administration of the structured questionnaire. Secondary data were sourced from existing literature, government reports, and previous studies on flooding in the Niger Delta Basin.

Duration of study

The study was conducted over a period of six months, from January to June 2024. This timeframe allowed for adequate planning, data collection, analysis, and reporting, ensuring that the study objectives were thoroughly addressed.

Data analysis

The collected data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics, including frequencies, percentages, and mean values, were used to summarize the data. Inferential statistics, such as chi-square tests and logistic regression, were employed to examine the relationships between variables and to test the study hypotheses. Data analysis was conducted using statistical software such as SPSS, ensuring accurate and reliable results.

Ethical approval

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Niger Delta University. The study was conducted in accordance with the ethical standards outlined by the IRB, ensuring that the rights and welfare of the respondents were protected throughout the research process.

Informed consent

Informed consent was obtained from all respondents before their participation in the study. The purpose of the study, the nature of the questions, and the potential risks and benefits were clearly explained to the respondents. They were assured of the confidentiality of their responses and were given the option to withdraw from the study at any time without any consequences.

Results and discussion

The demographic and socioeconomic characteristics of the respondents

The demographic and socioeconomic characteristics of the six hundred households surveyed from the 18 conurbations of Yenagoa Metropolis, located along natural levees, backswamps, and the banks of tributaries of the Epie Creek, reveal several significant trends (Table 1). This area, known for its flood-prone nature, is inhabited

by a relatively young population, with 80% of respondents falling within the age range of 30 to 45 years. This trend aligns with findings from Ajibade, McBean, and Bezner-Kerr,³⁵ who noted that younger populations often inhabit vulnerable urban areas due to economic pressures and the need for affordable housing. Gender distribution in Yenagoa also presents a notable pattern, with a majority of the respondents being male (84%), while only 16% were female. This male dominance in household representation is consistent with the findings of Adigun, Abolade, and Yusuf,³⁶ who observed similar gender disparities in flood-prone areas of Lagos State, Nigeria. The high percentage of married respondents (76%) indicates a strong cultural emphasis on marriage in the community, a characteristic that Aderogba³⁷ identified in his study of Nigerian urban centers, where marriage is a stabilizing social factor, even in flood-prone areas.

Table 1 Demographic Characteristics of the Household Heads

Demographic Variables	Respondents	Percentage (%)
Males	501	84
Females	97	16
Modal Class of Age Cohorts (30-40yrs)	454	76
Typology of Marriage		
Polygamy	47	47
Monogamy	53	53
Married	450	75
Single	124	20.7
Divorced	18	3
Widowed	8	1.3
Educational Attainment	Respondents	Percentage (%)
Informal	35	5.8
Primary	109	18.3
Secondary	368	61.3
Tertiary	68	11.3
Vocational	20	3.3
Occupation of Respondents	Respondents	Percentage (%)
Agriculture	133	22.2
Fishing	110	18.2
Forestry/lumbering	73	12.2
Trading	79	13.2
Services	21	3.5
Construction/crafts	14	2.3
Education	25	4.2
Healthcare	15	2.5
Palm oil milling	14	2.4
Oil and gas	9	1.2
Civil service	62	10.3
Gin distillery	20	3.3
Transport	13	2.2
Others	12	2

Source: Authors' field survey, 2022

However, the incidence of singlehood, at 20%, appears to be on the rise, a trend that may be associated with urbanization and changing social norms, as observed by Adelekan³⁸ in his study on vulnerability in Lagos. Household sizes in Yenagoa typically range from 4 to 9 people, with an additional 1 to 3 dependents, reflecting a high dependency ratio on household heads. This is particularly significant in flood-prone areas, as Ishaya, Ifatimehin, and Abaje³⁹ noted that larger households are often more vulnerable to the economic impacts of flooding due to

the increased financial burden on primary earners. The socioeconomic characteristics of the respondents, particularly their educational and occupational distribution, offer further insight into their vulnerability to flooding. While residents of Yenagoa are primarily engaged in the informal sector and public civil service, many also partake in farming, fishing, and retail trading. This multiple occupational disposition is a strategic response to economic instability and high dependency ratios, as observed in other studies of urban areas in Nigeria.^{37,40} The reliance on informal economic activities, which are often disrupted by flooding, underscores the precariousness of livelihoods in flood-prone areas.⁴¹

Comparing these findings with those from other regions, it is evident that Yenagoa’s demographic and socioeconomic patterns are reflective of broader trends observed in flood-prone areas of Nigeria. Studies by Ayoade and Akintola⁴² and Etuonovbe⁴³ similarly highlight the vulnerability of young, economically marginalized populations who are often forced to inhabit risky areas due to limited alternatives. The multiple livelihoods strategy observed among Yenagoa residents aligns with the adaptive behaviors noted by Adigun et al.,³⁶ where residents diversify their income sources to mitigate the impact of environmental hazards like flooding. Hence, the demographic and socioeconomic characteristics of Yenagoa’s population highlight their vulnerability to flooding, a finding that is consistent with numerous studies across Nigeria. The young, predominantly male population, the rising incidence of singlehood, and the reliance on multiple, often informal occupations all contribute to the community’s resilience, yet also underscore its susceptibility to the economic and social impacts of flooding. This analysis aligns with the broader literature, which consistently identifies these factors as critical in understanding the dynamics of urban flood vulnerability in Nigeria (Table 1).^{44,45} Similarly, the analysis of the migration status of the residents of Yenagoa revealed that about 70% of the household heads were non-migrants while the remaining proportion can be classified as migrants or in-movers. However, there are significant variations of migrants among the 18 conurbations of Yenagoa metropolis. On housing, majority of the respondents in Yenagoa own and dwell in their own houses on an owner occupier basis while the other urban dwellers live in privately rented housing units or quarters provided by their employers.

The awareness of flood hazards in yenagoa metropolis

The study’s findings on the awareness of flood hazards among the residents of Yenagoa Metropolis reveal a high level of cognizance of the risks associated with flooding, supported by the experiences and observations of the community (Table 2 and Figure 3). This is consistent with the findings of Ajumobi, Womboh, and Ezem,⁴¹ who documented the profound impacts of the 2022 flooding on Yenagoa residents, emphasizing how recurrent flood events have heightened the community’s awareness. The study reports that 95.3% of the respondents indicated a very high level of awareness of flood events, a statistic that underscores the community’s acute perception of flood risks due to the frequent and severe flooding episodes in the region. This high level of awareness is also attributed to the progressive improvement in the communication and reporting of flood hazards in the metropolis and the Niger Delta Basin. Odubo and Raimi¹ similarly highlighted the role of media and governmental communication in raising awareness and preparing communities for flood events. They argue that increased awareness is often a direct result of both personal experiences and systematic efforts to educate the public, a notion that aligns with the findings of the current study. Furthermore, the study highlights that 91% of respondents have personally experienced severe flooding, ranging from riverine floods to urban flooding that affects residential areas, farmlands, and critical infrastructure.

