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# RESIDENTS' PERCEPTION OF FLOODING AND MITIGATION IN A PERIURBAN AREA OF DELTA STATE, NIGERIA

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## ABSTRACT

This study investigated flooding characteristics and mitigation measures in a periurban area of Delta State, based on the perception of the residents. Specifically, it identified the causes and effects of flooding in the study area, examined the strategies used for flood mitigation, evaluated public perceptions of flood disaster mitigation measures, and assessed the level of community participation in the implemented mitigation strategies. Primary data were collected through a questionnaire survey in which 400 questionnaires were distributed across five selected communities. Secondary data on flood characteristics, including type or category, causes, impacts, duration, and flooding patterns, from 2005 to 2024, were obtained from the government emergency management agency. The results showed that the average inundated area during flood events was 6.31 km², while the mean flood length and width were 2.10 km and 2.10 km, respectively. The longest flood duration recorded spanned eight weeks. The data were analyzed using Chi-Square at a 0.05 level of significance. 61% of respondents considered existing flood mitigation measures to be ineffective, while 66% indicated that they were unaware of any flood mitigation initiatives in their communities. A significant association was discovered between public awareness and flood hazard readiness ($p < 0.05$, where $p = 0.010$). Overall, the study demonstrates that flood risk perception plays an important role in the effectiveness of mitigation efforts. This study therefore recommends awareness and an increase in community involvement through collaborations between government agencies and the communities.

**Keywords**: Delta State, Flooding, Flood Mitigation, Nigeria, Residents' Perception

## INTRODUCTION

Floods, globally, are usually associated with widespread devastation, resulting in loss of life and damage to personal property and critical public health infrastructure. Flooding has become a recurrent water-related hazard globally, driven by rising sea levels, overflowing riverbanks, and increased rainfall frequency and intensity due to global climate change (IPCC 2021). Flooding, a common environmental hazard worldwide, has in recent times increased as a result of climate change, with the effect felt more by the developing countries. In the developing countries, flooding results from excessive precipitation, owing to climate change, building in waterways, sea-level rise, soil moisture regime, dam operations, especially along the border, uncontrolled rapid growth, inadequate preparedness, and lack of political will (Adetunji & Oyeleye, 2013). Floods are devastating events and have been assessed to result in the highest number of casualties (Wantin et al., 2023). Recent statistics show that 95% -97% of fatalities from natural hazards are caused by floods in developing countries and are characterized by the highest economic losses of $250 billion worldwide over the last 15 years alone, when compared to all other disasters triggered by natural occurrences (Tariq, Farooq & Van De Giesen, 2020).

Flooding has become more common and intense on all continents. This increase is attributed to a range of factors, including changes in weather and/or climate events, as well as urbanization-related activities (Jha, Block & Lemond, 2012). Flooding has grown due to a number of factors, including rising sea levels and increased development activity on flood plains in major cities across the world. The problem of flooding is fast worsening in Nigeria.

According to the National Emergency Management Agency (NEMA, 2013), torrential storms that lasted several days in 2012 caused the country's worst floods in over 40 years. The incidence affected 32 states, with 24 classified as badly afflicted. The flood lasted from July to October of that year, affecting 7.7 million people, with over 2 million additional classified as Internally Displaced Persons. Nigeria is susceptible to yearly flooding, and the floods of 2022 have been the most severe since the disaster of 2012. The recent flood was caused by excessive rainfall, climate change, and the release of water from the Lagda dam in adjacent Cameroon. Given the history of catastrophic floods impacting millions and resulting in financial losses in the billions of US dollars, prioritizing the exploration of more effective flood risk reduction strategies for Nigeria is essential (OCHA, 2021). Over the years, despite yearly seasonal rainfall prediction by the Nigerian Meteorological Agency of sporadic floods in many parts of the country, most of the country has continued to suffer from the devastating effects of floods. The response in most cases usually comes after the event. Nothing has been done to guarantee that the danger and its related hazards are decreased to the barest minimum (Louw, 2019).

