ISSN 2504-9593
DOI: 10.5281/zenodo.19183334
https://ijree.com/index.php/publications/article/view/48

Int. J. Renew. Energ & Environ Vol.4 (1), pp 345-365(2026)

EVALUATION OF COMMUNITY-BASED COPING AND ADAPTIVE STRATEGIES TO FLOODING IN FLOOD-PRONE AREAS IN ILORIN, NIGERIA

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ABSTRACT

Flooding remains one of the most persistent environmental challenges affecting urban centres in Nigeria, especially rapidly growing cities with inadequate infrastructure and weak land-use control. This study evaluated community-based coping mechanisms and adaptive strategies to flooding in flood-prone areas of Ilorin, Nigeria. It examined residents' experiences of flooding, identified the major causes and impacts of flood events, and assessed the effectiveness of coping strategies adopted by local communities. Data were obtained from primary and secondary sources. Primary data were collected through structured questionnaires, oral interviews, and field observations, while secondary data came from relevant official publications. A simple random sampling technique was used to select 250 respondents from three flood-prone communities in Ilorin metropolis: Abdulwahab Folawiyo Road, Amilegbe/Ojagboro, and Abattoir along Sobi Barracks. Socio-economic characteristics were analyzed using frequencies and percentages, while an index termed Severity of flood Index (SFI) and Effectiveness of Coping Mechanisms Index (ECI) were developed. Findings showed that 65.8% of respondents had experienced flooding in the past year. Major causes identified were heavy rainfall (55.4%), indiscriminate waste disposal (35.8%), blocked drainage systems (26.5%), and development on floodplains (17.3%). The most severe impacts were on agricultural production (SFI=4.77), health (SFI =3.96), transportation (SFI=3.93), roads (SFI=3.68), and household property (SFI=3.62). Common coping measures included sandbags (35.4%), drainage clearing (20.0%), temporary protective structures (15.8%), and channelization of watercourses (9.6%). Protective structures had the highest effectiveness index (ECI=2.11), followed by drainage sediment removal (ECI = 2.04) and sand-filled sacks (ECI=1.89). The study concludes that community-based strategies significantly reduce flood impacts and recommends stronger institutional support, improved drainage infrastructure, effective land-use control, and integration of local adaptation practices into formal flood management policies.

Keywords: Urban flooding; Community-based coping strategies; Climate adaptation; Urban resilience; Drainage infrastructure; Land-use planning

1. Introduction

Urban flooding has become an increasingly critical global challenge, largely driven by rapid urbanization, the intensifying impacts of climate change, and the persistent inadequacy of urban infrastructure. Cities worldwide are experiencing the consequences of increasing rainfall intensity and frequency, resulting in severe socio-

economic and environmental disruptions (World Bank, 2020). The Intergovernmental Panel on Climate Change reports that urban areas, particularly in developing countries, are highly vulnerable to flooding due to dense population

concentrations, inadequate drainage infrastructure, and limited adaptive capacity (IPCC, 2021). In response to these challenges, several innovative urban planning strategies have been introduced to enhance flood resilience. One notable example is the **"**sponge city" concept**,** which promotes the integration of green infrastructure to absorb, store, and gradually release stormwater runoff (Yu, 2018). Cities in Europe such as Vienna and Amsterdam have adopted similar nature-based solutions, including green roofs, permeable pavements, rain gardens, and restored wetlands. These measures not only mitigate flood risk but also contribute to biodiversity conservation and urban temperature regulation (Kabisch *et al*., 2017; Li *et al*., 2020).

Despite these global innovations and increasing adoption of nature-based solutions (NbS) for flood risk management in Sub-Saharan Africa (World Bank, 2025), many cities in sub-Saharan Africa continue to experience persistent flooding, largely due to limited financial capacity, rapid population growth, weak urban governance, and inadequate infrastructure (Adelekan, 2016; Douglas, 2017; World Bank, 2025). In Nigeria, flooding has resulted in extensive displacement, loss of lives, destruction of infrastructure, and disruption of livelihoods, particularly in densely populated cities such as Lagos, Ibadan, Port Harcourt, and Ilorin (Adelekan, 2016; Douglas, 2017; Abdul-Azeez, Hisham, Olowoporoku, Akinbami, and Isola-Muyideen, 2025). Recent events in northern Nigeria further highlight the severity of the problem. For instance, the 2024 Borno flood triggered by the collapse of the Alau Dam displaced over 400,000 people and affected more than one million residents (NEMA, 2024; UN OCHA, 2024). Similarly, the 2025 flood in Mokwa, Niger State, resulted in over 500 deaths and widespread destruction of homes and infrastructure (NEMA, 2025). According to the National Emergency Management Agency, more than two million Nigerians were affected by flood disasters in 2022 alone, with significant damage recorded in both urban and rural communities (NEMA, 2022). Similarly, the Nigerian Hydrological Services Agency warned that increasing rainfall variability combined with weak land-use planning practices is likely to intensify flood vulnerability across the country (NIHSA, 2021). Scholars have also linked persistent flooding in Nigeria to structural governance challenges. Nkwunonwo *et al,*. (2020) argue that ineffective spatial planning frameworks, institutional weaknesses, and corruption have significantly undermined flood management efforts. Furthermore, high poverty levels and limited public awareness reduce the ability of vulnerable populations to adopt preventive measures, thereby increasing their exposure to flood hazards (Olajuyigbe *et al*., 2021; Abdulazeez, Akinbami, Abdul-Azeez, Omrin, 2025). These challenges highlight the need for locally appropriate and community-driven flood adaptation strategies, particularly in contexts where government interventions remain insufficient.

In Ilorin, flooding incidents is a known phenomenon in the food prone areas over the past decade. This trend has been attributed to uncontrolled urban expansion, poor land-use management, blocked drainage systems, and inefficient waste disposal practices (Shiru *et al*., 2018; Adeleke *et al*., 2021). The city's geographical setting also contributes to its vulnerability. Ilorin lies along the Asa River floodplain, which increases the likelihood of seasonal flooding during periods of heavy rainfall (Adetunji *et al*., 2020). In addition, climate variability has resulted in more intense rainfall events that frequently overwhelm the existing stormwater drainage infrastructure

(Ayanlade and Babatimehin, 2018). Recent empirical studies have documented a growing frequency of flood events in Ilorin. For instance, Alimi *et al*. (2023) and Aderoju and Jimoh (2022) reported an increase in flash floods affecting residential neighborhoods that were previously considered relatively safe. The expansion of informal settlements and the encroachment on natural floodplains have further intensified flood risk in many parts of the city (Olayiwola *et al*., 2019; Olanrewaju and Akinbobola, 2022).