Table 2 Awareness of Flood Hazards in Yenagoa Metropolis

Knowledgeability	Frequency	Percentage (%)
Organized Seminar & Workshops	230	38.3
Adherence to Proper use of Rivers & Waterways	102	17
Environmental Protection Policies	93	15.5
Public Participation in Community Organization	112	18.7
Establishment of Environmental Awareness	63	10.5
Total	600	100

Source: Author Field Work, 2022

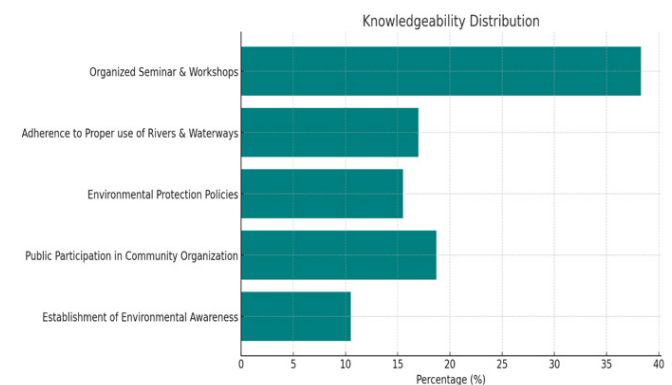


Figure 3 The chart displays the percentage of responses for each category, illustrating how the participants’ knowledge is distributed across different environmental awareness topics of flood hazards in Yenagoa Metropolis.

This widespread experience is consistent with the findings of Adedeji, Odufuwa, and Adebayo,⁴⁰ who noted that in flood-prone regions like Lagos, personal experience with flooding significantly influences residents’ awareness and perception of flood risks. The direct impact of flooding on daily life, as reported by respondents, reinforces the community’s understanding of the severity and frequency of flood events. In addition to personal experience, the study notes that awareness of flood risk has been further heightened by the recognition of the inadequacy of engineering structures designed to mitigate flooding. This finding is in agreement with Aderogba,³⁷ who observed that the failure of drainage systems and other flood control measures in Lagos contributed to increased public awareness and concern over flood risks. The perception that existing infrastructure is insufficient to prevent or manage flooding drives the community to seek more information and to participate in flood-related education and preparedness activities.

The study also explores the various ways in which the public has been educated about flood risks, with 38.3% of respondents participating in seminars and workshops, and others engaging in community organization (18.7%), environmental protection policies (15.5%), proper use of water resources (17%), and supporting the establishment of environmental agencies (10.5%). These findings echo the observations of Ayoade and Akintola,⁴² who emphasized the importance of community education and participation in mitigating flood risks in Nigerian cities. Similarly, Ajibade, McBean, and Bezner-Kerr³⁵ noted that public participation in flood risk management, particularly among vulnerable populations, is crucial for building resilience. Moreover, the study’s findings on the role of environmental agencies in regulating city planning and development align with the recommendations of Adelekan,³⁸ who argued for stronger regulatory frameworks to prevent the exacerbation of flood risks in urban areas.

The establishment of such agencies, as reported in the study, is a positive step towards mitigating the impact of flooding, though the effectiveness of these measures remains to be fully realized. Thus, the high level of awareness of flood hazards among the residents of Yenagoa Metropolis is both a reflection of their direct experiences with flooding and the result of concerted efforts to educate the public. This awareness is crucial for driving community participation in flood risk management and for advocating for better infrastructure and planning to mitigate flood impacts. The study’s findings are consistent with the broader literature on flood awareness and management in Nigeria, as documented by various scholars, including Ajumobi et al.,⁴¹ Odubo and Raimi,¹ and Aderogba³⁷ who have all highlighted the importance of awareness, experience, and community engagement in addressing the challenges of flooding in urban areas.

Perceived flood induced movements in yenagoa metropolis

The factors influencing the movement of people into flood-prone areas of Yenagoa metropolis reveal a complex interplay of socio-economic, cultural, and practical considerations (Table 3 and Figure 4). Despite the evident flood risks, residents perceive Yenagoa as offering better or safer socio-economic conditions compared to other locations, which drives their continued residency in these vulnerable areas. This optimistic disposition towards their environment, despite the risks, reflects a significant level of resilience and adaptation among the population. A significant portion of the respondents (10.2%) are motivated by the desire to maintain and defend their ancestral lands. This group, primarily composed of natives, perceives a threat to their traditional land ownership due to the influx of migrants and the activities of land speculators. This perception aligns with the findings of Ajumobi, Womboh, and Ezem,⁴¹ who noted that cultural ties to land play a crucial role in the decision-making process of residents in flood-prone areas. The desire to preserve ancestral heritage often outweighs the immediate risks posed by flooding, which is consistent with similar findings in other flood-prone regions.

Table 3 Factors Influencing the Movement of Residents to Flood-Prone Areas in Yenagoa Metropolis

Factors Influencing Movement	Respondents	Percentage (%)
To maintain and defend home land	61	10.2
For employment or Business	178	29.7
Forceful Eviction from force location	27	4.5
Cultural Affiliation to land	251	41.8
Educational needs	37	6.2
Migrant labour	20	3.3
Purposeful change of resource use	26	4.3
Total	600	100

Source: Authors’ field survey, 2022

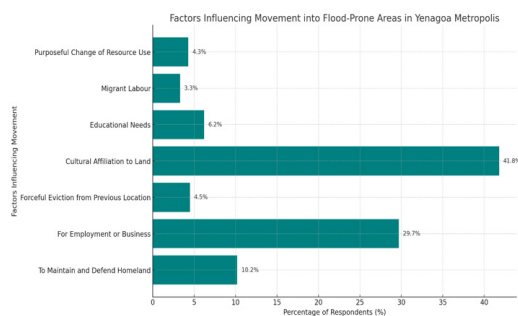


Figure 4 Horizontal bar chart that represents the factors influencing movement into flood-prone areas in Yenagoa Metropolis. The chart displays

the percentage of respondents associated with each factor, making it easy to see which factors have the most significant influence.