Nigeria has attempted to address flooding through various strategies, including the development of a comprehensive flood control master plan, implementing relief measures for victims, enhancing institutional capacity for flood prediction, promoting public awareness initiatives, and reducing flood impact by establishing and maintaining suitable infrastructure (Nabegu, 2012). Flooding has become an inherent problem in most urban centres close to the Nigerian coast. Over the years, this situation has extended to large settlements in the interior of the country where rainfall is more sporadic (Oriola, 1994). Urban flood damage is increasing due to the severe and destructive impacts of flooding. Therefore, it is essential to continuously examine its characteristics and effects in order to develop and implement effective disaster risk reduction strategies that can minimize flood impacts (Etuonovbe, 2011). Studies examining flooding perception in the study area are limited**,** and many of the existing works are outdated.

Previous research, including Ologunorisa and Adeyemo (2005), Week et al. (2019), Nwanosike et al. (2021), and Amangabara, G. T., Gobo, A. E., & others (2014)**,** focused broadly on flood perception across the Niger Delta states. While Ndakara and Atuma (2022) conducted research within the study area, their focus was, however, primarily on the ecological impacts and community vulnerability to flooding**.** To date, very few studies, if any, have specifically addressed public perceptions of flood risk and local mitigation strategies in these communities. Against this background, therefore, this study investigates public perception of flood risk and mitigation approaches in a peri-urban area of Delta State, Nigeria.

## MATERIALS AND METHODS

The study area, Udu Local Government Area, is located in the south-central part of Delta State within Southern Nigeria (Figure 1). Udu L.G.A is located between latitudes $5^0 45''$ and $5^0 55''$ N and longitudes $5^0 40''$ and $6^0 55''$ E, covering an area of about 38 kilometers sq. Just like other sections of the Niger Delta, the study area is underlain by sedimentary rock formations (Odemerho, 2007).

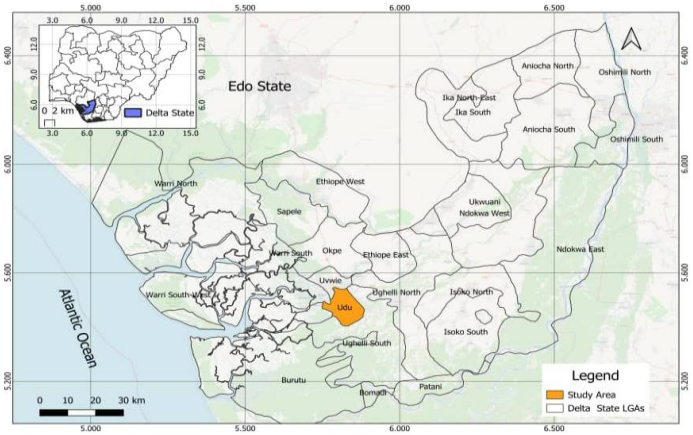


Figure 1: Map of Delta State Showing the 25 Local Government Area. Source: Adapted from Ministry of Lands, Survey and Urban Development, Asaba, (2025)

The soil is deeply leached, friable, and lacks distinct and well-defined horizons. The soil has low silt and clay content, low cation exchange capacity, and consequently low pH (Aweto, 1998). The people are predominantly subsistence farmers. Cassava is mainly grown in the area, owing to its ability to thrive in marginal soils. Other crops grown include maize, plantain as well as rubber and oil palm (FEPA, 2001, Akpovwovwo, 2014). The general elevation of the area is between 20 and 40 metres above sea level. The area is largely drained by the River Okpore in Ughelli from South to West and the River Euerchen in the North (Aweto, 1998). The area is characterized by a tropical climate. The average annual rainfall is about 266.5cm. Rainfall is heaviest in July, and no month is completely rainless. January, which is the driest month, is characterized by rainfall of up to 2.5cm in most year (Aweto & Igben, 2003). The natural vegetation of the study area varies from the tropical lowland rain forest, the undisturbed rainforest along the coast, to the secondary vegetation or forest, which is the highest occurring vegetation within Delta State. The secondary forest is actually an offshoot of the tropical lowland rainforest, which is also a sub- climax succession stage of the tropical rainforest vegetation that once covered the area (Akpovwovwo, 2007).
The study randomly adopted the following five (5) communities for the study: Emadadja, Ukporvwin, Okolo Waterside, Ukperheren, and Otor-Udu. A questionnaire survey was conducted among 400 randomly selected respondents within the five communities. 350 questionnaires were retrieved. Secondary data were obtained from the Delta State Emergency Management Agency (SEMA) and the Department of Environment, from 2005 to 2024. This time frame was used based on the availability of the required information for this study. The data were presented and analyzed alongside the data obtained from the questionnaire survey. Chi-square was used to test the significant difference in public perception of flood mitigation measures and flood hazard readiness.