In response to recurring flood disasters and limited institutional support, residents of Ilorin have developed various community-based coping mechanisms. These strategies include elevating building foundations, placing sandbags around buildings to prevent water intrusion, and regularly clearing drainage channels during the rainy season (Olorunfemi and Raheem, 2013; Uchegbu *et al*., 2022). Similar adaptive practices have also been reported in other Nigerian cities such as Ibadan and Makurdi, where communities rely on informal early warning systems based on local environmental observations and communal knowledge networks (Adelekan *et al*., 2020). At the household level, residents adopt several physical adaptation measures such as raising doorsteps, installing water-resistant building materials, and planting trees to reduce surface runoff (Ogunbode *et al*., 2019; Olajuyigbe *et al*., 2021). Community development associations also play an important role in mobilizing local resources for clearing blocked drainage systems, distributing relief materials, and advocating for government intervention (Akinyemi and Omole, 2021). Although many of these initiatives are informal and self-organized, they represent important forms of community resilience and local adaptive capacity in resource-constrained environments (Abdulkareem *et al*., 2023).

Numerous studies have examined urban flooding in major Nigerian cities such as Lagos, Ibadan, and Port Harcourt (Adelekan, 2016; Ogunbode *et al*., 2019; Nkwunonwo *et al*., 2020; Ayoola, 2021; Aluko and Olufunmi, 2022; Abdulkareem *et al*., 2023), relatively limited scholarly attention has been given to medium-sized cities such as Ilorin. Existing studies have primarily focused on institutional failures and infrastructural deficiencies while often overlooking the contributions of grassroots coping strategies. Nevertheless, communities living in flood-prone areas of Ilorin, particularly those located along the Asa River corridor continue to face recurring flood hazards and have developed locally driven adaptive responses. This study therefore seeks to examine the community-based coping mechanisms and adaptive strategies adopted by residents in flood-prone areas of Ilorin. Given the city's rapid urban expansion, hydrological vulnerability, and increasing flood occurrences, Ilorin provides a valuable case for understanding grassroots responses to urban flooding. This study contributes to the broader discourse on urban climate resilience and community-based flood management by documenting and evaluating these locally driven adaptation strategies, while offering policy insights that emphasize the importance of local participation in flood risk governance in Nigeria and similar developing urban contexts.

2. Conceptual Review

Concept of Flooding

Flooding is widely recognized as one of the most frequent and destructive environmental hazards affecting human settlements across the world. It refers to the temporary inundation of land areas that are normally dry as a result of excessive rainfall, river overflow, storm surges, or failure of drainage systems (IPCC, 2021; Douglas, 2017). Flood events typically occur

when the volume of water exceeds the carrying capacity of natural channels or artificial drainage infrastructure designed to convey stormwater runoff (Nkwunonwo *et al*., 2020; World Bank, 2020). In urban environments, flooding is often intensified by rapid population growth, unplanned land development, and the widespread replacement of natural surfaces with impervious materials such as asphalt and concrete, which significantly reduce water infiltration and increase surface runoff (Douglas, 2017; Adelekan, 2016).

flooding has become a recurring environmental challenge affecting both urban and rural communities in Nigeria. Major flood disasters recorded in recent decades have resulted in the destruction of infrastructure, disruption of economic activities, and displacement of large populations (Nkwunonwo *et al*., 2020; Abdulkareem *et al*., 2023). Cities such as Lagos, Ibadan, Port Harcourt, and Ilorin have experienced repeated flooding episodes largely due to inadequate drainage systems, uncontrolled urban expansion, and poor environmental management practices (Adelekan, 2016; Douglas, 2017). Climate variability and increasing rainfall intensity have further aggravated the flood situation in many Nigerian cities, making flooding one of the most pressing environmental management challenges confronting urban planners and policymakers (IPCC, 2021; Olajuyigbe *et al*., 2021). These conditions underscore the urgent need for effective flood management strategies capable of reducing vulnerability and improving resilience in flood-prone urban areas.

Flood Control and Adaptation Strategies

Flood control refers to a range of measures implemented to reduce the occurrence, intensity, and impacts of flooding. These measures are generally categorized into structural and non-structural approaches (World Bank, 2020; Nkwunonwo *et al*., 2020). Structural flood control measures involve engineering interventions designed to regulate water flow and prevent floodwaters from inundating vulnerable areas. Typical examples include the construction of dams, levees, drainage channels, retention basins, floodwalls, and improved stormwater management systems (Douglas, 2017; World Bank, 2020). Such infrastructure plays a critical role in controlling runoff and minimizing the physical impacts of flooding in urban environments.

Non-structural flood control strategies focus primarily on policy, planning, and environmental management approaches aimed at reducing exposure to flood hazards. These approaches include land-use zoning, floodplain regulation, environmental protection measures, early warning systems, and public awareness programmes (Nkwunonwo *et al*., 2020; Adelekan, 2016). Increasingly, scholars and disaster management practitioners advocate the integration of both structural and non-structural approaches in order to create more sustainable and resilient flood management systems capable of addressing both immediate and long-term flood risks (Douglas, 2017; Abdulkareem *et al*., 2023).

Closely related to flood control are adaptation strategies, which refer to deliberate adjustments undertaken by individuals, households, communities, or institutions in response to environmental hazards in order to reduce vulnerability and enhance resilience (IPCC, 2021; Olajuyigbe *et al*., 2021). In the context of flooding, adaptation strategies may include elevating building foundations, improving drainage maintenance, constructing protective barriers, using water-resistant building materials, and adopting land-use practices that minimize exposure to flood risks (Douglas, 2017; Abdulkareem *et al*., 2023). Such strategies are

particularly important in developing countries where government capacity to implement large-scale flood control infrastructure may be limited. In many cases, households and communities adopt these adaptation strategies as practical responses to repeated exposure to flood disasters. Research has shown that locally developed adaptation practices can significantly reduce the severity of flood impacts when they are effectively combined with formal flood management policies and institutional interventions (Olajuyigbe *et al*., 2021; Abdulkareem *et al*., 2023).

