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Last-mile household preparedness for future disasters: a study of flooding in Kogi State, Nigeria

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ABSTRACT

There are a number of studies that analyze flood preparedness in communities of the global south. However, only a few studies have investigated flood preparedness in underserved communities with heightened vulnerability. This paper analyzed household preparedness against future floods in Kogi State Last-Mile Communities (LMCs) using 14 indicators and employed chi-square statistics to examine whether households' socioeconomic characteristics influence their preparedness for future floods. Results show that across the LMCs in the study area, the preparedness against future floods depends on the gender of household heads. While access to flood sensitization resources from responsible agencies is poor, household heads remain a major source of flood education to LMCs. Recommendations and implications for harnessing local-level flood resilience and preparedness are discussed in this paper.

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KEYWORDS
Flood preparedness; last-mile communities; early warning messages; Kogi State; Nigeria

1. Introduction

Climate change is accelerating the intensity, duration, magnitude, and onset speed of hydrometeorological hazards (flood, drought, hurricanes, and typhoons) in various countries of the world (Arnell & Gosling, 2014; Paton et al., 2017; UNISDR, 2018). Of all the hydrometeorological hazards, river and coastal floods are the highest and most common hazards affecting developed and developing countries. In its Sixth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) affirms with high confidence that climate change will increase global flood disasters (Intergovernmental Panel on Climate Change, 2022). The severity and frequency of flood disasters are expected to increase as a result of the continuous changes in hydrological and socioeconomic systems (Lin et al., 2021; Twerefou et al., 2023).

Flooding remains the most damaging disaster worldwide, causing severe damages and disruptions, including economic losses, loss of human lives, and destruction of landscapes and infrastructure (Merz et al., 2021), especially in developing countries (Alfred et al., 2017; Dottori et al., 2018; Njoku et al., 2021). According to UNDRR (2020), climate change impacts in the last two decades have revealed a doubling of major floods across the world. This is evident in the drastic increase in flood events from 1,389 between 1980–1999 to 3,245 between 2000–2019. These changes affected over 1.6 billion people (representing the highest figure in comparison to other types of natural hazards) (UNDRR, 2020). Out of the 3,245 events that occurred between 2000 and 2019, African countries accounted for 763 flood events; those flood events have cascading implications on the economy, human health, and physical well-being of the people. In Nigeria, flooding has caused

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losses worth more than US$5 billion annually across the country since 2000 (Okunola et al., 2024). An example is the July to October 2012 catastrophic floods that occurred in Nigeria, which affected 32 states (out of the 36 states in Nigeria), with Kogi, Edo, Cross Rivers, Rivers, Benue, Delta, and Bayelsa States being the most affected. After the 2012 flood, Ojigi et al. (2013) assessed the spatial extent of the flood. Their result shows that approximately 4701 sq.km was impacted, rendering 1.3 million people homeless, with 363 deaths and 600,000 damaged houses (National Emergency Management Agency [NEMA], 2012; Nkeki et al., 2013; Ojigi et al., 2013).

In Kogi State (the study area of this paper), floods in 2018 destroyed about 1.8 billion Naira worth of properties while affecting over 89,547 people (National Emergency Management Agency, 2018). In September 2020, communities located at a buffer distance of the river confluence (River Niger and River Benue) experienced another devastating flood; reports indicate that the flood displaced 50,000 people living in 66 affected communities (Floodlist, 2017). Recent studies have predicted that more severe floods will occur in the future (Komolafe et al., 2020). This concern emphasizes the need for lasting flood preparedness intervention across the country. Flood preparedness involves initiatives designed to enhance the actions and capacities of individuals, community groups, and private and government organizations to adequately and effectively prepare, respond to and recover from the present, likely or future impacts of flood events (Mabuku et al., 2018).

According to the Global Disaster Preparedness Center (GDPC, 2023), the adverse impacts of floods are more devastating for rural or last-mile communities (LMCs), where issues like communication barriers, lack of accessibility of infrastructure and early warning information and the like, abounds. Apart from being unserved or underserved by various infrastructural facilities that build flood resilience, LMCs face heightened vulnerabilities to flood risks resulting from their social, cultural and human capabilities (Lundgren & Strandh, 2022). This heightened vulnerability is worsened by LMCs' inability to receive and act on flood warnings and the fragility of their local-level risk governance (Shrestha et al., 2021). These conditions necessitate the need for initiatives that address long-term preparedness for floods in LMCs.

The relationship between flood preparedness and early warnings is displayed in the recent flood events in Nigeria. In early 2023, the Nigeria Hydrological Services Agency (NIHSA) published its Annual Flood Outlook (AFO) and predicted a major flooding in 2023. In the AFO, they indicated that 32 of Nigeria's 36 states would be severely affected (Nigeria Hydrological Services Agency [NIHSA], 2023). As a result, the National Emergency Management Agency (NEMA) disseminated these flood early warning messages (EWMs) and enumerated necessary measures to mitigate its impacts (The Guardian, 2023). Despite efforts made by NIHSA and NEMA, the 2023 flood events in Nigeria had devastating effects, especially in Kogi State, where the two major rivers form a confluence, displacing 1.4 million persons and killing 603 people. Also, in early 2024, NIHSA released its 2024 AFO, and it was predicted that 148 local government areas in Nigeria would be severely affected (Federal Ministry of Information and National Orientation, 2024). With these EWMs, it is expected that concerned communities, especially LMCs in flood-prone areas, prepare to mitigate the impacts of this flood. To bolster the import of preparedness, Paton et al. (2017) opined that preparedness helps to reduce the risk of death and injury, minimize the reliance on external assistance during disaster response, and help to hasten recovery after an extreme event. In addition, the fourth priority of the Sendai Framework for Disaster Risk Reduction (SFDRR) states the need to enhance disaster preparedness for an effective response and 'Build Back Better' in recovery (UNISDR, 2018). The SFDRR's fourth priority can only be achieved through rigorous and extensive research on individuals, communities, institutions, and business preparedness for present and future disasters (Gaillard & Mercer, 2012). Hence, this study examines the flood preparedness of LMCs in Nigeria, taking cognizance of the 2024 AFO.

Globally, researchers have examined the flood preparedness and mitigation plan of private (small-medium size) and public organizations and businesses for flood disasters (Hashim et al., 2021; Heinkel et al., 2022; Kreibich et al., 2005). Others have conducted empirical studies on the impacts of floods and examined how demographic and other socioeconomic characteristics can influence individual

preparedness activities (Kreibich et al., 2010; Mavhura et al., 2020). For example, Coulston and Deeny (2010) assessed how previous flood experience and social factors (age, house ownership status) affect individual preparedness in two high-risk locations. Their findings show that increasing age was not associated with better preparedness against major flooding. Within the context of Nigeria, there have been numerous studies on flood vulnerability, risk perception, impact assessment (using geospatial information systems) and adaptation (Adelekan & Asiyanbi, 2015; Aderogba, 2012; Ahile & Ityavyar, 2014; Ezemonye & Emeribe, 2014; Ojigi et al., 2013; Osayomi & Oladosu, 2016).