## RESULTS AND DISCUSSION

The demographic characteristics of the respondents are shown in Table 1. The table shows a marginal difference between both sexes, with the females (52%) being slightly higher than the males (48%). In the case of the age groups, the majority of respondents fall into the 36-45 years age group (32%), while the lowest percentage is the 15-25 years age group (17%). Pertaining to educational level, the majority of respondents had attained a secondary school level of education (30%), while the lowest percentages (16%) were those who had attained primary education and standard six, respectively. This implies that the majority of the population is educated and, therefore, is expected to be knowledgeable, to a certain extent, on conventional issues about flooding and mitigation. In terms of the occupational status, the majority fall within the self-employed group (37%), while the lowest percentage falls within the "student" and "others" group. The family size of 5-8 persons (63%) formed the majority of respondents. This gives insight into the living conditions of the majority of the respondents. This is suggestive of the likely general crowded living conditions of the majority of the people in the study area. These conditions are likely to encourage the occurrence of flooding through factors such as inefficient waste management, amongst several others. On the whole, the biodata of the sample population shows a good representation of all categories stated, implying that information on flooding was derived from a good spread across the population. In other words, it qualifies to be an effective representation of the population of the study area. Adelekan et al (2016) affirmed the interconnectedness of biodata information on people's perception, hence its importance to this study.

**Table 1: Demographics of Respondents**

| Variable | Category | Percentage (%) |
|---|---|---|
| **Gender** | Male | 48 |
| | Female | 52 |
| **Age** | 15-25 | 17 |
| | 26-35 | 28 |
| | 36-45 | 32 |
| | 46 and above | 23 |
| **Educational Background** | Primary | 16 |
| | Secondary | 30 |
| | Tertiary | 27 |
| | Standard six | 16 |
| | No formal education | 11 |
| **Occupation** | Government employed | 23 |
| | Self employed | 37 |
| | Student | 11 |
| | Unemployed | 24 |
| | Others | 6 |
| **Family size** | Individual | 5 |
| | 1-4 persons | 26 |
| | 5-8 persons | 63 |
| | More than 8 persons | 6 |

Source: Field Survey (2025)

Table 2 shows the mean values of the flooding characteristics. The mean flood values for the study area include the following: 6.32 $km^2$, 2.10 km, 2.62km, and 234 ft for the inundated area, length, width, and height. Okolo waterside is seen to have the highest values of all the flooding characteristics among the communities. The duration of flooding in the area is recorded to last from several days to 8 weeks (Table 2). This could be due to the influence of its proximity to a water body; hence, it is referred to as a waterside. It could also be due to extreme weather conditions being depicted as consistently heavy rainfall. In view of this, Ntor et al. (2025) observed that extremely high rainfall is a common occurrence in the coastal communities of Warri, as well as other coastal communities of Delta state.