Economic factors also play a significant role, with 29.7% of respondents citing employment and business opportunities as their primary motivation for settling in flood-prone areas. This finding is consistent with studies by Adigun, Abolade, and Yusuf,³⁶ who observed that economic opportunities in urban centers often outweigh the risks of flooding, leading to increased urbanization in vulnerable areas. The economic allure of Yenagoa, despite its flood risks, underscores the broader trend of urban migration driven by the search for better livelihoods, as noted by Aderogba³⁷ in his studies on Lagos. Forced displacement is another critical factor, with 4.5% of respondents attributing their relocation to evictions from previous residences. This phenomenon has been particularly observed among returnees and ethnic strife refugees, such as the Bakassi Peninsula returnees and Ijaw-Yoruba-Ilaje, and Ijaw-Itsekiri refugees from 2006-2008. Odubo and Raimi¹ similarly documented the challenges faced by displaced populations in Bayelsa State, noting that the lack of alternative safe housing options often forces these groups to settle in flood-prone areas. The connection between forced migration and settlement in hazardous areas is a recurring theme in flood management literature, highlighting the vulnerability of displaced populations.

Cultural affiliations to land were the most significant factor, influencing 41.8% of respondents. This strong cultural attachment to land is a key driver of settlement patterns, even in the face of significant environmental risks. Ayoade and Akintola⁴² emphasized that cultural ties to land often lead to a persistent occupancy of flood-prone areas, as people are reluctant to abandon their heritage and the land of their ancestors. This cultural resilience is a significant aspect of the broader socio-cultural dynamics in flood-prone regions of Nigeria. Educational needs (6.2%) and migrant labor (3.3%) were also cited as reasons for residing in flood-prone areas. These factors indicate that the availability of educational opportunities and the demand for labor in urban areas like Yenagoa continue to draw people into these regions, despite the inherent risks. Ajibade, McBean, and Bezner-Kerr³⁵ similarly noted that educational and economic opportunities in urban centers often lead to increased vulnerability to flooding, as people prioritize these opportunities over environmental safety. Interestingly, 4.3% of respondents have chosen to adapt to the flood risks by altering their resource use and production patterns, thereby reducing their vulnerability. This adaptive behavior aligns with the findings of Adelekan,³⁸ who observed that urban dwellers in flood-prone areas often develop coping strategies to manage the risks associated with flooding. The purposeful acceptance of flood risks in exchange for socio-economic benefits demonstrates a pragmatic approach to living in vulnerable areas. Hence, the movement of people into flood-prone areas of Yenagoa metropolis is influenced by a combination of cultural, economic, and practical considerations. The findings of this study are in agreement with the broader literature on urban flooding and settlement patterns in Nigeria. The resilience and adaptability of the residents, as well as their cultural ties to the land, play a significant role in their decision to remain in these vulnerable areas. These factors highlight the complex interplay between human behavior, cultural heritage, and environmental risk in shaping settlement patterns in flood-prone regions (Table 3 and Figure 4).

Variations in the perception of floods in yenagoa metropolis

The analysis of variations in flood perception and their association with resource use and development in Yenagoa metropolis reveals a nuanced understanding of how residents navigate the risks associated with living in flood-prone areas (Table 4 and Figure 5). This study

employs both objective and subjective risk perception analysis to explore the factors influencing residents' attitudes and behaviors towards flooding. While, the objective risk perception analysis in this study considers the physical situational factors of location, particularly the proximity of residents to flood hazards. In Yenagoa metropolis, flooding is characterized by downstream floods that are generally tranquil and non-violent. The floodwaters rise quietly, except where they encounter natural or human-made barriers. This relatively calm nature of floods in Yenagoa contributes to a sense of complacency among residents, who may underestimate the risks despite the significant magnitude of flood depth, losses, and areal coverage. This finding aligns with the observations of Adelekan,³⁸ who noted that the perception of flood hazards often depends on the nature and frequency of the flooding events. In environments where floods are less violent, residents may develop a false sense of security, leading to less proactive flood risk management.

Table 4 Variation in the Perception of Flooding in Yenagoa Metropolis

Factors Affecting Perception	Frequency	Percentage (%)
Locational Proximity to Stream Channels	211	35.2
Complacent Attitude of Residents to Floods	107	17.8
Flooding as a Valuable Resources	51	8.5
Resilience by Adaptation to Floods	39	6.5
Socioeconomic & Demographic Characteristics of the Residents	101	16.8
Experience of Flood Hazard	81	13.5
Expectation of Relief & Rehabilitation from Government & NGOs	10	1.7
Total	600	100

Source: Author Field Work, 2022

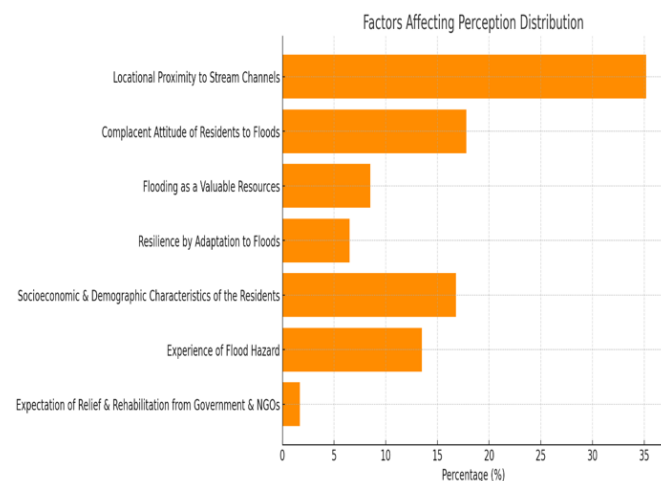


Figure 5 visualizes the percentage of responses for each factor, highlighting how different elements influence the perception of floods among residents.

The complacency observed in Yenagoa is a reflection of this broader trend, where the perceived tranquility of floods diminishes the urgency to adopt stringent flood mitigation measures. In the backswamp areas of Yenagoa metropolis, residents have culturally adapted to flooding, viewing it as a valuable resource rather than a mere hazard. This adaptation is evident in the structural characteristics of their residential buildings, with the development of both temporal and permanent stilted housing units designed to withstand flooding.