In the same vein, few researchers have conducted related studies in Kogi State (the study area) due to the increasing perennial floods. Similar studies in Kogi have focused on flood risk assessment (Nkeki et al., 2013), flood vulnerability assessment and risk management (Ajodo & Olawepo, 2021; Ifatimehin et al., 2009; E. T. Umaru & Adedokun, 2020), flood impact assessment (Ndukson Buba et al., 2021), flood early warning strategies (Alfa et al., 2018), flood perception (J. U. Umaru & Hafiz, 2019), and knowledge of flood preparedness and response mechanisms (Danjibo et al., 2019). Also evident in recent flood studies in Kogi State is the diversity of methods. While Aladejana and Ebijuoworih (2024) analyzed flood risk using a geospatial model – Fuzzy Analytical Hierarchy Process, Buba et al. (2021) examined flood vulnerability in Lokoja (Kogi State) from a participatory geographic information system lens. On the contrary (Oyedele et al., 2022), developed an index to unravel flood vulnerability in local communities.

Similarly, global, national and local studies have addressed relevant aspects of flooding; however, only a few studies have examined local flood preparedness levels, especially in the context of LMCs. Therefore, this paper aims to (a) assess household preparedness against future floods in Kogi State's last-mile communities; and (b) examine whether households' socioeconomic characteristics influence their preparedness for future floods. This paper contributes to the existing bodies of flood preparedness literature in Nigeria that mostly focuses on rural and urban flooding (Ajodo & Olawepo, 2021; Okunola et al., 2024) and opens discussion in a novel area that explores flood preparedness in last-mile communities. This contribution uncovers the flood preparedness implications of underserved communities with heightened vulnerabilities and emphasizes the role of lasting flood preparedness in Nigeria's LMCs in building national resilience to floods. The next section of this paper will detail the methodology. The subsequent section will present the results before the discussion in section four. The last section will conclude this paper.

2. Material and methods

2.1. Study area

Kogi State, one of the 36 states in Nigeria (Figure 1), is located between Latitudes 6.33°′N and 8.44°′N and Longitudes 5.40°′E and 7.49°′E. It occupies a total land area of 29,833 km^2. The state comprises 21 local government areas (LGAs) (Figure 1). It borders Nasarawa (to the Northeast), Benue, Anambra and Edo (to the South), Abuja (to the North), Ondo and Ekiti (to the West) and Kwara (to the Northwest). In terms of topography, the height of Kogi State rises 300 m (above sea level) along the River Niger and Benue and increases up to 600 m toward the upland (Njoku et al., 2021). Kogi State has been selected for study due to its historical records of one of Nigeria's most devastating flood disasters, especially with the recent 2022 catastrophic floods in Nigeria (NIHSA, 2023). Besides, the confluence of Nigeria's two major rivers, Rivers Niger and Benue, in Kogi State, makes it more exposed to flood risk (Ndukson Buba et al., 2021).

Kogi's State climate is characterized by Dry and Wet Aw (based on Koppen's classification) (Ologunorisa & Adeyemo, 2005). Kogi state is drained by two rivers (River Niger and River Benue) with numerous tributaries. These rivers form a confluence in Kogi and flow into the Atlantic Ocean (Ologunorisa & Adeyemo, 2005). Agriculture is one of the significant economic activities in Kogi. The most common farm produce includes Yam, Rice, Melon, Cashew and Groundnut (E. T. Umaru & Adedokun, 2020). A large proportion of the residents of Kogi State are traders, public/civil

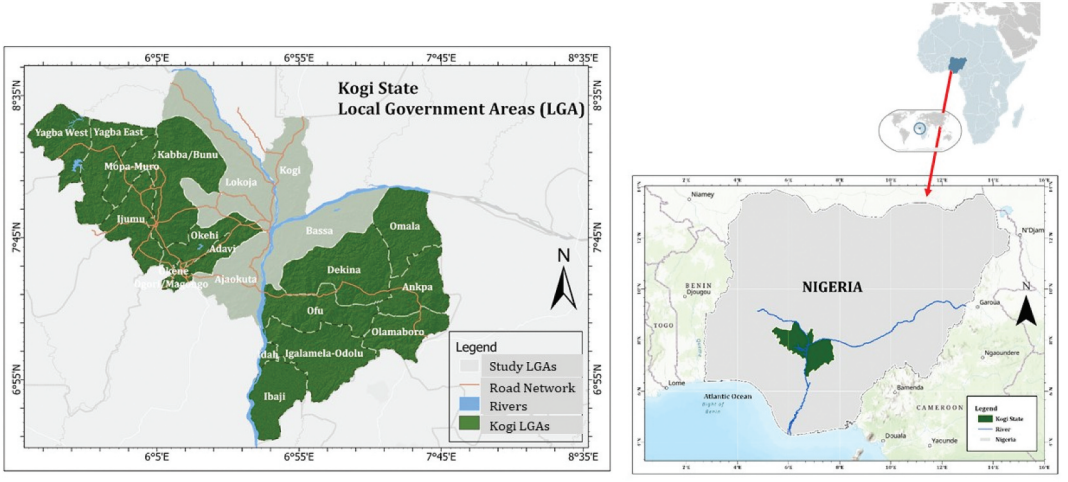

Figure 1. The study area.

servants, fishermen, and agrarian peasantry (E. T. Umaru & Adedokun, 2020). According to the City Population (City Population, n.d.) released population report, the population of Kogi State is 4,473,500.

2.2. Research design

A structured questionnaire was designed to gather quantitative data on the level of household preparedness against floods. The questionnaire was grouped into three sections. The first section entails questions relating to the respondent's socio-demographic characteristics (including age, gender, income, occupation, ownership status of their property, and the number of household members) and the second section consists of questions on the respondent's duration of residence/stay in the community and other information about their house/properties, including the perception of their flood preparedness. The last section focuses on preparedness indicator questions that were analyzed to quantify the household level of preparedness against future floods through the computation of a flood preparedness index. The questions in the third section were informed by the researchers' preliminary survey of the study area, literature and Dufty (2021) flood preparedness framework (Figure 2). For example, in the third section, questions such as 'Do you have where to move your household members in the event of floods?' and 'Do you frequently educate your household members about flood disasters?' were asked (see Table 2). To facilitate easy computation of the indicators and in preparing the preparedness index, this current paper adopted a four-point Likert scale, which is used to quantify the extent to which household members agreed to a particular question or preparedness variables on a scale of 1–4: 1= '*I don'know*,' 2= '*Not Prepared*,' 3= '*Partly Prepared*,' 4= '*Very Prepared*.' Previous researchers have proven that using Likert scales is suitable for measuring interval scales and indicators approach studies (Baggaley & Hull, 1983; Maurer & Pierce, 1998). Therefore, the score attached to the various household flood preparedness questions determines the level of preparedness.