**Table 2: Duration of Flooding Across Selected Communities**

| Community | Duration Range (days) | Approx. Mean (days) |
|---|---|---|
| Otor-Udu | 7–56 | 31.5 |
| Ukporwin | 4–28 | 16 |
| Emadadia | 7–14 | 10.5 |
| Ukperheren | 1–5 | 3 |
| Okolo Waterside | 14 | 14 |

Source: Delta State Emergency Management Agency (SEMA), Asaba (2025)

Figure 2 shows the mean width and area of the various sample communities in the study area. Okolo waterside had both the highest mean inundated area and width. These relatively high values could be attributed to its status as a water side, owing to its proximity to a water body. Conversely, Ukporwin and Emadadia recorded the lowest values for mean inundated area and lowest mean width respectively.

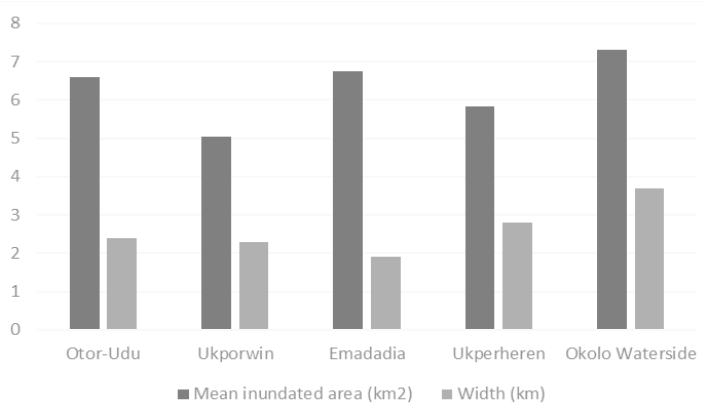


Figure 2: Mean Width and Area of Inundated Area

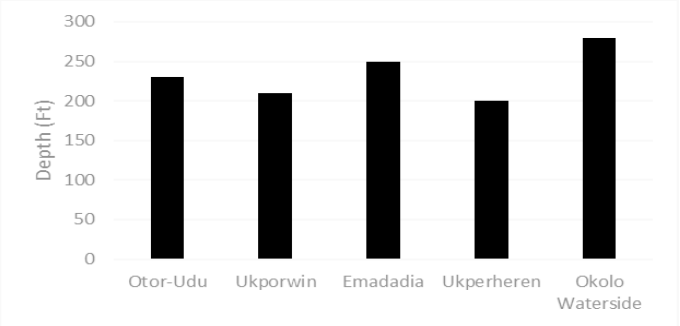


Figure. 3: Depth of Inundated Areas Within the Study Area

Figure 3 also shows Okolo waterside recording the highest value for depth while Ukperheren recorded the lowest. Figure 4 shows that the highest increase in annual flooding events in the study area occurred between 2016 and 2024. It also showed a consistent increase from 2005 to 2024. This confirms an increase in flooding occurrence, which may be related to factors such as consistent population increase, urbanization, and climate change. This is particularly so due to its proximity to the city of Warri, as it combines to form the Warri metropolis.

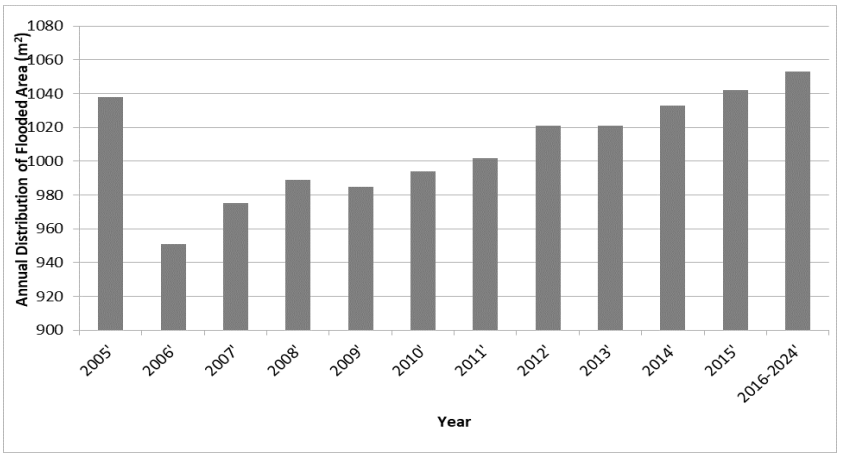


Figure 4: Mean Annual Distribution of Flooded Area ($m^2$) in Udu L.G.A (2005-2024)