The pattern of resource use in these areas, including the application of modernized agriculture and flood-resistant building designs, indicates a systematic approach to living with floods. This adaptive behavior is consistent with the findings of Ajibade, McBean, and Bezner-Kerr,³⁵ who observed that communities in flood-prone areas often develop resilience through cultural practices and innovative building designs. The stilted housing units in Yenagoa are a practical manifestation of this resilience, showcasing how local knowledge and cultural practices contribute to flood risk management. The ability of residents to turn a potential hazard into a resource highlights the importance of culturally informed approaches to disaster management.

While the subjective risk perception in this study examines the personal and psychological factors that influence residents' responses to flooding. This includes emotional and behavioral attributes, such as worry, fear, and the tendency to take specific actions to mitigate flood risks. The location choices of residents in the backswamp areas are influenced by demographic, socioeconomic, informational, and direct experience factors, which shape their perceptions and decisions regarding flood risks. The subjective perception of flood risk plays a crucial role in motivating residents to take action to reduce the negative impacts of flooding. Aderogba³⁷ highlighted the importance of subjective risk perception in driving community-level flood preparedness and resilience. In Yenagoa, the urban poor and low-income groups, who often reside in marginal wetlands highly susceptible to flooding, exhibit high levels of worry and fear due to their direct experiences with flooding. These emotional responses, however, do not always translate into proactive risk management. Instead, these residents often accept the risks and associated losses without altering their behavior, reflecting a sense of fatalism or resignation.

For the vulnerability and lack of social safety nets also reveals that the urban poor in Yenagoa, who typically live in large households (6-12 people), are particularly vulnerable to the impacts of flooding. Despite having access to information and direct experience of flooding, these residents often bear the full burden of flood damage independently. Their income levels are diminished, and their livelihoods disrupted, yet there are no social devices or safety nets in place to share the burden of flooding in Yenagoa. Instead, residents rely on relief and rehabilitation assistance from government agencies, NGOs, and religious organizations. This observation is in agreement with the findings of Odubo and Raimi¹ who noted the lack of institutional support for vulnerable populations in flood-prone areas of Bayelsa State. The reliance on external aid rather than proactive, community-based risk-sharing mechanisms highlights a significant gap in the social infrastructure needed to manage flood risks effectively.

The absence of social safety nets exacerbates the vulnerability of the urban poor, making them more susceptible to the long-term impacts of flooding. Conclusively, the variations in flood perception among residents of Yenagoa metropolis are closely linked to their resource use and development patterns. The objective and subjective risk perception analyses reveal that while some residents have developed resilience and adaptive strategies to manage flood risks, others, particularly the urban poor, remain highly vulnerable. The complacency observed in the objective risk perception, coupled with the emotional and behavioral responses captured in the subjective analysis, underscores the complexity of flood risk management in Yenagoa. The findings of this study are in broad agreement with existing literature on flood risk perception and management in Nigeria, highlighting the need for culturally informed, community-based approaches to enhance resilience and reduce vulnerability in flood-prone areas (Table 4 and Figure 5).

The perceived causes of flooding in yenagoa metropolis

The results and discussion regarding the perceived causes of flooding in Yenagoa metropolis align with and expand upon the findings presented in the referenced literature. The residents of Yenagoa identified several causes of flooding, including heavy rains, climate change,^{8,9} inadequacies in water resource engineering structures,¹³ defects in waste management,⁴⁶ deforestation,^{2,3} the “will of God,” and the siltation of rivers and creeks. These factors reflect a combination of natural and human-induced causes, which are consistent with findings in other Nigerian urban centers (Table 5 and Figure 6). While, the respondents’ identification of heavy rains and climate change as major causes of flooding is well-supported by existing literature. Aderogba³⁷ and Adelekan³⁸ both highlight the role of increasing rainfall intensity, often linked to climate change, in exacerbating flooding in Nigerian cities. The mention of heavy rains as a primary cause is consistent with broader observations across the Niger Delta and urban coastal communities in Lagos, where climate-induced weather changes have intensified flood risks.

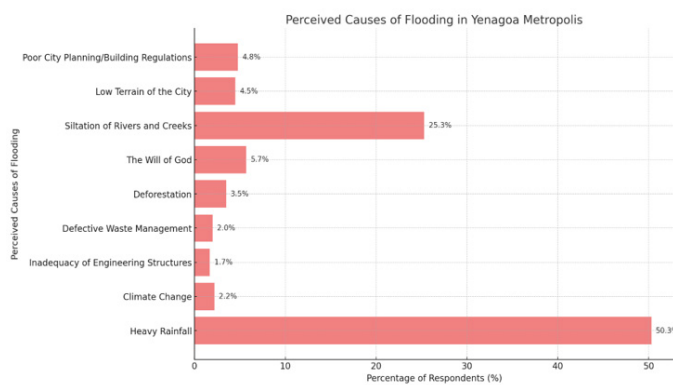


Figure 6 visually represents the perceived causes of flooding in Yenagoa Metropolis. It shows the percentage of respondents who identified each cause, making it easy to see which factors are most commonly associated with flooding in the area.

The inadequacies in water resource engineering structures, defects in waste management, and deforestation mentioned by Yenagoa residents are also widely recognized in the literature as contributing factors to urban flooding. For instance, Etuonovbe⁴³ and Adedeji, Odufuwa, and Adebayo⁴⁰ discuss how poor drainage systems, combined with unplanned urban expansion and deforestation, have worsened flood conditions in Nigerian cities. The study’s observation that clogged drains and deteriorating pavements exacerbate flooding in Yenagoa echoes similar findings in Lagos, where poor drainage and infrastructural decay are key issues.³⁷ Similarly, the inclusion of the “will of God” as a perceived cause of flooding reflects a socio-cultural perspective that is not uncommon in Nigeria. This aligns with the findings of Ayoade and Akintola,⁴² who noted that religious and cultural beliefs significantly shape public perception of natural hazards in Nigerian cities. This highlights the importance of integrating socio-cultural factors into flood risk communication and management strategies. Also, additional observations shows that the study goes beyond the commonly cited causes of flooding by examining the specific urban infrastructure issues in Yenagoa, such as the condition of pavements and drains. The observation that flooding is inversely related to the quality of these infrastructures adds a layer of detail to our understanding of urban flooding dynamics.