Community-Based Coping Mechanisms and Locally Driven Adaptation Strategies

Community-based coping mechanisms refer to collective actions undertaken by local residents to manage environmental risks and respond to disaster events. These mechanisms are often rooted in indigenous knowledge systems, strong social networks, and shared community resources developed through long-term interaction with the local environment (Douglas, 2017; Adelekan, 2016). In flood-prone environments, communities frequently develop coping strategies based on their past experiences with flood disasters and their understanding of local environmental conditions (Abdulkareem *et al*., 2023; Nkwunonwo *et al*., 2020). In many developing cities, community-based coping mechanisms play a crucial role in disaster risk reduction because formal institutional support systems are often inadequate. Residents frequently organize communal activities such as clearing drainage channels, constructing temporary flood barriers, dredging streams, and relocating vulnerable households during periods of intense rainfall (Abdulkareem *et al*., 2023; Douglas, 2017). Informal early warning systems based on local environmental observations, traditional rainfall indicators, and community information networks are also commonly used to anticipate flood events and mobilize precautionary measures.

Studies conducted across Nigerian cities have documented the importance of these locally driven adaptation strategies in reducing flood vulnerability. For instance, households in flood-prone communities often raise building foundations, install protective barriers around residential compounds, and reinforce drainage pathways to prevent floodwater intrusion into buildings (Ogunbode *et al*., 2019; Olajuyigbe *et al*., 2021). Community associations, religious organizations, and youth groups also play significant roles in coordinating emergency responses, mobilizing labour for environmental sanitation, and providing support to vulnerable households during flood disasters (Adelekan, 2016; Abdulkareem *et al*., 2023). Beyond their immediate practical benefits, community-based coping mechanisms contribute significantly to strengthening social resilience within vulnerable communities. Strong social networks facilitate the sharing of information, pooling of resources, and provision of mutual support during disaster events (Adelekan, 2016; Douglas, 2017). Consequently, many scholars argue that integrating community knowledge and locally driven coping strategies into formal flood management frameworks can significantly enhance disaster preparedness and long-term urban resilience (Abdulkareem *et al*., 2023; Nkwunonwo *et al*., 2020).

3. Material and Method

Study Area

Ilorin, the capital city of Kwara State in north-central Nigeria, serves as the study area for this research. Situated approximately between latitude 8°30′N and 8°50′N and longitude 4°20′E and 4°35′E, the city lies within the transitional zone between the forest and savannah belts. This geographical location places Ilorin in a unique ecological and climatic

setting, characterized by a tropical wet and dry climate (Aw) according to the Köppen classification. The city experiences a distinct rainy season from April to October and a dry season from November to March, with an annual rainfall range of 1,000–1,300 mm and peak precipitation typically occurring between July and September. Topographically, Ilorin is traversed by several rivers and streams, most notably the Asa River, which flows from the north-east to the south-west of the metropolis (Figure 1). These water bodies serve as natural drainage channels but have also become major conduits of urban flooding due to encroachments and siltation. The terrain is generally undulating, with floodplains that are increasingly being converted into residential and commercial uses, thereby heightening flood risks. Ilorin is one of Nigeria's fastest-growing medium-sized cities, with a population exceeding one million as per the 2006 census, and current estimates suggest a figure well above 1.5 million due to rapid urbanization (National Population Commission (NPC), 2006; National Bureau of Statistics (NBS), 2021).