2.2.1. Local government areas and LMCs selection

In selecting the local government areas (LGAs) to be surveyed for this study, insight was drawn from previous literature that has analyzed flood extent and its impact on various communities of Kogi State (Adedeji et al., 2021; Aladejana & Ebijuoworih, 2024; Ojigi et al., 2013; Oyedele et al., 2022) and from the flood extent maps of Kogi in 2018 (Figure 3) which indicates the concentration

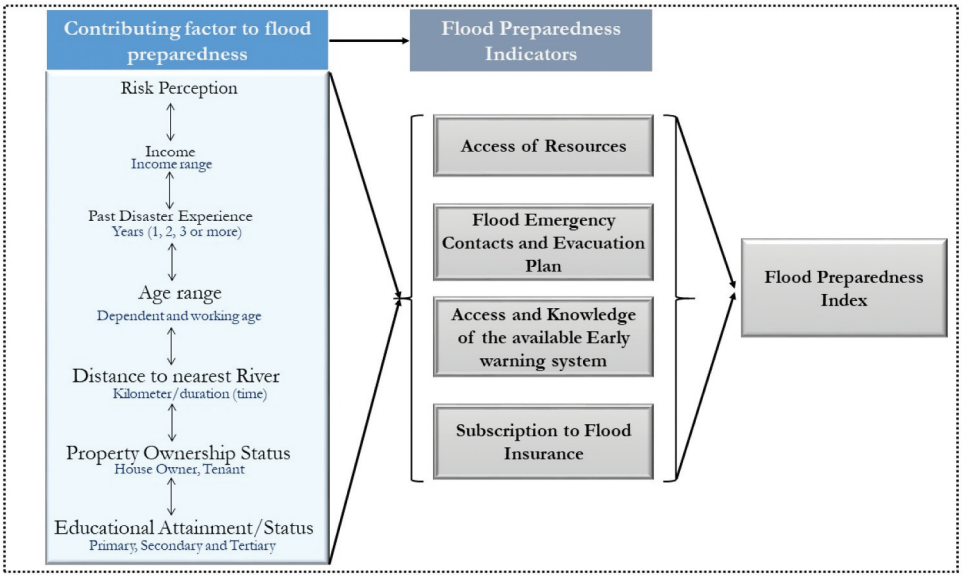

Figure 2. Research framework designed to examine factors affecting flood preparedness. (adapted from Dufty, 2021).

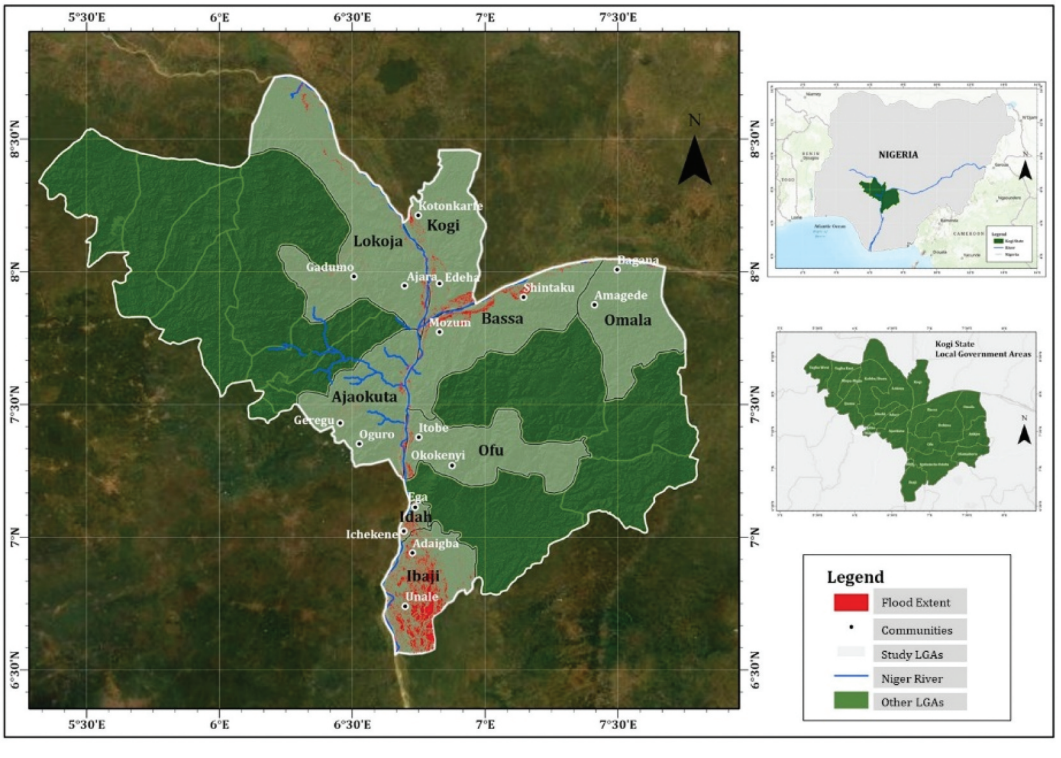

Figure 3. Map showing the flood extent of the study LGAs as of September 2018 (osayomi et al., 2022).

of flood water at the confluence of the River Niger and Benue. With the area extent of those previous flood maps coupled with the studies of Nkeki et al. (2013) and E. T. Umaru and Adedokun (2020), highly flood-exposed communities were categorized based on a buffer distance of 6 km and 13 km from the river confluence, Hence, the Geographic Information System (GIS) software was used to draw a buffer of 6 km along the River Benue and River Niger (see Figure 4), and the LGAs falling within this buffer were selected for survey. The buffer automatically covers the following LGAs: Ajaokuta, Bassa, Lokoja, and Kogi-Kortokarfe. Due to the population size, time and resource availability, the purposive sampling technique[1] was adopted in selecting LMCs from those four LGAs, especially those communities that fall within the 6 km buffered distance from River Niger/Benue Confluence. The 2022 AFO published by NEMA classified some of the selected LMCs as having a 'significant' risk of flooding. Table 1 summarizes the selected LMCs and their resultant LGAs.

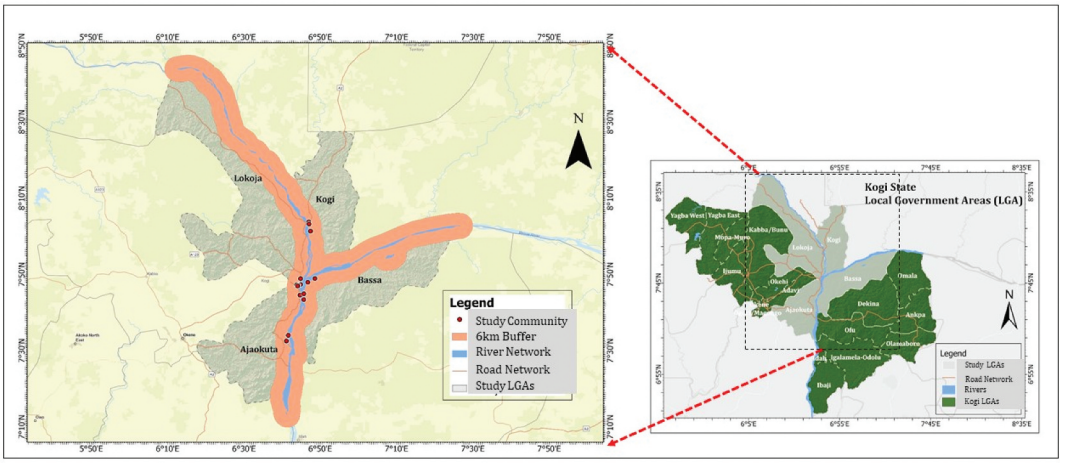

Figure 4. Map of the selected study LGA, including the buffer distance of 6 km and surveyed communities.

