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EXPLORING FLOOD MITIGATION STRATEGIES TO ENHANCE FOOD SECURITY AMONG RURAL RICE FARMING COMMUNITIES IN IBAJI LOCAL GOVERNMENT, KOGI STATE, NIGERIA

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Abstract

Flooding remains one of the most pressing environmental threats to agricultural productivity in Nigeria, with Ibaji Local Government Area of Kogi State particularly vulnerable given its reliance on rice farming as the dominant livelihood. This study examined flood mitigation strategies for enhancing food security among rural rice farming communities in Ibaji, guided by four objectives and three hypotheses. Data were obtained from 371 farmers through purposive sampling, alongside secondary sources, and analysed using descriptive and inferential statistics, anchored on Food Security Theory and Flood Risk Management Theory. Findings revealed that 74.9% of respondents confirmed flooding had increased over the preceding five years, with 65.2% describing incidents as very severe and 81.7% reporting direct exposure to at least one flood event. Regarding productivity effects, 82.2% affirmed that flooding drastically reduced rice output, while 66.3% acknowledged adverse psychological effects on their mental well-being. On mitigation and coping, 54.7% adopted flood-resistant rice varieties and 56.9% engaged in post-flood replanting. Hypothesis testing showed a statistically significant relationship between flood prevalence and mitigation strategies adopted ($r = 0.486$, $p < 0.05$), leading to rejection of the null hypothesis. Further ANOVA results indicated significant gender-based differences in both mitigation strategies and coping mechanisms between male and female farmers ($p < 0.05$). The study concluded that flooding severely threatens rice farming and food security in Ibaji, recommending early warning systems, flood-resistant varieties, and agricultural insurance to strengthen farmer resilience.

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Keywords: Flood Mitigation Strategies, Food Security, Rice Productivity, Rural Farming Communities, Flood Prevalence

1.1 Background to the Study

Flooding is one of the most frequent and destructive natural disasters affecting rural rice farming communities worldwide. These communities are often located in low-lying areas with fertile soils suitable for rice cultivation, which are also highly susceptible to inundation during heavy rainfall or seasonal floods as floods disrupt farming activities, damage crops, erode soil fertility, and destroy infrastructure such as irrigation systems, roads, and storage facilities, leaving farmers economically vulnerable (Muyinatu and Liesbeth, 2024).

Globally, smallholder farmers constitute the bulk of the farming population with an estimated 450 - 500 million, which represents 85% of the world's farmers. One of the characteristic features of this farming class is its vulnerability to climate change, which are occasioned by poor financial resources, low institutional and technological adoption capability (Mendy, *et al*., 2024). This farming class constitutes not only more than 80% of the farming population and is responsible for the attainment of the nation's food security (Masha *et al.*, 2023). The vulnerability of this class of farmers to rainfall variability, if not checked, will spell doom to the nation's economy considering the roles agriculture plays to her economic growth and development (Zagre, *et al*., 2024).

Sub-Saharan Africa (SSA) is one of the areas that is most susceptible to climate change and unpredictability (Rabin & Shiva, 2024). These regions currently experience high levels of climate variability and unpredictable rainfall patterns, high reliance on climate-sensitive activities, frequent food shortages and water scarcity, rapid population growth, and a lack of institutional and economic resources to deal with and adapt to climate change and variability (Idu, *et al*., 2023). Climate variability induced by climate change, especially in SSA, is a significant source of danger for smallholder farmers and pastoralists (Stewart *et al*., 2020). This environmental challenge leads to an increase in mean annual temperatures, more unpredictable rainfall that will likely make water shortages worse, high productivity declines for cereal crops, and an increase in disease, pest, and weed burden on livestock and crop systems (Grigorieva, *et al.*, 2023).

Also, in Africa, Rice (*Oryza sativa L.*) is one of the food security crops in the continent but its production is not growing fast enough in relation to the available potentials (Oketayo, *et al*., 2022). Uloh, *et al*., (2023) reported that Nigeria demands about 5.0 million metric tonnes of rice annually, however about 3.2 million metric tonnes are produced domestically, resulting in a deficit of about 1.8 million tonnes. The low rice production could perhaps be linked to climate change as generally acknowledged by researchers (Tien, *et al*., 2022). Climate change according to IPCC, (2022) is change in climate over time whether due to natural variability or as a result of human activity. It may be referred to as any noteworthy change in measures of climate lasting for an extended period.