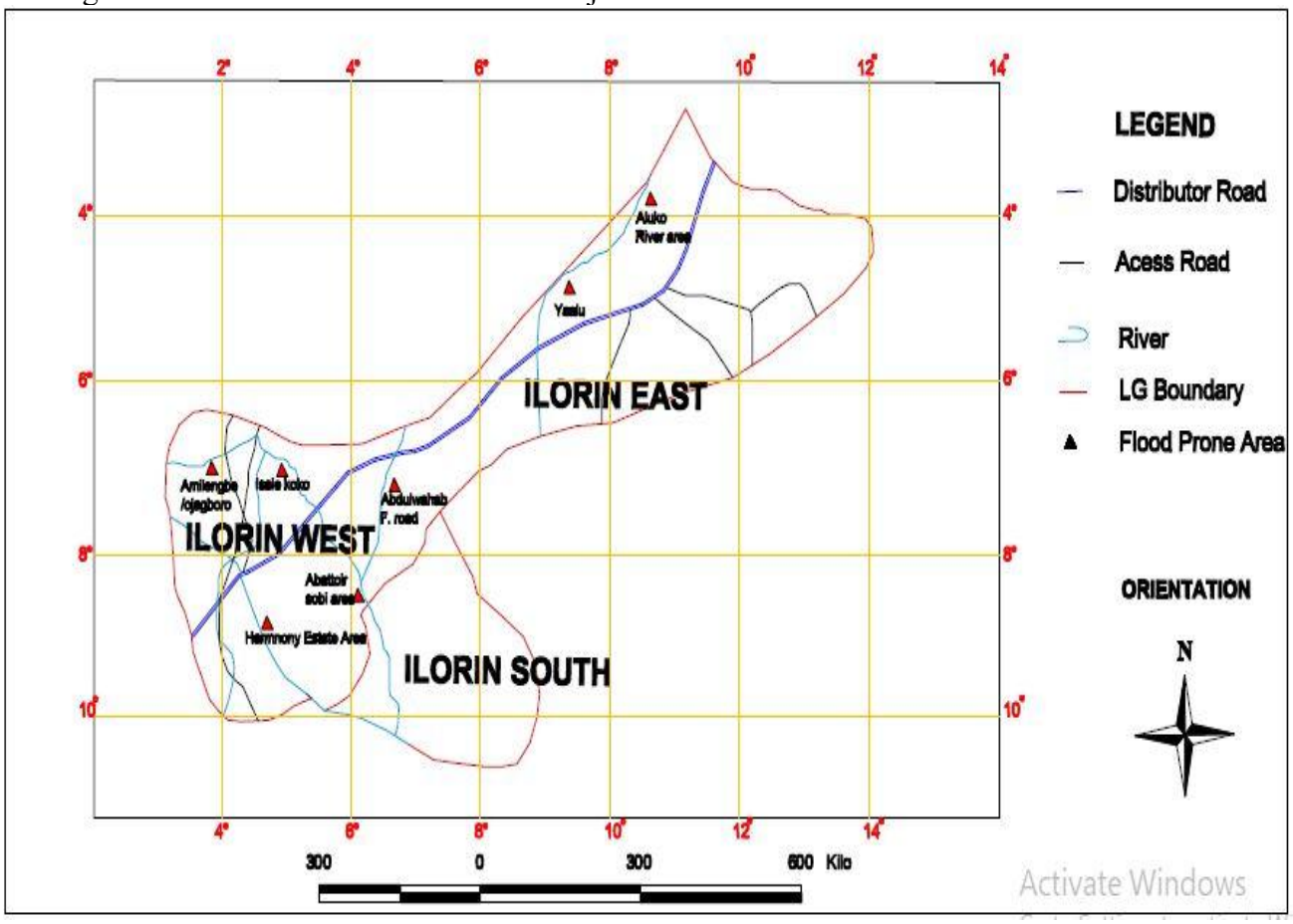

Figure 1: Food Prone Areas in Ilorin

Research Methodology

Data Types and Sources

The study utilized both primary and secondary data sources. Primary data were obtained directly from the field through structured questionnaires, oral interviews, and personal observations. The questionnaire was designed to collect detailed information on residents' experiences of flooding, perceived causes, impacts, coping mechanisms adopted, and the effectiveness of these strategies. Oral interviews were conducted with selected residents and

relevant government officials, particularly individuals who had resided in the affected communities for over ten years, to provide deeper contextual insights. Secondary data were sourced from official publications and institutional records, including the National Population Commission and the Kwara State Geographic Information System (KWAGIS), which provided population statistics and spatial data for mapping and analysis.

Study Population and Sampling Design

The study population comprised residents of flood-prone communities within Ilorin metropolis. A simple random sampling technique was adopted to ensure fair representation of respondents. A 500-metre buffer zone was delineated around identified flood-inundated areas: Abdulwahab Folawiyo Road, Isale Koko, Aluko River, Amilegbe/Ojagboro, Harmony Estate, and Abattoir near Sobi Barracks. From these, three communities, namely Abdulwahab Folawiyo Road, Amilegbe/Ojagboro, and Abattoir, were randomly selected for detailed investigation. The sample size was determined by selecting eight percent (8%) of the buildings within the selected areas. One household was selected per building, targeting the household head or, in their absence, an adult member aged 18 years and above (Table 1).

Data Collection Methods

A systematic sampling technique was adopted to ensure a fair and evenly distributed selection of respondents within the study area. In this approach, buildings within the identified flood-prone areas were first listed or mapped, after which every 13th building was selected for questionnaire administration. The first building was chosen randomly to avoid selection bias, and subsequent selections followed the fixed sampling interval of thirteen. This method ensured adequate spatial coverage and minimized clustering of responses.

Methods of Data Analysis

Descriptive statistical tools, including frequencies, tables, and charts, were employed to analyse the data. These tools were used to summarise the socio-economic characteristics of respondents, their experiences of flooding, and the major causes and impacts of flood events. In addition, two indices were developed to enhance analysis: the Severity of Flood Index (SFI), used to assess the intensity of flood impacts, and the Effectiveness of Coping Mechanisms Index (ECI), used to evaluate the relative effectiveness of the coping strategies adopted by residents.

Table 1: Questionnaire Schedule.

S/N	Localities	Number of buildings	Sample size selected (8%)
1.	Abdulwahab Folawiyo Road	1240	99
2.	Amilegbe/Ojagboro	997	80
3.	Abattoir along Sobi barrack	1023	81
	Total	**3260**	**260**

4. Results and Discusion

Socio-economic Characteristics of Respondents in the Study Area

This section examines the socio-economic characteristics of respondents in the study area. The variables considered include age, gender, marital status, occupation, educational attainment, income level, religion, and occupancy status of the respondents.

Out of the 260 respondents captured in the survey, 48.1% were male while 51.9% were female (Table 2). Although the sampling design primarily targeted household heads who are traditionally assumed to be male in many

Nigerian households. The findings indicate a slightly higher proportion of female respondents. This suggests that a notable number of households in the study area are female-headed or that women were more available during the data collection process. Similar observations have been reported in flood-risk studies conducted in Nigerian urban communities, where female participation in household surveys tends to be relatively high because women are often present at home during survey periods (Adelekan, 2016; Olajuyigbe *et al*., 2021). The age distribution of respondents shows that a considerable proportion (44.6%) of the sampled population falls within the 18–35 years age group. Respondents aged between 36–45 years accounted for 35.0%, while 13.5% were between 46–55 years and only 6.9% were above 56 years. This indicates that the majority of respondents belong to economically active age groups who are likely to possess adequate knowledge and awareness of environmental challenges such as flooding. Similar demographic patterns have been reported in studies on urban flood vulnerability in Nigerian cities where the majority of respondents were within the active working population capable of making informed decisions regarding environmental risks (Nkwunonwo *et al*., 2020; Abdulkareem *et al*., 2023).

The marital status distribution shows that 40.4% of the respondents were married, while 40.0% were single. Separated respondents accounted for 11.9%, and widowed respondents constituted a smaller proportion. The high proportion of married and single individuals implies that flood disasters could have significant socio-economic consequences for households within the study area. Previous studies have indicated that household structure and family size often influence the vulnerability of residents to flood hazards, as families with dependents may face greater economic and social impacts during flood events (Douglas, 2017; Olajuyigbe *et al*., 2021). With regard to occupational status, 23.1% of the respondents were civil servants, while the largest proportion (37.7%) were engaged in trading or small-scale businesses. Artisans accounted for 6.9%, and 9.2% were self-employed. Farmers, students, and unemployed individuals constituted 11.2%, 10.0%, and 1.9% of the respondents respectively. This occupational structure indicates that a significant proportion of respondents depend on informal or small-scale economic activities for their livelihood. Consequently, flooding can have severe implications for their economic stability, particularly where business premises or goods are damaged by floodwaters. Similar findings have been reported by Ogunbode *et al*. (2019) and Abdulkareem *et al*. (2023), who noted that residents engaged in informal economic activities are particularly vulnerable to flood disasters due to limited financial capacity and lack of insurance protection. The educational profile of respondents indicates that literacy levels in the study area are relatively high. The survey revealed that 8.5% of respondents had no formal education, while 8.8% possessed primary education. A larger proportion (40.0%) had completed secondary education, 9.2% held NCE/OND qualifications, 25.8% possessed BSc/HND qualifications, and 7.7% had postgraduate qualifications. The relatively high level of education among respondents suggests that many residents are likely to have some level of awareness regarding environmental risks and the consequences of improper waste disposal and construction activities in flood-prone areas. However, despite this awareness, many residents continue to live in flood-prone environments, often due to economic constraints and limited access to safer housing options.