This is particularly relevant in the context of Yenagoa, where poorly maintained roads and drainage systems contribute to localized flooding. The finding that floodwaters accumulate in areas with

sagged street surfaces and clogged drains, while well-paved streets with clean drains experience little flooding, aligns with the findings of Raji, Adeniyi, and Odunufa,⁴⁷ who conducted a multi-criteria flood risk analysis in the Lower Ogun River Basin. They also found that the quality of urban infrastructure plays a critical role in flood mitigation. On the influence of impervious areas and urban density on flooding duration, it provides further insight into the specific conditions in Yenagoa. The observation that densely populated areas like Amarata, Biogbolo, and Obele suffer from flash floods due to impervious roofing and wall-fencing is consistent with the findings of Ajibola, Izunwanne, and Ogungbemi,⁴⁴ who noted similar patterns in Lagos. The prolonged flash floods in urban slums with attached buildings mirror the experiences of other Nigerian cities where rapid urbanization and inadequate infrastructure exacerbate flood risks.

In divergence, the study in Yenagoa provides a detailed and localized perspective on flood causes, one area where it diverges from some of the referenced literature is in its emphasis on the specific urban infrastructure challenges. For example, while the broader literature often discusses the general inadequacy of drainage systems,⁴⁰ this study’s focus on the condition of pavements and the role of wall-fencing in prolonging flooding offers a more granular view of how urban design flaws contribute to flood risks. This level of detail is not always present in the broader discussions but is crucial for developing targeted urban planning interventions. Hence, the perceived causes of flooding in Yenagoa metropolis, as identified by respondents, align well with the broader findings in the literature on urban flooding in Nigeria.⁴⁸ The study reinforces the importance of both natural and human-induced factors, including climate change, poor infrastructure, and urban planning deficiencies. The additional insights into the specific infrastructural issues in Yenagoa, such as the quality of pavements and drains, contribute valuable new information that complements existing knowledge. This study underscores the need for improved urban planning, infrastructure maintenance, and culturally sensitive flood risk management strategies to mitigate the impacts of flooding in Yenagoa and similar urban areas in Nigeria (Table 5 and Figure 6).

Table 5 Perceived Causes of Flooding in Yenagoa Metropolis

Perceived Causes of Flooding	Respondents	Percentage (%)
Heavy rainfall	302	50.3
Climate change	13	2.2
Inadequacy of engineering structures	10	1.7
Defective Waste Management	12	2
Deforestation	21	3.5
The will of God	34	5.7
Siltation of rivers and creeks	152	25.3
The low terrain of the city	27	4.5
Poor city planning/building regulations	29	4.8
Total	600	100

Source: Authors’ field survey, 2022

Perceived flood damages in yenagoa metropolis

The assessment of flood damage in Yenagoa metropolis, as presented reflects significant agreement with findings in the referenced literature on the impacts of flooding in Nigeria. However, this analysis also introduces unique observations that expand on the understanding of flood-induced residential mobility and the broader socio-cultural implications of flooding in Yenagoa (Table 6 and Figure 7). The

damage caused by flooding in Yenagoa, including the destruction of residential properties, critical infrastructure, and agricultural assets, as well as the tragic loss of lives, aligns closely with observations made in other flood-affected regions of Nigeria. Ajumobi, Womboh, and Ezem⁴¹ document similar widespread destruction in Yenagoa during the 2022 floods, emphasizing the economic losses and disruptions to everyday life. The mention of goods and services worth billions of naira being damaged or disrupted is consistent with the scale of economic impact observed in major flood events across the country, as discussed by Etuonovbe⁴³ and Adelekan³⁸ who noted significant economic losses resulting from urban flooding in Nigeria.

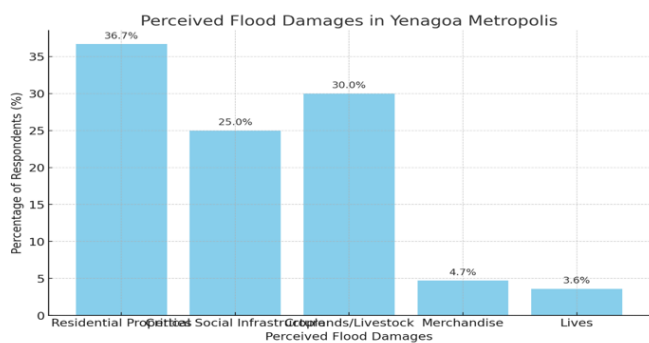


Figure 7 visually represents the perceived flood damages in Yenagoa Metropolis. It displays the percentage of respondents who identified each category of damage.

The internal displacement of residents in Yenagoa due to flooding is a critical issue highlighted and other referenced studies. Odubo and Raimi¹ explore similar patterns of displacement and the struggles of affected communities in Bayelsa State, where residents face inadequate relief measures and prolonged displacement. Your discussion on the displacement of residents with little or no relief materials underscores the common challenge of inadequate disaster response and support for flood victims, a point also emphasized by Adedeji, Odufuwa, and Adebayo⁴⁰ in their analysis of disaster preparedness and response in Nigeria. While, the cultural impact of flooding, particularly the disturbing event where floodwaters exhumed bodies and caskets from the Azikoro Cemetery, adds a unique dimension. This incident not only highlights the physical devastation but also underscores the deep psychological and cultural trauma experienced by the community. Although such specific incidents are less commonly discussed in the literature, the broader implications of flooding on cultural and social structures are acknowledged. Ayoade and Akintola⁴² noted the profound impact of flood hazards on public perception and the cultural significance of land and burial sites in Nigerian cities.

For the residential mobility in Yenagoa, driven by factors such as conflicts, socioeconomic conditions, and environmental changes, provides valuable insights into the complex dynamics of urban movement in flood-prone areas. While the literature frequently addresses the physical impacts of flooding, the analysis goes further by examining how flood risks influence residents' decisions to relocate within the city. This aspect of residential mobility, including the role of perceived safety and cultural affiliation, adds depth to the understanding of how flooding shapes urban demographics and social structures. The difficulty in establishing the reasons behind these local movements and the extent to which flood risk perception influences relocation decisions highlights the complex interplay between environmental hazards and human behavior. This observation aligns with Ajibade, McBean, and Bezner-Kerr³⁵ who discuss the varying degrees of vulnerability and resilience among urban residents in Lagos, suggesting that flood risk perception is a significant but not

always straightforward factor in residential decision-making. The finding that 92% of respondents have been residents of Yenagoa for 10-20 years, despite the flood risks, is intriguing and suggests a complex relationship between residents and their environment.