In many developing countries in Africa, Charlemagne, *et al.* (2022) reported that rice production depends on environmental factors provided by nature and the optimum combination of these factors, plus production inputs determines yield. They maintained that rainfall characteristics (intensity and duration), relative humidity and temperature constitute some environmental factors that affect rice yield and its variability. However, the negative influence of climate change in rice production, included reduction in crop yields, reduction in grain quality, loss of crops due to flood, destruction of farm lands by flood, incident of pests and diseases, surge of infectious disease (such as malaria and cholera on farmers) and decrease in soil fertility (Gita, *et al.*, 2023). The other effects are soil erosion, incidence of droughts, high

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winds velocity, high incidence of weed, post-harvest losses, premature ripening, heat from high temperature, shortening of crop cycle, decrease in soil moistures, change in storage quality of rice, Increased salinity/water pollution and change in production calendar (Nkiene *et al.,* 2021).

In Nigeria, the rice farmers' adaptation strategies are high yielding varieties, inorganic fertilizers, harrowing, early maturing varieties, irrigation, drought tolerant varieties, herbicides, planting during recommended period, reducing farm size and planting in rows (Sufiyan, 2020). However, it becomes necessary to identify the adaptation strategies used by the farmers in Kogi State, Nigeria and factors responsible for such choice, since there is paucity of such information in the study area to the best knowledge of the researchers. This forms the background for this study which explored flood mitigation strategies to enhance food security among rural rice farming communities in Ibaji Local Government, Kogi State, Nigeria.

1.2 Statement of the Problem

This study was prompted by the fact that rice farmers are faced with uncontrollable issues which include flood, drought, salt stress, extreme temperatures, drastic changes in rainfall patterns and rise in temperatures. All these introduced unfavorable growing conditions into the rice cropping seasons. These changes modify growing seasons and subsequently reduce productivity. This is because rice (*Oryza Sativa L.*) production is greatly dependent on environmental factors provided by nature and the optimum combination of these factors plus production inputs determine yield (Fiawoo, *et al.,* 2024). Rice productivity and sustainability are threatened by both biotic and abiotic stresses and the effects of these stresses can further be aggravated by dramatic changes in the global climate leading to frequent flood events.

Hence, flooding poses a significant threat to rural rice farming communities, where agriculture is often the primary livelihood. The recurring nature of floods not only damages crops and agricultural infrastructure but also disrupts food production, economic stability, and the social fabric of these communities. In addition to the immediate economic losses, prolonged exposure to flood-related risks can lead to land degradation, reduced agricultural productivity, and heightened vulnerability to food insecurity. Despite existing flood management efforts, many rural rice farming communities lack adequate flood mitigation strategies tailored to their unique geographical, social, and economic contexts. Traditional practices often prove insufficient in addressing the scale and frequency of modern flood events, exacerbated by climate change and environmental degradation. Furthermore, limited access to resources, technology, and knowledge restricts the ability of these communities to adapt and recover effectively.

This arouses the interest of researchers worldwide as there are spatial, contextual and temporal gaps where Nkiene *et al.*, (2021) revealed that plant level, farm level and farmer's level of adaptation were revealed to be inefficient to mitigate the effects of climate variability and reduce vulnerability of swamp rice production. Oketayo, *et al.,* (2022) show that rice farmers in Oru are much aware of climatic variability, observed variability and ascertain rainfall as the most varied climatic parameter. Uloh, *et al.,* (2023) show that the adaptation strategies adopted by the farmers against climate changes were crop diversification, early planting strategy, use of improved crop varieties, use of chemical fertilizer, use of crop tolerant variety and off- farm income. Hence, this study filled these gaps by exploring flood mitigation strategies to enhance food security among rural rice farming communities in Ibaji Local Government, Kogi State, Nigeria.