Similar observations have been reported in previous studies, which indicate that awareness alone does not necessarily translate into risk-avoidance behaviour where socio-economic conditions restrict residential mobility (Adelekan, 2016; Nkwunonwo *et al*., 2020). Religious affiliation among respondents shows that Islam is the dominant religion in the study area, with 68.8% of respondents identifying as Muslims. Christianity accounted for 30.0% of respondents, while 1.2% practiced other religions such as traditional beliefs. The findings suggest that religious affiliation does not significantly influence residential location decisions in flood-prone communities. Previous research has similarly indicated that settlement patterns in urban areas are largely determined by economic opportunities and housing affordability rather than religious considerations (Douglas, 2017).

The monthly income distribution of respondents reveals that 22.7% earned between ₦18,000 and ₦30,000, while the largest proportion (43.5%) earned between ₦31,000 and ₦50,000. Respondents earning between ₦51,000 and ₦75,000 accounted for 14.2%, while 17.7% earned between ₦76,000 and ₦100,000. Only a small proportion (5%) earned above ₦100,000 per month. These findings suggest that a significant proportion of households in the study area fall within the low-income category, which may limit their ability to implement effective flood mitigation measures or relocate from flood-prone areas. Similar income patterns have been documented in flood vulnerability studies across Nigerian cities, where low-income households were found to be disproportionately exposed to flood hazards due to limited adaptive capacity (Olajuyigbe *et al*., 2021; Abdulkareem *et al*., 2023).

Table 2: Socio-economic Characteristics of Respondents in the Study Area

S/N	Variable	Frequency	Percent
1	**Sex**		
	Male	125	48.1
	Female	135	51.9
	Total	**260**	**100.0**
2	**Age**		
	18-35 years	116	44.6
	36-45 years	91	35.0
	46-55 years	35	13.5
	above 56 years	18	6.9
	Total	**260**	**100.0**
3	**Marital Status**		
	Single	104	40.0
	Married	105	40.4
	Widowed/Widower	20	7.7
	Separated	24	11.9
	Total	**260**	**100.0**
4	**Occupational Status**		
	Civil servant	60	23.1
	Trading/business	98	37.7
	Artisan	18	6.9
	Self-employed	24	9.2
	Faming	29	11.2
	Student	26	10.0

	Unemployed	5	1.9
	Total	**260**	**100.0**
5	**Educational Qualification**		
	no formal education	22	8.5
	primary education	23	8.8
	secondary education	104	40.0
	NCE/OND	24	9.2
	BSC/HND	67	25.8
	post graduate degree	20	7.7
	Total	**260**	**100.0**
6	**Religion afflation**		
	Christianity	78	30.0
	Islam	179	68.8
	Others	3	1.2
	Total	**260**	**100.0**
7	**Monthly Income**		
	18,000 - 30,000	59	22.7
	31,000 - 50,000	113	43.5
	51,000 - 75,000	37	14.2
	76,000 - 100,000	46	17.7
	Above - 100,000	5	1.9
	Total	260	100.0

Experience of Flood in the Last One year

The survey results reveal that a considerable proportion of the respondents (65.8%) reported experiencing flooding in the study area within the past one year, while 34.2% indicated that they had not encountered any flooding during the same period (Figure 1). This finding suggests that flooding is a relatively common occurrence in the area, affecting a majority of residents within a short time frame. The high percentage of respondents who have recently experienced flooding indicates that the communities in the study area remain highly vulnerable to recurrent flood events and may continue to face similar risks in the future if appropriate mitigation measures are not implemented. This result is consistent with the findings of Aderoju and Jimoh (2022), who observed that residents in several flood-prone neighbourhoods of Ilorin frequently experience seasonal flooding due to inadequate drainage systems and rapid urban development. Similarly, Ogunbode *et al*. (2019) reported that a large proportion of residents in flood-prone communities across Nigerian cities have experienced flooding within recent years, highlighting the persistent nature of flood hazards in rapidly growing urban centres. These similarities suggest that recurrent flooding has become a common environmental challenge in many Nigerian cities, particularly in areas where urban infrastructure and environmental management practices are inadequate.