This stability could indicate a perceived lack of alternatives, as suggested, or a deep-rooted cultural and emotional attachment to the land, even in the face of recurring floods. This observation adds a nuanced perspective to the discussion of flood resilience and adaptation, suggesting that for many residents, the risks associated with flooding are either normalized or outweighed by other factors such as community ties, economic opportunities, or cultural significance. In conclusion, the assessment of flood damage in Yenagoa metropolis is largely in agreement with the broader findings in the literature on the impacts of flooding in Nigeria. This corroborates the significant economic, social, and cultural damage caused by floods, as well as the challenges of displacement and inadequate relief efforts. At the same time, the analysis expands on these themes by exploring the nuances of residential mobility and the stability of the population in flood-prone areas, offering a more comprehensive understanding of how flooding affects urban communities in Yenagoa. This study underscores the importance of addressing both the immediate physical impacts of flooding and the longer-term social and cultural consequences in flood risk management and urban planning efforts (Table 6 and Figure 7).

Table 6 Perceived Flood-Damage in Yenagoa Metropolis

Perceived Flood Damages	Respondents	Percentage (%)
Residential Properties	220	36.7
Critical Social Infrastructure	150	25
Croplands/livestock	180	30
Merchandise	28	4.7
Lives	22	3.6
Total	600	100

Source: Authors' field survey, 2022

Perceived adjustments to flooding in yenagoa metropolis

The survey on the identification of Adjustments open to the floodplain dwellers as they act to reduce the impact of flooding in Yenagoa provided evidence of purposeful and incidental adjustments to flooding in the metropolis (Table 7 and Figure 8). It is true that culture and traditions promote continuity and permanence in building types and styles, time and environmental conditions often control human activities in hazardous areas. Within hazardous locations, according to Kates⁴⁹ "A range of livelihood choices may be open; and small or large shifts in the pattern of resource use can be made. As people locate in these areas, they use a variety of psychological, personal and social devices to reduce their level of the perceived risk. These devices or adjustments may range from: (1) modifying the loss burden (2) modifying hazard events, to (3) modifying human vulnerability." The relics of the pre-urban compound style of housing units among the conurbations of Yenagoa depicted cultural adaptations to flooding. The people constructed stilted houses which were raised well above the ground level thereby minimizing damage to household properties during floods.

Table 7 Adjustment to Floods in Yenagoa Metropolis

Mode of Adjustment	Frequency	Percentage (%)
Change of usual location	78	13
Change of Resources Use	63	10.5
Prevention of Effects	83	13.8

Table 7 Continued...

Modifying Flood Events	42	7
Evacuation	43	7.2
Accepting the Loss	102	17
Aid from Relation & Friends	80	13.3
Relief Materials from Government & NGOs	67	11.2
Insurance Policies	42	7
Total	600	100

Source: Author Field Work, 2022

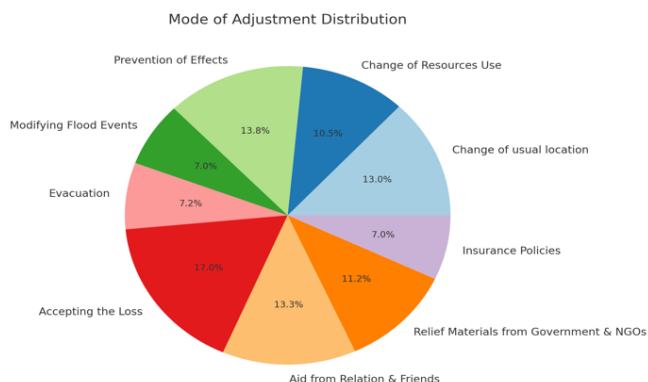


Figure 8 The pie chart illustrates how different strategies are utilized by respondents to cope with flood events, with each segment showing the proportion of responses for each mode.

The cultural landscape also prompted the use of “houseboats” and “dug-out canoes” during flood peaks for movement in the area. In the creeks of the sub-urban Yenagoa, most of the traditional housing units are built of wood, bamboo, mud and mat materials and roofed with thatch, showing some association and affiliation with the dense luxuriant forest. In the observed initial and post urbanization Yenagoa, the introduction of new ideas in construction has, however, led to the abandonment or modification of some indigenous building practices in the metropolis. Modern structural foundation designs were adapted to resist floods ranging from raft and strip to sand fill and pile foundation are now obtainable in the metropolis. Despite the processes of urbanization, the indigenous people still maintain their building methods when they are displaced. Buildings on stilts have therefore become an integral part of the culture of the metropolis, an adaptation not to be quickly replaced by other technologies in the Niger Delta Basin. Responses to the question, “As a resource user, what do you do to reduce potential losses in the face of flooding in Yenagoa?” 19% of the respondents who were aware of the onset of flooding changed their usual residences or locations. 11.5% simply changed use of their resources.

Farmers who cultivated croplands at the floodplains used the same plots in the face of flooding for harvesting crabs and crayfish as they migrate from the river to the backswamps for spawning, while others changed from vegetable to rice cultivation for their subsistence and livelihood. 16.8% of the respondents opined that they tried to prevent the effect of flooding by adopting building designs and construction works to resist flood waters in their homes. 52% of the respondents on the other hand selected the option of modifying the event. This category of respondents resorted to reduce losses by adjusting the damaging effects of floods by physically suppressing the event via environmental control engineering works like drainages, dykes and artificial levees.

On the response to flooding in residential areas, 41% of the respondents indicated their willingness to embark on evacuation as proper warning notices were given by certified forecasting agencies or schemes. A further 27.5% expressed optimism by accepting the losses and remains in their usual residential areas. They are ready to accept the full consequences or burden of the damage or share it in some fashion with others. Another 13.3% revealed that they resorted to seeking aid from relatives and friends. Results of the data analysis further indicated that 11.2% of the respondents relied on relief materials from the government and other donor organizations.⁵⁰ Although an important flood alleviation measure, only 7% of the respondents indicated a knowledge of insurance schemes and policies against flood hazards in Yenagoa. Insurance schemes were therefore not perceived as a veritable adjustment to floods as a means of distributing flood losses among the people in Yenagoa metropolis. Response to hazards is related both to perception of the phenomena themselves and to awareness of opportunities to make necessary adjustments. Rarely are individuals completely unaware of the existence of possible hazards; yet their perception and definition of the threat may differ markedly from the estimates of professionals and experts.³²

In response to the question, “what is your reason for moving into and remaining in the flood prone areas of Yenagoa metropolis?” both negative and positive responses were advanced which had some social, economic and cultural implications. Among the positive reasons cited, by far, the most frequent response was cultural affiliation to land. Other reasons cited were to maintain and defend home ground, perceived employment or business opportunities and purposeful change of resource use. The negative reasons, on the other hand, suggested eviction from their usual residences rather than being attracted to their present flood-prone residential or business locations. The reasons cited to this effect included forceful eviction from former business locations and residences due to the violation of city planning regulations and building codes, demolition or fire, conflicts and youth restiveness, politically displaced returnees, as well as agitations for resource control. Consequently, the apparent redistribution of population observed in the Yenagoa metropolis prior to the study cannot be wholly ascribed to evacuation due to flooding but also to some socio economic and cultural re-adjustments in the metropolis.