Table 1. Selected LMCs and their geolocation information.

LGAs	LMCs	Number of Household Head Surveyed	Latitude	Longitude
Lokoja LGA.	Kpata	25	7.815183	6.747723
	ADANKOLO (Old Market)	25	7.789853	6.747723
	ADANKOLO (Cemetery)	25	7.788092	6.736723
	ADANKOLO (Dunamis)	25	7.788026	6.730824
	Total	**100**		
Ajaokuta LGA	Geredu	25	7.567470	6.694231
	Gaduma	25	7.783271	6.734769
	Ganaja	25	7.743296	6.745096
	MTI	25	7.542776	6.685877
	Total	**100**		
Bassa LGA	Shintaku	25	7.723657	6.761147
	Gbobe	25	7.749418	6.761655
	Ogande	25	7.799678	6.779299
	Ogwoze	25	7.816021	6.809965
	Total	**100**		
Kogi Korto Karfe LGA	Edeha	25	8.063366	6.783386
	Iganuma	25	8.054074	6.784422
	Edegachi	25	8.022834	6.791358
	Ikumo	25	7. 984738	6.788867
	Total	**100**		

2.2.2. Household sample size selection technique and data collection

The simple random method was used to select the sample from the houses located within the LMCs to collect the most representative data. Moreover, the questions were directed to the household head (male or female) at each of the randomly selected houses or properties. The questionnaire focuses more on the household head because, according to Mumin et al. (2013) and Digafe et al. (2015), a household head (head of the family) is the one person who manages the household, provides economic support, protection, and caters for the household members. Regardless of whether the household head is a male or female, he or she is solely responsible to the household member and, in most cases, stands *as* a representative of the house even during community meetings. Other household members depend significantly on household heads economically, so they might not have the agency and knowledge of how well the household is prepared for floods. Where the head of the household was not available, every effort was made to administer the questionnaire to an adult household member knowledgeable about the general livelihood and functionality of the household. Due to the lack of population census data for each of the LMCs (as the last population census was done in 2006 and was only aggregated by LGA and not disaggregated to the community level, it is difficult to use a sample size derivation formula). Therefore, an equal number of household heads were chosen from the selected communities in this current study. Thus, 25 household heads were surveyed in each LMC, comprising 100 households in each LGA and collectively, 400 household heads were investigated in this study.

The 400 questionnaires were randomly administered to the household heads living in the selected communities. Random sampling technique was employed to avoid selection biases. However, to ensure the accuracy of the randomization employed, only houses within the flood extent map of the study area were selected. The identification of respondents was based on the availability of the household members and their consent to participate in the survey. Additionally, to ensure that responses represent the totality of the study area, an equal number of household heads were chosen from all LMCs selected for the study. A pilot study of 10 questionnaires was conducted to understand the people's responses to the questionnaire and to check for the validity of the questions. Before conducting the survey, a courtesy visit was made to the Local Government Unit head, National Inland Water Authority and Community leaders to discuss the research, its essentials and the approach to survey the community members. The survey was conducted from July 3 to July 30, 2023, which is about one or two months to August/September (the period of the yearly floods, based on past flood events), making it a perfect time to access the community member's level of preparedness.

2.3. Flood preparedness indicators

Flood preparedness involves building knowledge and capacities that enable at-risk populations to anticipate, respond to and recover from hazardous flood events (Mabuku et al., 2018). Thus, flood preparedness indicators in the selected LMCs encompass pre-disaster activities undertaken within the context of disaster risk management. The flood preparedness indicators employed in this study were informed by the researchers' preliminary survey of the study area, flood preparedness literature and Dufty's (2021) flood preparedness framework (Figure 2). The indicators employed in this study are presented in Table 2.

2.4. Data analysis

Data was processed using Microsoft Excel and the Statistical Package for Social Scientists (SPSS) version 2. Tables of frequency and percentage were used to represent the socio-demographic characteristics of the household heads sampled at the four surveyed LGAs. To test the association between the socio-demographic/economic characteristics of households (independent variables) and their perceived preparedness against future floods, cross-tabulation and Chi-square analysis

Table 2. Flood preparedness constructs and variables.

Flood Preparedness Indicators (adapted from (Dufty, 2021))	Description	Variables	References
Flood emergency plans, contacts and evacuation plans	Moving people and assets temporarily to safer places before a hazardous event, including having access necessities during such evacuations.	Do you have a stockpile of emergency food, water and money in the case of a flood disaster? Have you constructed embarkments or similar protective barrier to shield and protect your house or farm from future floods? Have you secured and moved all household members vital documents and other valuables to a safe place that cannot be affected by the floods? Do you have where to move any household members (evacuate or seek shelter) in the event of floods? Do you have a drawn-up plan for where household members can converge in the case of flood events? (contingency plan) Do you have neighbors contact that you and your household members can stay with during the event of flooding? I have the contact of civil protection members (emergency phone numbers of NEMA or SEMA) to call in the event of flooding I have cleared all the drainage system from solid waste which may hinder the flow of rainfall water	(Alexander, 2015; Farley et al., 2017; Kunz et al., 2014; Mabuku et al., 2018; Mehiriz & Gosselin, 2016; Rodríguez-Espíndola et al., 2018)
Access to resources	Access to material and informational resources for use during and after disaster	Do you frequently educate your household member about flood disaster? Do you have access to canoe/ boat to rescue your household members when crossing flooded areas after a flood disaster? Do you receive any education/ sensitization on flood disasters?	(Alexander, 2015; Kunz et al., 2014; Mabuku et al., 2018; Mehiriz & Gosselin, 2016; Rodríguez-Espíndola et al., 2018; Yadav & Barve, 2019)
Access and knowledge of the available early warning systems	Set of capacities and information needed to generate and disseminate timely and meaningful warnings to enable communities to prepare and act appropriately and timely before a disaster.	Do you have access to the new released Annual Flood Outlook 2023 for Nigeria? Do you receive or have access to the river discharge (water level) information?	(Alexander, 2015; Atreya et al., 2017; Farley et al., 2017; Mabuku et al., 2018; Maduz et al., 2019; Mehiriz & Gosselin, 2016; Parker et al., 2019)
Subscription to flood insurance	Availability of flood insurance to bear the burden of disaster-related losses and damages.	Did you insure your house or farmland against flood	(Elum & Lawal, 2022)

were conducted to understand whether the socioeconomic characteristics of households influence their perceived preparedness against future floods. The hypothesis is stated thus:

(1) H_0 (null hypothesis): There is no significant association between households' socioeconomic characteristics and their perceived level of flood preparedness.
(2) H_1 (alternative hypothesis): There is a significant association between households' socio-economic characteristics and their perceived level of flood preparedness.