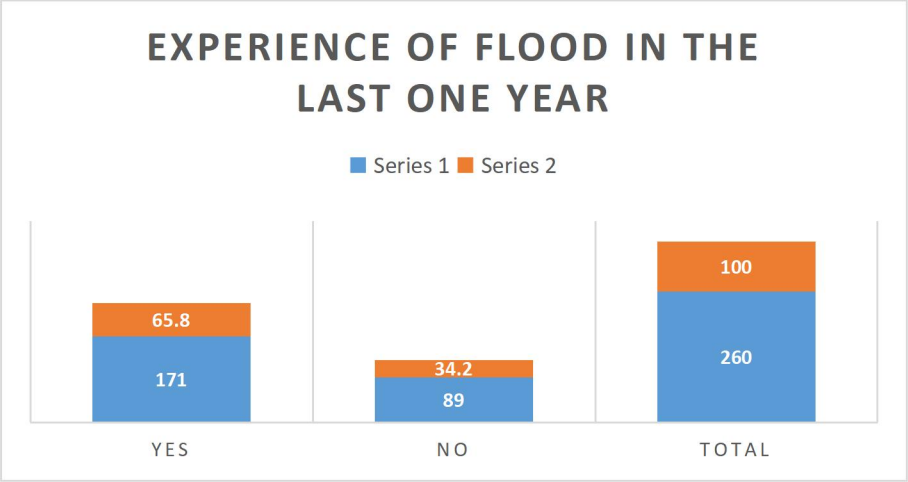

Figure 1: Experience of Flood in the Last One year

Period Flood occur in the Area

Analysis of the period when flooding occurs in the study area shows that the majority of respondents (52.7%) indicated that flooding happens mainly during periods of heavy rainfall. In addition, 35.4% of the respondents reported that flooding typically occurs during the rainy season, while a smaller proportion (11.9%) stated that flooding can occur at any time of the year (Table 3). These responses indicate that flooding in the study area is largely associated with intense rainfall events, suggesting that heavy downpours play a significant role in triggering flood occurrences (Figure 2). This pattern is expected because intense rainfall often leads to a rapid increase in water levels within rivers and drainage channels, which may exceed their carrying capacity and result in overflow. The finding is consistent with a study carried out by Adelekan (2016). He reported that flooding in many urban areas of Nigeria is strongly linked to intense rainfall events that overwhelm poorly maintained drainage systems. Similarly, Nkwunonwo *et al*. (2020) observed that heavy rainfall remains one of the primary drivers of urban flooding in Nigerian cities due to inadequate drainage infrastructure and uncontrolled urban development. In the context of Ilorin, Shiru *et al*. (2018) also noted that flood incidents in several neighbourhoods tend to occur during periods of intense rainfall when stormwater runoff exceeds the capacity of existing drainage networks. These similarities suggest that the flooding pattern observed in the study area reflects a broader trend in many Nigerian urban environments where heavy rainfall combined with limited drainage capacity contributes significantly to flood occurrences.

Table 3: Period Flood occur in the Area

Description (in Years)	Frequency	Percent
Anytime during rainy season	92	35.4
Only during heavy rain	137	52.7
Anytime of the year	31	11.9
Total	**260**	**100.0**

Figure 2: Water flowing beyond river bank during heavy rainfall

Frequency of Flood experience

The occurrence of flooding in the area raises serious concerns regarding the safety of lives, property, and infrastructure, particularly during the peak rainy season when rainfall intensity is usually highest. For instance, the results indicate that 42.3% of the respondents reported experiencing flooding once annually, 31.5% stated that flooding occurs more than once within a year, while 26.2% indicated that such incidents occur only rarely (Table 4). These findings suggest that a substantial proportion of residents in the study area encounter flood events at least once each year. Similar patterns of recurring urban flooding have been documented in other Nigerian cities. For instance, Adelekan (2016) observed that many urban communities in Lagos experience frequent annual flooding due to inadequate drainage infrastructure and rapid urban expansion. Likewise, Ogunbode *et al*. (2019) reported that households in flood-prone areas of Ibadan are often exposed to seasonal flood events that occur repeatedly during periods of heavy rainfall. These findings therefore corroborate the present study, indicating that recurrent flooding remains a persistent challenge in many Nigerian urban environments and poses significant risks to the well-being and security of residents.

Table 4: Frequency of Flood experience

Description (in Years)	Frequency	Percent
Once in a year	110	42.3
More than once in a year	82	31.5
Not often	68	26.2
Total	**260**	**100.0**

Causes of Flooding

Flooding can result from both natural processes and human activities. Natural factors often include intense or prolonged rainfall and the overflow of rivers or streams, which may lead to inundation and flash floods in vulnerable areas. At the same time, human-induced factors such as the construction of buildings along natural waterways, indiscriminate disposal of solid

waste into drainage channels, poor building practices, and weak compliance with urban planning regulations also contribute significantly to flood occurrence. These combined factors have led to considerable loss of lives and destruction of property in Nigeria in recent years (Onwudinjo, 2012). Findings from the present study indicate that a majority of respondents (55.1%) perceived natural factors, particularly heavy rainfall, as the main cause of flooding in Ilorin metropolis, while 16.9% attributed flooding primarily to human activities, and 27.7% believed that both natural and human factors jointly contribute to flood events. This pattern is consistent with the observations of Adelekan (2016) and Nkwunonwo *et al*. (2020), who reported that urban flooding in many Nigerian cities results from the interaction of climatic factors and anthropogenic pressures such as poor drainage maintenance and unregulated urban development. Similarly, Douglas *et al*. (2021) emphasized that flooding in rapidly urbanizing cities is rarely caused by a single factor but rather by the combined effects of extreme rainfall, land-use changes, and inadequate urban infrastructure.

Table 5: Causes of Flooding

Description (in Years)	Frequency	Percent
Natural (heavy rainfall)	144	55.4
Man induced(dumping of waste in water channel, encroachment of building on flood plain)	44	16.9
Both	72	27.7
Total	**260**	**100.0**

Role of Human Activities in Causing Flooding in The Study Area

The findings on the role of human activities in causing flooding in the study area indicate that several anthropogenic factors contribute significantly to the occurrence of flood events. As presented in Table 6, 26.5% of the respondents identified non-functional drainage systems as the primary cause of flooding**,** while 35.8% attributed the problem to the indiscriminate dumping of refuse into drainage channels**.** 17.3% of the respondents linked flooding to the construction of buildings on floodplains**,** 9.6% associated it with the accumulation of sand and debris that block drainage systems**,** and 10.8% believed flooding results from the overflow of water bodies during heavy rainfall. These findings suggest that poor environmental management practices and inadequate urban planning significantly contribute to flood occurrence in the area. The results are consistent with previous studies in Nigeria which have identified blocked drainage channels, improper waste disposal, and encroachment on natural waterways as major human-induced drivers of urban flooding. For instance, Adelekan (2016) and Nkwunonwo *et al*. (2020) reported that uncontrolled urban development and poor waste management practices significantly increase flood vulnerability in Nigerian cities. The similarity between these findings and the results of the present study underscores the widespread influence of human activities in exacerbating flood risks in rapidly growing urban environments.