To the indigenous Epie-Atissa people, a sub-Ijaw tribe, in Yenagoa, relocation to other areas of Yenagoa metropolis indeed a little clue to the problem of flooding in the metropolis. These residents (civil servants, businessmen, fishermen, farmers and artisans) perceived Yenagoa as a good location for their activities. Their location in flood-prone areas was not actually preceded by a detailed assessment of the environment as would have necessarily been done. These residents are therefore willing to accept the risk of flooding in order to satisfy their work, housing, fishing and agricultural needs. This sampled population was observed to show a considerable degree of stability as about 72% of the respondents have lived for 11 years or more, and thus had experienced at least one severe land inundation resulting from river overflows and heavy rainstorms. Also, the residents of Yenagoa by their occupational distribution were also observed to have developed some periodic movement patterns with flooding in the city and the Niger Delta Basin generally. This is particularly more pronounced among the sub-urban and rural resource users.

In the brackish and fresh water creeks, during floods, fishermen move from their permanent settlements to temporary or semi-permanent camps with two or more huts close to the fishing grounds. The fishermen operate from these camps during the fishing season which last for a few months until the flood waters recede. The camps are then abandoned. These camps have to be rebuilt annually with the floods. Thus, akin to the transhumance system of pastoralism,

fishermen, as well as migrant labourers move in response to the flood regimes in the study area, thereby introducing a form of “periodicity” into mobility of labour in resource use and development among the indigenous residents of the metropolis. In contrast to the periodic movement of labour in the sub-urban and rural areas, majority of the urban flood victims migrate to higher grounds during the flood seasons on permanent relocations while maintaining cyclical movement patterns in pursuit of their livelihoods in the metropolis. From the foregoing, it is clear that there is a great hazard sensitivity in terms of awareness on the part of agricultural land users. However, the frequency of the hazards that encouraged certain responses of the resource users was approximately equal for both urban and agricultural land users. Kates⁴⁹ suggested that the frequency of natural events is related to the perception of the hazards. According to him, where the events in question are frequent, there is little variation among resource users in their perception. The same holds true where the events are infrequent. Here the failure to perceive a significant hazard is widely shared.

It is in the situation of moderate frequency that one expects to find considerable variation of perception among resource users. Seemingly, an attitude portrayed commonly among floodplain dwellers in the study is the residents’ optimistic outlook with regard to the risk of future flood events. Burton et al.³² posits that the inhabitants of flood-prone areas often tend to view floods as cyclical events rather than random occurrences, and tend to reason that disastrous natural (flood) events won’t happen among those with or no education in the study. Optimism and a generally simplistic understanding of the causes of floods have almost certainly encouraged a complacent attitude among the residents of the flood-prone areas in Yenagoa metropolis. A very high proportion of the householders interviewed in the survey were willing to assume that alleviation measures were being implemented, although they were often unsure of the specific nature of the schemes.

Perhaps, the occasional cleaning of drains, covered manholes and catch basins; construction of concrete drains and cross culverts to transfer the runoff discharge from one road to another, and from a drain to a natural depression, such as a river valley, were experienced in the Yenagoa metropolis. References to these flood mitigation measures in the press and on the electronic media may have reinforced the optimistic and complacent attitudes to flood hazards among the residents of Yenagoa metropolis and the Niger Delta generally. Furthermore, although the non-establishment of public relief funds to assist flood victims affected them, their reliance on friends and relatives further heightened the developed attitude of complacency among the residents in the area. Smith⁴ noted that the provision of public relief constitutes a major reason for persistent human occupancy of floodplains when such is made without any obligations on the part of the recipients to undertake measures to reduce their vulnerability to future losses.

Besides the optimistic and complacent attitudes which have greatly encouraged the occupancy of flood prone areas in Yenagoa metropolis in the Epie Creek catchment of the Niger Delta Basin, the residents’ decision to remain in the conurbations of the metropolis has been greatly influenced by their perception of the metropolis as a residential area by a real or perceived lack of alternatives.⁵¹ For most of the residents interviewed, there were plausibly strong incentives to remain in the metropolis. “The nearness of flood prone residential areas to work, employment or business is certainly an important socioeconomic consideration to low income earners who are least capable of bearing transport costs. Those living in residential quarters provided by their employers pay very low rents. Owner-occupiers may similarly have a strong incentive for remaining. It is unlikely that they

would be able to purchase houses and land of comparable or better quality in other parts of the metropolis at prices they could afford. In common with most urban and rural areas in Nigeria, house prices in Yenagoa metropolis have risen sharply in recent years and most of the new housing units being built are aimed at the middle-class market and few houses in the low-cost category are being constructed. For many of the residents in flood-prone areas in Yenagoa, thus, there is almost certainly little practical floods mitigation alternatives but to accept the flood risk and remain in the Epie Creek catchment of the Niger Delta Basin.”⁴⁸

Conclusion

The population of Yenagoa metropolis is predominantly composed of various ethnic groups, with the Ijaw people making up over 70% of the residents. The economy of Yenagoa is primarily based on agriculture, fishing, and forestry, which engage approximately 52.6% of the population. Additionally, 10.3% of the residents are employed as civil servants, while the remaining population is involved in various other sectors. This diverse economic engagement reflects the broader socio-cultural landscape of Yenagoa, where traditional livelihoods remain central to the community’s identity and sustenance. For the awareness and perception of flood hazards, the respondents exhibited a high level of awareness regarding the occurrence of floods in Yenagoa metropolis. Their perception of flood hazards is not only influenced by their direct experiences but also closely linked to their ethnic backgrounds, socioeconomic status, and the designated land use within floodplain areas. Furthermore, the choices residents make concerning where to live and how to use resources in the area are shaped by these factors. This suggests that their understanding of flood risks is deeply intertwined with their cultural identity, economic activities, and the inherent value they place on their land. The decision of many residents to live in and remain within flood-prone areas of Yenagoa is driven by a combination of perceived opportunities and socio-cultural ties.