To develop a Flood Preparedness Index, the household head's preparedness questions were quantified through scoring using a four-point Likert scale: 1 = 'I don't know/NA,' 2 = 'Not Prepared,' 3 = 'Partly Prepared,' and 4 = 'Very Prepared.' The individual household head answers the questions based on their current level of preparedness for each activity or action taken to prepare against floods. The total sum of all the preparedness activities questions for respondents in each LMC was scored and classified into four categories using equal intervals. These categories are Very low preparedness (1–25), Low preparedness (26–50), High preparedness (51–75), and Very high preparedness (76–100). Furthermore, a preparedness index was developed to understand the variation and difference in the level of flood preparedness across the four surveyed LGAs based on Khan et al (Khan et al., 2022). averaging method of perception index construction.

3. Results

3.1. Socioeconomic characteristics of household heads

The gender analysis of the household heads revealed that Bassa LGA and Kogi/Koton-karfi have the highest number of Male respondents (97% and 95%, respectively). Across the four LGAs, the highest female representation is in Lokoja LGA (10%), and Bassa LGA has the lowest female representation (3%). Overall, the survey has more male gender representation (Figure 5). The age distribution shows that most household heads are within the working age (35–50 years old), representing 38% (Figure 6). Also, the result shows that the majority of the households have a family size of '6 and above' (Figure 7). Also, secondary education (51%) is the most attained among household heads, and only 18% attended a university/polytechnic/college of education (Tertiary institution) (Figure 8). Farming/fishing is the most dominant economic activity practiced by the household heads (51%) (Figure 9).

In terms of income, 47% of the respondents earn a monthly income between ₦18,000 - ₦50,000 (between 23–65 US Dollars), while 40% earn less than ₦18,000 (<23 US Dollars)

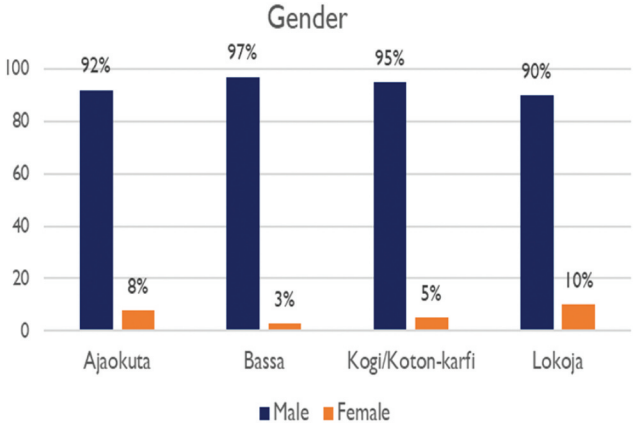

Figure 5. Percentage of gender representation. Male-headed households are dominate in the study area.

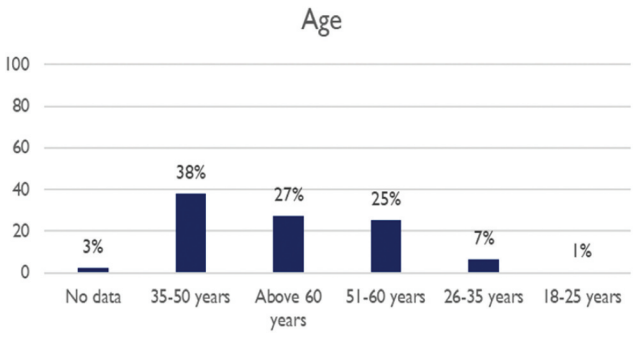

Figure 6. Age representation across the LGA reveals that the majority of the household heads are within the working age (ages 35–50).

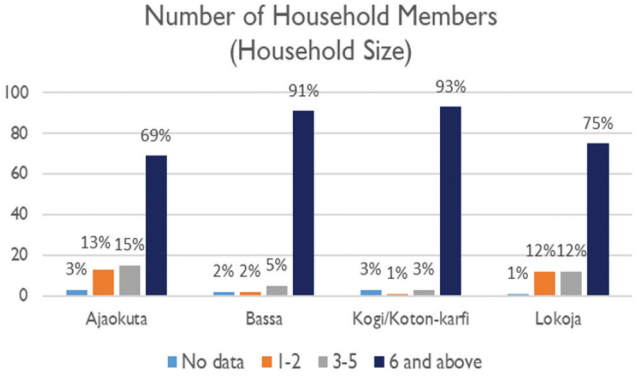

Figure 7. Household size across the four LGAs. This figure reveals that most households are about 6 and above.

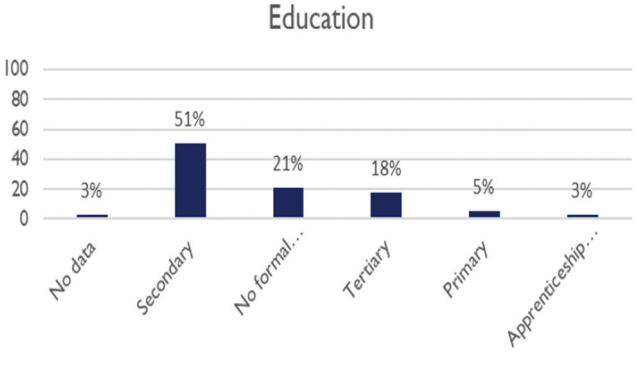

Figure 8. Educational status. Secondary education is the most attained among household heads, and only 18% attended a tertiary institution.

(see Figure 10). Further, 67% of the respondents live in their Family House (a house built by their forefathers or grandfathers of the household heads). In comparison, Landlords and Tenants have an equal representation of 16% each. Only 1% of the respondents did not respond to the question (see Figure 11).

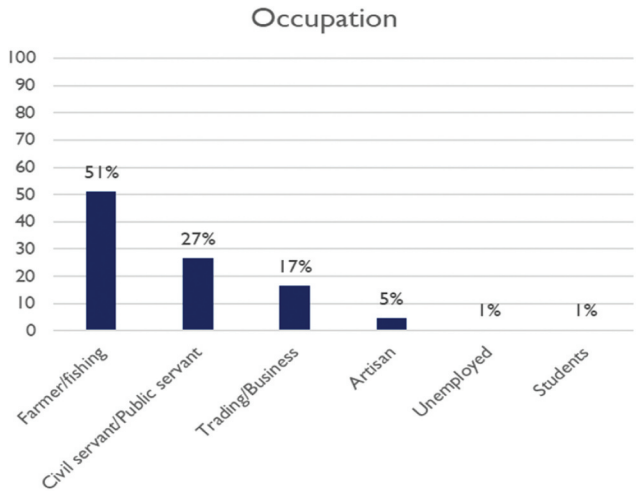

Figure 9. Occupation. Primary activities (fishing/farming) are the most common occupation across the LMCs.