Table 6: Role of Human Activities in Causing Flooding in The Study Area

Description (in Years)	Frequency	Percent
Non-functional drainage system	69	26.5
Dumping of waste in the water channels	93	35.8
Encroachment of building on the flooding plain	45	17.3
Silting up of drainage a system	25	9.6
Over flow of water bodies	28	10.8
Total	**260**	**100.0**

Severity of flood in the Study Area

The analysis of the severity indices indicates that the destruction of agricultural produce recorded the highest severity index of 4.77, suggesting that flooding has the greatest impact on farm output and related livelihoods in the study area. This was followed by health-related impacts (3.96), disruption of vehicles (3.93), damage to roads (3.68) (Figure 4), loss of household property (3.62), (Figure 3) and contamination or disruption of potable water supply (3.61). Other impacts with relatively lower severity indices included damage to other infrastructure (3.36), disruption of educational facilities (3.31), damage to sanitary facilities (3.31), disruption of investments (3.13), and loss of items with sentimental value, which respondents perceived as comparatively less severe. Overall, the findings clearly indicate that agricultural production is the sector most severely affected by flooding in the study area. This pattern is consistent with findings from other studies conducted in Nigeria and similar developing regions where floods often devastate farmlands and rural livelihoods. For instance, Adelekan (2016) reported that flooding in southwestern Nigeria significantly reduced agricultural productivity and household food security, while Nkwunonwo *et al*. (2020) observed that flood disasters in Nigerian cities and peri-urban areas frequently result in severe damage to farmland and crops. Similarly, Douglas *et al*. (2021) noted that agricultural losses are among the most immediate and economically significant consequences of flood events in many developing countries where farming remains a primary livelihood activity.

Table 7: Severity of flood in the Study Area

	5	4	3	2	1	SWV	NR	SFI	E	d	D2
Destruction of Farm output production,	1055	152	30	2	0	1239	260	4.77	3.61	1.15	1.32
Destructing residential Housings	675	172	114	48	20	1029	260	3.96	3.61	0.34	0.12
Destruction	480	412	72	54	5	1023	260	3.93	3.61	0.32	0.10
Vehicle	450	316	111	66	21	964	260	3.71	3.61	0.09	0.01
Destruction of Road	440	312	129	50	26	957	260	3.68	3.61	0.07	0.00
Appliances / property	500	208	126	82	25	941	260	3.62	3.61	0.00	0.00
Portable water	230	464	147	98	0	939	260	3.61	3.61	0.00	0.00
Other infrastructures (transformer, electricity)	500	164	57	104	48	873	260	3.36	3.61	-0.26	0.07
Sanitary facilities	175	380	171	122	12	860	260	3.31	3.61	-0.31	0.09
Investment (shops and services)	285	288	66	132	43	814	260	3.13	3.61	-0.48	0.23
Items of sentimental value	95	384	114	132	41	766	260	2.95	3.61	-0.67	0.45
Total								43.38			

Figure 3: Road damaged as a result of flooding

Figure 4: Flooded Residential Building

Community Based Coping Mechanism to Flood Incidence in the Area

The findings of the study reveal that residents in the study area adopted several community-based coping mechanisms in response to flood incidents. The most commonly adopted strategy was the use of sandbags, which was reported by 35.4% of the respondents. This was followed by ensuring that drainage channels remain functional during the rainy season**,** reported by 20.0% of the respondents. Additionally, 19.2% of the respondents indicated that they usually wait and deal with the consequences after flooding occurs, suggesting that some residents adopt a reactive rather than preventive approach

to flood management. Furthermore, 15.8% of respondents coped with flooding by temporarily relocating to another area during flood periods, while **9.6%** reported that they raised the height of their entrance walls as a protective measure against floodwater intrusion (Table 8).

The predominance of sandbag usage among residents suggests that many households rely on simple, low-cost, and locally available materials to minimize the impact of floodwaters. This finding is consistent with earlier studies which reported that residents in flood-prone Nigerian cities often depend on temporary and affordable coping strategies such as sandbags, drainage clearing, and small flood barriers to protect their homes and properties (Olorunfemi and Raheem, 2013; Ogunbode *et al*., 2019). Similarly, Adelekan (2016) observed that households in vulnerable urban communities frequently adopt improvised physical measures because formal flood protection infrastructure is often inadequate or poorly maintained. The finding that 20.0% of respondents ensured that drainage channels remain functional during the rainy season further highlights the importance of environmental maintenance as a local flood mitigation strategy. In many Nigerian cities, blocked drainage channels have been identified as one of the major causes of urban flooding. Studies conducted in Ibadan and Lagos have shown that community participation in drainage clearing significantly reduces the intensity and duration of flood events in affected neighborhoods (Adelekan *et al*., 2020; Nkwunonwo *et al*., 2020). Consequently, regular maintenance of drainage systems by residents represents an important form of community-driven environmental management.

The proportion of respondents (19.2%) who indicated that they wait and deal with the consequences of flooding is also noteworthy. This behavior suggests that some households may lack the financial resources, technical knowledge, or institutional support necessary to implement preventive measures before flooding occurs. Similar observations have been reported in studies of low-income communities where residents often rely on post-disaster coping mechanisms rather than preventive strategies due to limited adaptive capacity (Olajuyigbe *et al*., 2021; Douglas, 2017). This indicates that vulnerability to flooding is not only influenced by environmental factors but also by socioeconomic conditions that constrain the ability of households to implement proactive mitigation strategies. The finding that 15.8% of respondents resorted to temporary relocation during flood periods indicates that displacement is sometimes used as a coping strategy when flood conditions become severe. Temporary relocation has been identified in previous studies as a common response among households residing in highly flood-prone areas where structural protection measures are insufficient (Adelekan, 2016; Abdulkareem *et al*., 2023). However, relocation is often considered a last resort because it may disrupt livelihoods, social networks, and access to basic services.

The relatively small proportion of respondents **(**9.6%**)** who raised the height of their entrance walls suggests that permanent structural modifications are less common among residents in the study area. Such modifications usually require additional financial investment and technical knowledge, which may not be readily available to many households. Nevertheless, similar structural adaptation measures have been documented in other Nigerian flood-prone communities where residents modify their buildings to reduce the risk of floodwater entering residential spaces (Ogunbode *et al*., 2019; Olajuyigbe *et al*., 2021).

The findings demonstrate that community-based coping mechanisms play a crucial role in mitigating flood impacts in the study area. The reliance on sandbags, drainage maintenance, and temporary relocation indicates that residents actively develop practical responses to recurrent flooding using the resources available to them. However, the dominance of short-term and reactive coping strategies also suggests that these measures may not provide sustainable protection against increasing flood risks.