Figure 5 shows the response of the people concerning the causes of floods within their areas. The highest response of the causes of floods is attributed to microclimatic characteristics, being indicative of the high rainfall amount in the area. Olanrewaju et al. (2017) confirmed that rainfall, inadequate drainage, and poor urban planning were identified as primary causes of flooding based on public perception. This further aligns with the findings of Maina et al. (2022) about the major flooding cause being attributed to heavy rainfall. A minimal proportion of respondents attributed flooding to the anger of the gods. This finding suggests a persistent attachment to traditional heritage that continues to influence perspectives regardless of educational attainment.

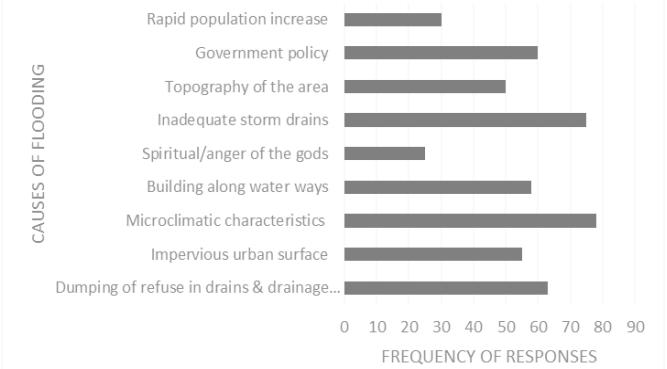


Figure 5: Perception of Causes of Flooding in the Study Area
Source: Field survey (2025)

Figure 6 shows the responses about the effects of flooding. Most respondents identified water turbidity as the primary effect of flooding, followed by traffic congestion. Fewest responses cited blocked or clogged drains.

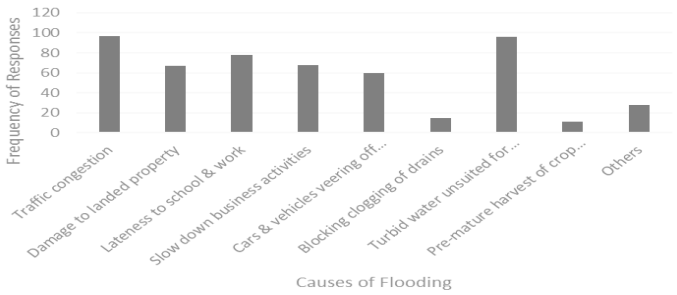


Figure 6: Perception of Effects of Flooding. Source: Field Survey

Figure 7 shows the responses pertaining to the number of flooding occurrences over the past two years. The majority (39%) affirmed that flooding occurrences had occurred more than four times within the past two years. The remaining 31% and 30%, however, noted that flooding events had occurred between 1 and 4 times within the said period. The response of the majority is suggestive of the increased consistency and severity of the floods in the study area.

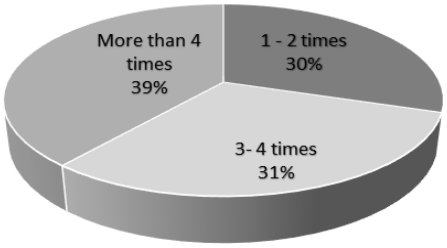


Figure 7: Flood Occurrences within the Past Two Years
Source: Fieldwork (2025)

Table 3 shows that 88 %, at one point or another, had reason to evacuate. The fact that the majority of the respondents had reason to evacuate is suggestive of the destructive nature of the flooding occurrences, being likely characterized by extreme flooding characteristics.