Employment prospects, business opportunities, and educational needs are significant motivators, as are the residents’ cultural connections to the land and their desire to make purposeful changes in how resources are used. Consequently, the movement of people within Yenagoa is not solely a reaction to flooding but also reflects broader socioeconomic and cultural adjustments. While floods do trigger certain patterns of movement, such as rural-to-rural and periodic relocations within the creeks, as well as cyclical and permanent relocations among urban floodplain dwellers, these movements are also influenced by a complex interplay of economic and cultural factors. In line with the conceptual framework of this study, residents of Yenagoa metropolis, particularly those in the Epie Creek catchment area of the Niger Delta Basin, employ various psychological, personal, and social strategies to cope with the impacts of flooding. These strategies include minimizing or disregarding the financial and emotional losses caused by floods, accepting these losses as part of the cost of living in a flood-prone area, or sharing and distributing the burden among the community. Psychologically, it appears that the residents have developed an optimistic outlook toward the risk of future floods, which, coupled with a simplistic understanding of the hazard, fosters a sense of complacency. This attitude, while providing some degree of emotional resilience, may also contribute to a lack of proactive measures to mitigate flood risks in the future.

Significance statement

The significance of this study lies in its potential to enhance the resilience of Yenagoa metropolis to flooding through improved

flood management strategies and sustainable urban development. By advocating for the implementation of robust infrastructure, sustainable land use practices, and environmental conservation initiatives, the study provides a framework for reducing the frequency and severity of flood-related disasters. These measures not only protect lives and property but also contribute to the long-term economic stability and quality of life for the city's residents. Additionally, the study offers valuable insights for policymakers, emphasizing the need for informed policy development that integrates flood risk reduction with community awareness and preparedness. The recommendations support the creation of safer, more informed communities by promoting early warning systems, emergency response plans, and public education initiatives. This focus on public safety is critical in minimizing the risks associated with flooding and ensuring a more resilient urban population. Finally, the research underscores the importance of environmental stewardship in flood management. By protecting and restoring natural ecosystems such as wetlands and forests, the study highlights the long-term ecological benefits of conservation efforts, which not only mitigate flooding but also contribute to biodiversity conservation and climate regulation. These initiatives are essential for promoting sustainable development in Yenagoa and aligning with broader global efforts to address environmental degradation and climate change. Thus, graphically it is represented (Figure 9 below) as:

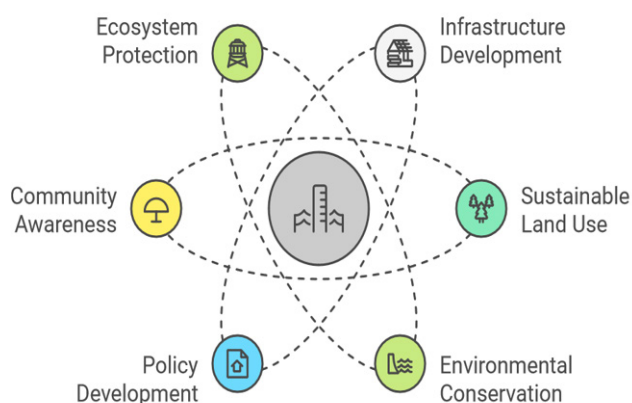


Figure 9 Enhancing Flood Resilience in Yenagoa.

Recommendations

Strengthening flood management infrastructure: To mitigate the impact of flooding in Yenagoa metropolis, there is an urgent need to invest in and upgrade the flood management infrastructure. This includes the construction and maintenance of robust drainage systems, flood barriers, and water retention basins. It is recommended that government agencies collaborate with urban planners and engineers to design and implement these systems, ensuring that they are capable of handling the volume of water associated with both seasonal rains and unexpected flood events. Regular maintenance and periodic assessments of these infrastructures should also be prioritized to prevent deterioration and ensure their effectiveness.

Promoting sustainable urban planning: Urban planning in Yenagoa should incorporate flood risk assessments and promote sustainable land use practices. This involves enforcing zoning regulations that restrict the development of residential and commercial properties in high-risk flood zones. Additionally, incentives should be provided to encourage the use of permeable materials in construction and the development of green spaces that can absorb excess rainwater. Integrating these measures into the city's development plans will

help to reduce the vulnerability of the population and infrastructure to flooding.

Enhancing community awareness and preparedness: Community education programs should be established to increase public awareness of flood risks and promote preparedness among residents. These programs should focus on educating the community about the causes and consequences of flooding, as well as providing guidance on how to protect property and ensure personal safety during flood events. Moreover, establishing early warning systems and emergency response plans, including evacuation routes and temporary shelters, will equip residents with the necessary tools and knowledge to respond effectively in the event of a flood.

Implementing ENVIRONMENTAL CONSERVATION INITIATIVES: The preservation and restoration of natural environments, such as wetlands and forests, can play a crucial role in flood mitigation. These areas act as natural buffers, absorbing excess water and reducing the speed and volume of runoff. It is recommended that environmental conservation initiatives be implemented to protect these critical ecosystems in and around Yenagoa. Afforestation projects, the protection of existing vegetation, and the regulation of activities that contribute to deforestation and land degradation should be prioritized as part of a broader flood risk management strategy.

Fostering collaborative efforts: Addressing the issue of flooding in Yenagoa requires a coordinated effort between various stakeholders, including government agencies, non-governmental organizations, community groups, and the private sector. Collaborative efforts should be focused on developing comprehensive flood management plans, sharing resources, and conducting joint research on flood prevention and mitigation strategies. By fostering partnerships and encouraging the active participation of all stakeholders, it will be possible to develop more effective and sustainable solutions to the challenges posed by flooding in the metropolis.

Disclosure statement

The authors declare no conflict of interest.

Funding: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Author's contribution: All authors contributed equally to conceptualization, validation, writing review and editing.

Acknowledgments: The authors would like to express their appreciation to all anonymous reviewers, for feedback and discussions that helped to substantially improve this manuscript.

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