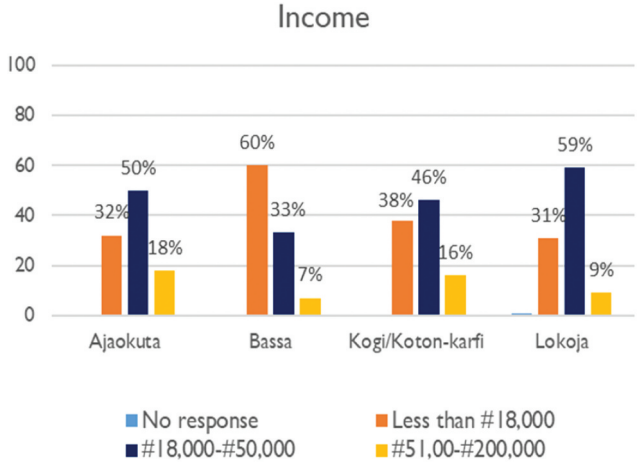

Figure 10. Income distribution. Most household heads earn between ₦18,000 - ₦50,000 except Bassa in where the dominant income is less than ₦18,000.

3.2. *Perception of flood preparedness in LMCs of Kogi State*

The cross-tabulation results (Table 3) show a relationship between the gender of households' heads and flood preparedness in Ajaokuta, Bassa and Lokoja LGAs. However, in Kogi/Koton-karfi LGA, flood preparedness is not dependent on the gender of the household head. For ages, the null hypothesis (H_0) is accepted for Ajaokuta, Bassa and Lokoja LGA (because the p-value is greater than 0.05). However, H_1 is accepted for Kogi/Koton-karfi LGA (because the p-value is less than 0.05). This means there is no significant relationship between the ages of household heads and the perception of their preparedness for floods in Ajaokuta, Bassa and Lokoja LGAs. However, in Kogi/Koton-karfi LGA, there is a significant relationship between the ages of household heads and the perception of their preparedness for floods. Results for the third socioeconomic variable (household size) show that flood preparedness is not dependent on the sizes of households in the majority of the sampled LGAs, except Lokoja, which reveals a significant relationship between household size and flood preparedness.

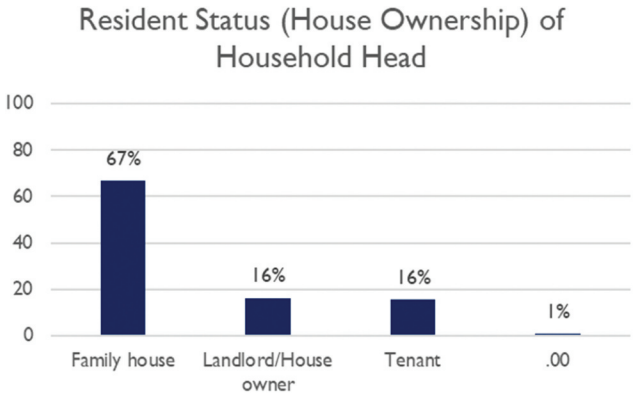

Figure 11. House ownership status. In the study area, family-owned houses are dominant.

Table 3. Summary of the Chi-Square test between household heads socioeconomic variables and flood preparedness.

Socioeconomic Variables	Local Government Area	Pearson Chi-Square Value	Asymptotic Significance (p) (2-sided)	Decision
Gender	Ajaokuta	15.393	0.000	Accept H_1
	Bassa	33.129	0.000	Accept H_1
	Kogi/Koton-karfi	0.651	0.420	Accept H_0
	Lokoja	0.9601	0.008	Accept H_1
Age	Ajaokuta	15.359	0.120	Accept H_0
	Bassa	8.637	0.374	Accept H_0
	Kogi/Koton-karfi	13.123	0.011	Accept H_1
	Lokoja	8.053	0.624	Accept H_0
Household size	Ajaokuta	11.417	0.076	Accept H_0
	Bassa	4.844	0.564	Accept H_0
	Kogi/Koton-karfi	.930	0.818	Accept H_0
	Lokoja	26.811	0.000	Accept H_1
Educational Status	Ajaokuta	13.288	0.208	Accept H_0
	Bassa	8.796	0.360	Accept H_0
	Kogi/Koton-karfi	38.180	0.000	Accept H_1
	Lokoja	21.733	0.017	Accept H_1
Occupation	Ajaokuta	9.841	0.276	Accept H_0
	Bassa	8.334	0.215	Accept H_0
	Kogi/Koton-karfi	2.575	0.765	Accept H_0
	Lokoja	15.239	0.055	Accept H_0
Income Status	Ajaokuta	8.215	0.084	Accept H_0
	Bassa	12.809	0.012	Accept H_1
	Kogi/Koton-karfi	6.842	0.033	Accept H_1
	Lokoja	7.623	0.267	Accept H_0
House Ownership Status	Ajaokuta	23.377	0.000	Accept H_1
	Bassa	1.067	0.900	Accept H_0
	Kogi/Koton-karfi	.310	0.856	Accept H_0
	Lokoja	46.033	0.000	Accept H_1

Similarly, the interpretation of the Chi-square test in Table 3 reveals that there is no relationship between the educational status of household heads and the perception of their preparedness for floods in Ajaokuta and Bassa. On the other hand, this relationship is significant in Kogi/Koton-karfi and Lokoja. For occupation, it was discovered that in all the sampled LGAs, the flood preparedness of households' heads was not dependent on their occupation. Further, preparedness for floods is not dependent on household heads' income levels in Ajaokuta and Lokoja. However, for Bassa and Kogi/Koton-karfi, flood preparedness is income-dependent. In terms of the house ownership status of household heads, the result suggests an association between household heads' house ownership status and the perception

of their preparedness for floods in Ajaokuta and Lokoja. On the other hand, the flood preparedness of households' heads is not dependent on their house ownership status in Bassa and Kogi/Koton-karfi.

3.3. Flood preparedness index

Table 4 shows the flood preparedness index of the selected LMCs across the four survey LGAs. Generally, flood preparedness is relatively higher in the LMCs across Ajaokuta, Bassa and Kogi LGAs, except for the indicators reflecting the access to available early warning systems and subscription to flood insurance. With regards to the 'flood emergency contacts and evacuation plans,' LMCs across Ajaokuta, Bassa, and Kogi show very high preparedness and, in a few cases, high preparedness for floods in terms of stockpiling food, water and money, constructing flood shields, securing households valuables, and contingency planning. However, regarding access to emergency institutions and anticipatory actions (clearing solid wastes from drainage systems), LMCs in Bassa, Kogi and Lokoja exhibit low and very low preparedness for floods. Reflecting on the 'access to resources' indicators in Table 4, it can be deduced that the LMCs across the study area are very prepared to rescue their household members in the event of floods using canoes or boats. LMCs in the study area (excluding those in Lokoja LGA) have great access to flood education from their household head, making them prepared for future floods. LMCs across the study area barely access flood sensitization resources from responsible agencies.