**Table 3: Did You Have Reason to Evacuate During Any of the Floods**

| Causes to Evacuate | Number of Respondents. | Percentage (%) |
|---|---|---|
| Yes | 308 | 88 |
| No | 42 | 12 |
| Total | 350 | 100 |

Source: Fieldwork (2025)

Figure 8 shows the flood mitigation methods adopted in the study area. The majority of these mitigation strategies were carried out by the government at various levels. The majority of respondents (30%) alluded to the adoption of the environmental sanitation programme as being a major method. This is a common approach that is adopted across almost all the states of the country, whereby a day within a month is designated by law for cleaning the surroundings. During this time, human and vehicular traffic are restricted. However, given the regular severity of flooding in the area, the effectiveness and implementation of this strategy are called into question.

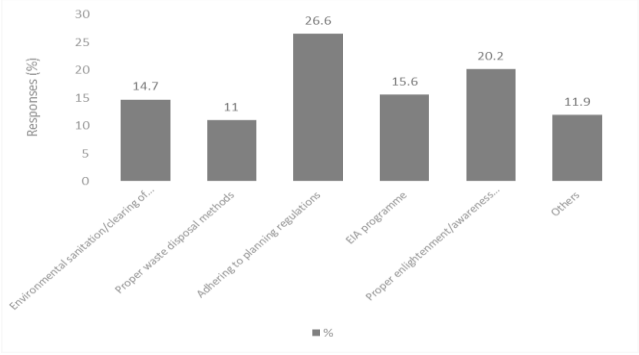


Figure 8: Flood Mitigation Methods Adopted in the Study Area
Source: Field Survey (2025)

The answers based on the efficacy of existing flood mitigation techniques are displayed in Figure 9. The majority of responders (61%) stated that the mitigation strategies currently in use were unsuccessful.

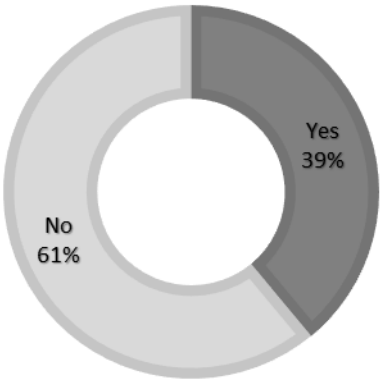


Figure 9: The Effectiveness of Current Forms of Mitigation Measures in Reducing the Flood Problem in the Area

66 % of respondents, being the majority, indicated that they were not aware of the operationalization or adoption of any flood mitigation approach (Figure 10). The implication is that more than half the sample population was unaware of the adoption or functionality of any mitigation measure, thereby confirming their ineffectiveness. Their ineffectiveness could be a result of inadequate funding, which serves as a limitation to effective management. Maina et al. (2022) similarly reported that the majority of residents in flood-prone areas had not adopted any flood-mitigation measures. This can be attributed to factors such as prevailing attitudes, low income levels, and a high dependence on government support.

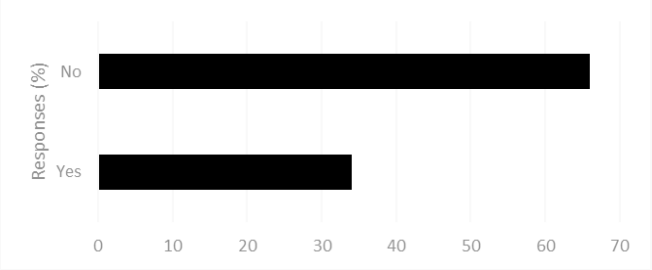


Figure 10: Awareness of Mitigation Approaches Adopted within the Area

Table 4 shows that the majority (63%) indicated they had no form of involvement in the planning of flood mitigation strategies. This situation is likely to have contributed significantly to the ineffectiveness of the mitigation strategies adopted, confirming sole involvement of the government. These further lays credence to the lack of awareness of flooding issues among the people.