Table 8: Community Based Coping Mechanism to flood incidence in the area

Description (in Years)	Frequency	Percent
Use of structures (tyres, planks, etc.)	41	15.8
making use of sandbags	50	19.2
Frequent removal of sand of block drainage	52	20.0
Channelization of water course	25	9.6
making use of sandbags	92	35.4
Total	**260**	**100.0**

Effectiveness of Coping Mechanisms employed by Respondents in the study Area

The analysis of the effectiveness of the coping mechanisms adopted by residents indicates that the use of physical protective structures recorded the highest effectiveness index of 2.11 (Table 9). This suggests that residents perceive structural measures such as the use of temporary barriers, planks, tyres, and other locally improvised materials as the most effective approach for mitigating the immediate impact of flooding within the study area. These measures are often implemented at the household level and provide direct protection against the intrusion of floodwater into residential buildings and surrounding compounds. Their relatively high effectiveness rating may be attributed to their accessibility, affordability, and the fact that residents can easily implement them without relying on external institutional support. Closely following this measure is the removal of sediment from drainage systems, which recorded an effectiveness index of 2.04. The clearing of drainage channels helps improve water flow and reduces the likelihood of blockages that often contribute to surface flooding during heavy rainfall. Similarly, the use of sand-filled sacks recorded an effectiveness index of 1.89, while the frequent removal of sand or debris blocking drainage channels also received a relatively favourable rating among residents. These findings indicate that residents place considerable importance on drainage maintenance and small-scale structural protection as practical strategies for managing flood risks in their communities.

The effectiveness of drainage clearing and structural barriers observed in this study is consistent with findings from other studies conducted in Nigerian cities. For instance, Ogunbode *et al*. (2019) reported that residents in flood-prone communities often rely on household-level protective structures and routine drainage clearing to reduce the severity of flooding. Similarly, Olajuyigbe *et al*. (2021) observed that community-led drainage maintenance and the use of sandbags were among the most commonly adopted coping mechanisms in urban flood-prone areas, particularly in locations where formal drainage infrastructure is inadequate. These locally implemented strategies provide immediate and practical solutions that can be deployed quickly during periods of intense rainfall.

Channelization of watercourses recorded a lower effectiveness index of 1.73, while

relocation from buildings recorded the lowest effectiveness index of 1.50. The relatively low effectiveness rating assigned to these measures may be linked to their financial and logistical implications. Channelization of watercourses typically requires significant engineering intervention, technical expertise, and substantial financial investment, which are beyond the capacity of most households or local communities. As a result, such projects are generally expected to be undertaken by government agencies or public institutions responsible for urban infrastructure development. Similarly, relocation from flood-prone areas, although theoretically an effective long-term flood mitigation strategy, may not be feasible for many residents due to economic constraints, land tenure issues, and social attachments to existing neighbourhoods. Many households lack the financial resources required to relocate or acquire housing in safer areas. This situation is consistent with findings by Douglas *et al*. (2021), who noted that relocation as an adaptation strategy is often limited in developing countries because vulnerable populations tend to reside in high-risk areas due to economic necessity rather than choice. In addition, Adelekan (2016) highlighted that many urban residents in Nigeria remain in flood-prone environments despite repeated flood incidents because of limited alternative housing options and strong social ties within their communities.

The findings therefore suggest that community-level flood management strategies are largely dominated by low-cost, locally driven coping mechanisms rather than large-scale infrastructural interventions. Residents tend to adopt measures that are affordable, easy to implement, and capable of providing immediate protection during flood events. While these strategies may not completely eliminate flood risks, they play an important role in reducing the severity of flood impacts and enhancing household resilience. No doubt, community-based coping mechanisms remain a crucial component of flood adaptation in Ilorin, particularly in the absence of sufficient government intervention. These findings support the argument that local adaptation strategies should be recognized and integrated into broader urban flood management policies. Strengthening collaboration between government agencies and local communities could therefore enhance the effectiveness of flood risk management initiatives and improve resilience in flood-prone urban environments.

Table 9: Effectiveness of Coping Mechanisms employed in the study area

	3	2	1	SWV	NR	ECI	E	D	D2
Use of structures (tyres, planks, etc.)	285	198	66	549	260	2.11	1.86	0.26	0.07
Removal of sediment from drainage systems	195	280	55	530	260	2.04	1.86	0.18	0.03
Sand fill sacks	138	278	75	491	260	1.89	1.86	0.03	0.00
Frequent removal of sand of block drainage	180	206	97	483	260	1.86	1.86	0.00	0.00
Channelization of water course	174	150	127	451	260	1.73	1.86	-0.12	0.01
Building Relocation	147	66	178	391	260	1.50	1.86	-0.35	0.12
							11.13		

5. Conclusion and Recommendations

The study examined community-based coping mechanisms and adaptive strategies to flooding in flood-prone areas of Ilorin, Nigeria, with a view to understanding residents' experiences, perceived causes of flooding, severity of

impacts, and the effectiveness of locally adopted responses. The findings revealed that flooding remains a recurrent environmental problem in the study area, with a large proportion of respondents reporting direct experience of flood events within the past year. Heavy rainfall, poor drainage conditions, indiscriminate waste disposal, and encroachment on floodplains emerged as the major drivers of flooding. The study further showed that flooding imposes substantial socio-economic consequences on residents, particularly through damage to agricultural output, health, roads, vehicles, household property, and potable water sources. In response, residents have developed various coping strategies, among which the use of temporary protective structures, drainage clearing, and sand-filled sacks were perceived as the most effective. These findings confirm that local communities in Ilorin are not passive victims of flood hazards but active agents who employ practical and accessible measures to reduce flood impacts despite limited institutional support.

Based on these findings, the study recommends that government agencies should strengthen urban flood management in Ilorin through improved drainage infrastructure, stricter enforcement of land-use regulations, and the regular clearance of blocked waterways. There is also a need to integrate community-based coping mechanisms into formal flood risk management policies, since locally driven strategies have proven relevant in reducing immediate flood impacts. Community awareness programmes should be expanded to promote proper waste disposal, environmental sanitation, and preparedness for extreme rainfall events. In addition, government and relevant stakeholders should support vulnerable households through flood early warning systems, technical guidance on low-cost household adaptation measures, and targeted assistance for residents in highly exposed neighbourhoods. Strengthening collaboration between public institutions and local communities will enhance resilience and promote more sustainable flood adaptation in Ilorin.

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