Results for the third indicator, 'access and knowledge of the available early warning systems,' reveal that LMCs in the study area have low or very low accessibility to early warning systems. For the indicator, 'subscription to insurance,' results show that LMCs in the study area lack or have limited insurance subscriptions against losses and damages incurred from floods. With respect to the overall flood preparedness for the sampled LGAs (Figure 12), three LGAs – Ajaokuta, Bassa and Kogi – exhibit overall moderate preparedness for floods (53%, 50% and 52%, respectively) except for Lokoja LGA, where flood preparedness is poor (44%).

4. Discussion

This study uncovers how access to flood emergency and evacuation plans, material and informational resources, early warning systems, and flood insurance can influence flood preparedness in underserved communities – LMCs. Findings have revealed a high level of male household head representation in the sample LMCs, and this is because Nigeria is more patrilineal – male

Table 4. Flood Preparedness Index (indicators) in Kogi State.

		Ajaokuta					Bassa					Kogi					Lokoja				
		LMCs				Overall Index (Ajaokuta)	LMCs				Overall Index (Bassa)	LMCs				Overall Index (Kogi)	LMCs				Overall Index (Lokoja)
Flood Preparedness Indicators	Indicator Questions	Gadu ma	Ganaj a	Gereg u	MTI		Gbobe	Ogan de	Ogwo ze	Shint akiu		Edega chi	Edeha	Iganu ma	Ikumo		Adankolo-Cemetery	Adankolo-Dunamis	Adankolo-Old market	Kpata	
Flood Emergency Contacts and Evacuation Plans	Do you have a stockpile of emergency food,water, and money in the case of a flood disaster?	87	77	83	81	82	69	67	75	74	72	78	72	74	76	75	68	78	68	67	70
	Have you constructed an embankment and similar protective barrier to shield to protect house/ farm from the future flood?	56	57	52	51	54	51	51	50	51	51	51	53	50	52	52	52	50	49	49	50
	Have you secured and moved all household members vital documents and other valuable item to a safe place that cannot be affected by the floods?	87	91	94	92	91	83	85	93	86	87	79	79	84	71	79	43	45	48	46	46
	Do you have where to move my household members (evacuate or seek shelter) in the event of flood?	98	98	96	99	98	88	97	95	94	94	92	91	98	88	92	44	50	41	47	46
	Do you have a drawn-up plan for where household members can converge in the case of flood event? (Contigency plan)	84	90	81	82	84	55	51	56	58	55	49	52	60	59	55	44	50	41	47	46
	Do you have neighbourhood contact that you and your household members can stay with during the event of flooding?	98	98	96	100	98	93	96	94	94	95	86	88	93	87	89	87	92	94	92	91
	I have the contact of civil protection members, (emergency phone number of NEMA or SEMA), emergency institution staff to call in the	50	55	52	59	54	50	50	50	50	50	48	49	45	49	48	50	50	50	51	50
	I have cleared all the drainage system from solid waste which may hinder the flow of rainfall water	31	38	33	36	35	25	25	25	25	25	25	27	25	25	26	28	28	25	35	29
Access to Resources	Do you frequently educate your household member about flood disaster?	100	100	100	100	100	100	100	100	100	100	80	79	81	77	79	45	45	46	42	45
	Do you have access to a canoe/boat to rescue your household member when crossing flooded area after a flood disaster?	87	85	85	97	89	55	51	56	58	55	89	82	96	89	89	92	100	90	93	94
	Do you receive any education/sensitization on flood disasters?	45	38	48	44	44	44	46	45	49	46	40	44	41	43	42	44	37	25	36	36
Access and Knowledge of the available Early Warning Systems	Do you have access to the new release Annual Flood Outlook 2022 for Nigeria?	27	28	29	29	27	30	27	33	29	30	34	31	29	30	31	33	37	29	31	33
	Do you receive or have access to the river discharge (water level) information?	40	35	39	31	36	35	38	46	49	42	47	50	33	39	42	54	38	33	40	41
Subscription to Flood Insurance	Did you insure your house or farmland against flood?	33	32	37	28	33	28	31	29	26	29	39	30	37	33	35	33	26	28	26	28
	KEYS	Very High Preparedness					High Preparedness					Low Preparedness					Very Low Preparedness				

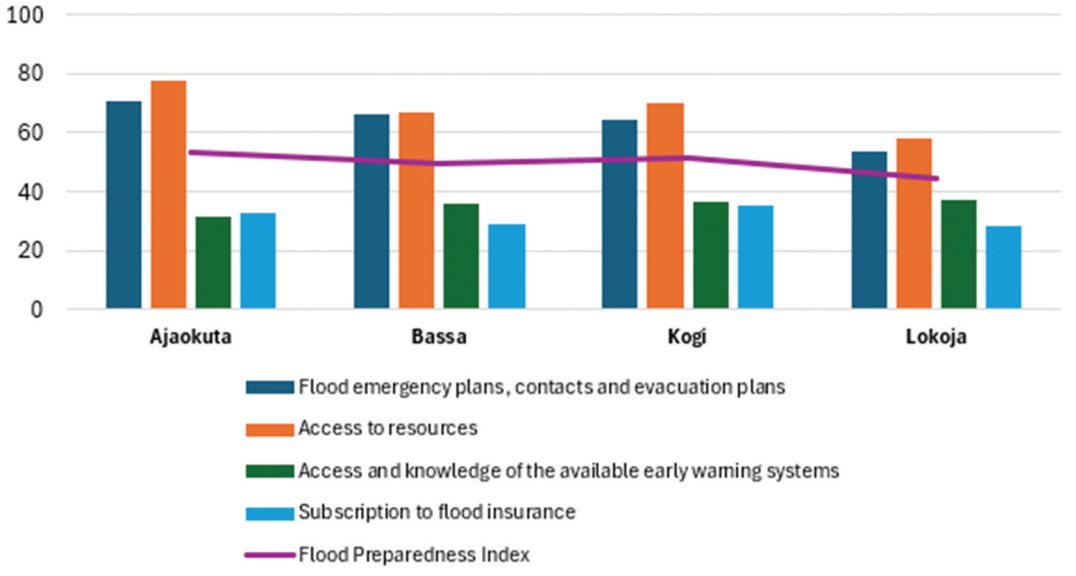

Figure 12. Overall flood preparedness across sampled LGAs. While flood emergency planning and access to resources are relatively higher across the LGAs, early warning accessibility and flood insurance are on the low side and need attention.

dominating society (Ashagidigbi et al., 2022), which makes the male gender the head of the house, and only in a few situations (when the male/husband is not available), will female occupy the position of being the head of the household (Ashagidigbi et al., 2022). It was discovered that across the LMCs, the preparedness against future floods depends on the gender of household heads. This can be regarded as valid when the patriarchal nature of Nigeria (Ashagidigbi et al., 2022) and some countries in the global south (for example, Bangladesh and Pakistan) is considered (Hadi, 2017; White, 2017). This further validates earlier assertions by the Connecting Business initiative (CBI) (2020) that posit that the preparedness for disasters and its impacts on gender is context-specific and has a connection to the overall gender inequality situation of a society. Regarding taking anticipatory actions, women's capacity in the Global South is often disproportionately affected – and in some cases, up to nine times more than men (CBI, 2020). In areas of the Global South, cultural roles may be a key factor for this gender pattern. Dube and Mhembwe (2019) show that women's heightened vulnerability and less preparedness for floods in Zimbabwe is more attributed to their household caring responsibilities.