**Table 4: Is the Community Involved in the Planning and Implementation of Flood Mitigation Measures**

| Planning | Number of Respondents. | Percentage (%) |
|---|---|---|
| Yes | 129 | 37 |
| No | 221 | 63 |
| Total | 350 | 100 |

Source: Fieldwork (2025)

Table 5 shows the result of the chi-square test, which was used to analyze the status of the association between public perception and flood hazard readiness. With $p < 0.05$, where $p = 0.010$, the public perception is seen to be significantly associated with the level of flood hazard readiness at the 0.05 significance level. The implication is that the level of understanding and awareness of flooding events and effects can be said to significantly influence the level of readiness/preparedness towards flooding occurrences.

**Table 5: Chi-Square Result for the Association Between Public Perception and Flood Hazard Readiness**

| Model | -2 Log Likelihood | Chi-Square | Df | Sig. |
|---|---|---|---|---|
| Intercept Only | 13.322 | | | |
| Final | .000 | 13.322 | 4 | .010 |

Source: SPSS Output (2025)

The study demonstrates the critical role of public awareness and perception in effective flood mitigation and management, as observed from the chi-square result. Inhabitants of the study area exhibit limited awareness of flooding issues despite

most of the sample population having attained a secondary school level of education. This suggests that the educational level attained do not necessarily meet the standards required for comprehension of flood-related issues. In other words, literacy and education levels in the study area did not significantly influence their understanding of flooding. This thereby highlights the limitations of formal education in adequately imparting knowledge about flooding, environmental concerns, and broader issues related to sustainable development and livelihoods. It therefore reveals the interplay of other factors working in concert with educational level attainment. This is confirmed by Lewchowska (2018), noting that educational level had a limited influence on perceptions of flood prevention and mitigation issues. This is also confirmed by several other authors such as Lindell and Hwang (2008), Zaalberg et al. (2009), Botzen and van den Bergh (2012).

The people's experience provides relevant information that is key and more reliable in providing a proper understanding of flooding risk and mitigation (Duží et al. 2014; Lechowska, 2018). Wachinger et al. (2013), in turn, affirmed that experience gathered from previous flooding occurrences was a key factor in providing solutions. However, Bhatti et al. (2023) pointed out that despite their experience, the locals did not fully comprehend spatial dynamics and the reasons behind floods. In addition, they noted that in order to effectively plan and control floods, suitable methods must be developed to overcome the difficulty of transmitting flooding information. They also mentioned the necessity of location-specific research that includes data on the history of local flooding.

The importance of local knowledge in flood control was mentioned by Fabiyi et al. (2011). However, he pointed out that financial limitations typically act as a restraint. Additionally, Adelekan et al. (2015) pointed out that solving the flooding problems required an awareness of people's perceptions. They added that in order to guarantee their capacity for adaptability, it was necessary to take into account their viewpoint and give priority to their choices. Akukwe (2014) further confirmed the importance of human perception by pointing out that two-thirds of the causes influencing floods originate from human factors.

Lechowsky (2018) alluded to the importance of the role of government in strengthening the relationship between public perception of flood risk and preparedness. The study, however, has revealed the limited contribution of the government to flood mitigation in the study area, thereby contributing to the severity of flooding events experienced in the area. In view of this, Aguiyi (2022) noted that government flood agencies responded more reactively rather than proactively. This reactionary stance, therefore, has contributed to the severity of destruction associated with flooding in the area. The government's collaboration with non-governmental bodies and community groups in ensuring efficient flood mitigation is highly recommended. In this regard, community leaders should be supported in organizing self-help initiatives. Irrespective of educational background, the study recommends implementing practical environmental awareness programs across diverse community groups, including youth, women's, and men's forums. This aligns with the assertion by Daukere et al. (2025), who emphasized that awareness campaigns should be tailored to specific age groups based on their demographic characteristics.

## CONCLUSION

It has been proven, therefore, that public opinion plays a crucial role in managing and mitigating flood hazards. Furthermore, the government ought to exercise leadership by providing financing and formulating favorable policies. To ensure sustainable flood management, local communities and the government must work together.

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