Comparing the flood preparedness index across the LMCs in this study with the categorization of flood preparedness by Mavhura et al (Mavhura et al., 2020), it can be deduced that the LMCs in Kogi State are poorly prepared for flood events in terms of non-structural anticipatory actions. However, regarding structural preparedness activities, the LMCs are well prepared (except the LMCs in Lokoja). This has major implications for local-level flood resilience and preparedness that could be upscaled nationally. Given that LMCs are largely disadvantaged by their underserved nature and heightened vulnerability (Lundgren & Strandh, 2022), local-level organizing can be harnessed to build flood resilience using structural resources as evidence in the study area. This finding corroborated recent studies that stress the importance of utilizing community resources and organizing for local-level disaster risk reduction (Amaratunga et al., 2018) and community-based flood resilience (Lwin et al., 2020).

Related studies in the study area revealed unique patterns. While Aladejana and Ebijuoworih (2024) categorized three of the four LGAs of study (Lokoja, Bassa and Kogi) into areas of extremely high flood hazard, this study (Table 4) revealed that these areas are relatively well-prepared for flood hazards (except for accessing early warnings and insurance subscription). Though the reasons for this relatively

high level of preparedness in a flood-affected zone are not revealed in this study, related analysis from other studies assert that flood preparedness is positively correlated with flood experience, individual self-efficacy (Gammoh et al., 2023), and protective behavior (Köhler & Han, 2024).

Further, reflecting on global anticipatory action frameworks for disaster such as the four priorities of the Sendai Framework for Disaster Risk Reduction (SFDRR) (UNDRR, 2015), it can be argued that the study area is far from contributing to the outcomes of the four priorities of the SFDRR – understanding disaster risk (sensitization), strengthening disaster risk governance, investing in disaster risk (insurance) and enhancing disaster preparedness (access to early warning, risk information etc). Another notable pattern from Table 4 is that LMCs in this study have poor access to flood early warning messages and flood information. According to GDPC (2023), such a pattern undermines disaster preparedness. This is because early warning systems help plan preparedness activities – by providing information about potential hazards, decision-makers can be better informed in developing response plans, allocating resources, and taking appropriate measures to reduce the impact of a disaster GDPC (2023). Given the last-mile nature of the study area, community-based flood warnings should be developed. For specifics, community-based flood warnings should employ local epistemologies, and low-cost technologies for monitoring floods, communicate in local languages and local settings and suggest strategies to respond to floods using local resources and capabilities (Pham et al., 2024). This includes exploring community meetings, worship centers, and local extension workers among others (Pham et al., 2024).

The SFDRR criticizes data limitations on societal response to targeted climate change vulnerability and disaster risk management issues (UNDRR, 2015). It thus becomes crucial to support decision-making systems and inform specific interventions across various local disaster governance systems from local to national as opposed to a broad framework or flood early warning systems. For example, the annual AFO released by NIHSA focuses on the LGAs and is not disaggregated to the community level (Nigeria Hydrological Services Agency NIHSA, 2022). This scenario presents data limitations to support flood preparedness decision-making and early warning systems in Nigeria's LMCs and communities in general. Thus, local flood governance needs to be strengthened.

It is important to note that this study had a few methodological limitations. First, in this study, only household heads were surveyed. This is a limitation because flood preparedness may vary for household heads and members. As a result, future studies should consider comparing the preparedness of households' heads and members. Second, although answers to standardized survey questions are a valid way of creating an index, this study did not consider the relative importance of the 14 indicators in determining flood preparedness. Third, this study did not consider the factors influencing the ability to take anticipatory actions in LMCs. Hence, as an outlook, it is suggested that future studies incorporate the factors influencing the ability to take anticipatory actions and the relative importance of indicators in the computation of the flood preparedness index. Also, there is a need for future studies to compare the flood preparedness outcomes of female and male-headed households to reveal specific perspectives and reasons for gendered patterns of flood preparedness.

5. Conclusion

Floods affect LMCs in Kogi State, Nigeria, with varying magnitudes and frequency yearly, even in the face of early warning messages. Therefore, this study assessed the preparedness of such communities in Kogi State, Nigeria and how their socioeconomic characteristics influence their flood preparedness. Although levels of preparedness vary from one community to another, this study concluded that all the LMCs in Kogi State are unprepared for flood disasters in varying respects. Key areas that need capacity building to improve communities' flood preparedness include flood sensitization, accessibility to flood information, flood insurance subscription, clearing drainage systems, and contact with flood emergency agencies.

The study, therefore, suggests six policy recommendations to improve flood preparedness among LMCs in Kogi State. First, LMCs need to enhance their capacities for anticipatory actions to improve contingency planning and floodproofing. Second, access to local hydrological and weather forecasts (such as the AFO) will enable LMC to monitor flood water levels and develop accurate and context-specific early warning messages. This will mean that LMCs translate AFO into local languages and use local media. Third, the LMCs need to embrace and strengthen non-structural flood preparedness measures because they are relatively cheap. Where funding is available, low-cost appropriate structural designs for flood risk reduction may be considered. Fourth, the LMCs in Kogi State should subscribe to suitable flood insurance. Due to the predisposition and disadvantaged nature of the communities to flood, the government should subsidize flood insurance. Fifth, deliberate initiatives and policies aimed at promoting gender-inclusive capacity building should be initiated by the government. This will help address gender inequalities and improve the capacities of women to take anticipatory flood actions. Lastly, community-based flood early warning systems integrating local epistemologies, low-cost technologies and local communication channels should be developed to strengthen local disaster governance. The careful and context-specific application and modifications of these recommendations will help increase preparedness for floods and build capacities for anticipatory actions in the LMCs of Kogi State and similar communities of the Global South.

Note

1. (Purposive sampling means the choice of information-rich cases for an in-depth study (Mcmillan & Schumacher, 1997) selected based on the researcher's judgment about which units will be most beneficial for the research or most representative of the population study).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Authors' contributions

TO and CI were involved in the conceptualization, writing, data analysis and review of this paper.

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