1.3 Research Questions

i. What is the prevalence of flood in Ibaji Local Government Area, Kogi State?

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ii. What is the effect of flood on rice productivity in Ibaji Local Government Area, Kogi State?
iii. What are the types of flood mitigation strategies available to rice farmers in Ibaji Local Government Area, Kogi State?
iv. What are the coping strategies employed to combat the effect of flood and enhance food security among rural rice farming communities in the study area?

1.4 Aim and Objectives of the Study

The aim of the study was to explore flood mitigation strategies to enhance food security among rural rice farming communities in Ibaji Local Government, Kogi State, Nigeria.

The specific objectives were to:

i. examine the prevalence of flood in Ibaji Local Government Area, Kogi State;
ii. identify the types of flood mitigation strategies available to rice farmers in Ibaji Local Government Area, Kogi State;
iii. examine the effect of flood on rice productivity in Ibaji Local Government Area, Kogi State,
iv. evaluate the coping strategies employed to combat the effect of flood and enhance food security among rural rice farming communities in the study area

1.5 Hypotheses of the Study

Ho_1: There is no significant relationship between flood prevalence and type of flood mitigation strategies adopted in Ibaji Local Government Area, Kogi State.

Ho_2: There is no significant difference in types of flood mitigation strategies adopted by male and female rice farmers in Ibaji Local Government Area, Kogi State.

Ho_3: There is no significant difference in the coping strategies employed to combat the effect of flood among male and female rural rice farming communities in the study area.

1.6 Scope of the Study

The geographical scope of this study covered neighborhoods in Ibaji community (Onugwa, Aya, Omabo, Ochuchu and Oyendega) including both male and female rice farmers, private or commercial between the age of 18 to 60 years and above. These neighborhoods were purposively selected on the basis of the geographical spread and the researcher familiarization with the study area. Contextually, this study focused on examining the prevalence of flood in Ibaji Local Government Area, Kogi State; Identified the types of flood mitigation strategies available to rice farmers in Ibaji Local Government Area, Kogi State; Examined the effect of flood on rice productivity in Ibaji Local Government Area, Kogi State; and Evaluated the coping strategies employed to combat the effect of flood and enhance food security among rural rice farming communities in the study area.

1.7 Significance of the Study

This study on flood mitigation strategies is of critical importance for enhancing the security and resilience of rural rice farming communities, as it addresses a pressing challenge with far-reaching social, economic, and environmental implications. This study will be beneficial to the following group of persons:

- **Residents**: This study aims to reduce crop losses and ensure consistent rice yields, contributing to food security for both farmers and the broader population. Hence, this research seeks to empower farmers with tools, knowledge, and strategies to minimize losses, enabling them to maintain economic stability and invest in their future productivity.
- **Policymakers**: The findings of this study will provide valuable insights for policymakers,

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development agencies, and stakeholders involved in rural development. It will inform the design of targeted infrastructure projects, resource allocation, and disaster risk reduction policies tailored to the needs of rice farming communities.

The study fosters awareness and education on flood risks and mitigation strategies, empowering rural populations with the knowledge and tools to safeguard their livelihoods. This empowerment can strengthen community cohesion and promote proactive disaster management. Students and researchers will therefore benefit from this study as it will serve as a foundation for future study of this nature to build upon. On the other hand, the study will also be useful to the policy makers as it will guide them on the types of policies to make concerning this subject matter in the study area. It will add to already existing literature on flood mitigation strategies to enhance food security. This study shall be theoretically relevant as it will contribute to the existing knowledge on the subject matter.

2. LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Flood

According to Ward (2018), floods are hydrological phenomena that result from a complex sequence of natural events. Prediction of such events is possible only when there is an adequate understanding of causes of flood events in a basin. The frequency, duration and magnitude of floods are determined by several factors. Flooding results from a number of factors among which are meteorological factors, geomorphic factors and anthropogenic factors (Ward, 2018).

Karmakar *et al*. (2019) define flood risk as the consequence of flood hazards, (the physical and statistical aspects of the actual flooding for example, the extent and depth of inundation) and the vulnerability (the exposure of people and assets to floods and the susceptibility of the elements). Flood risk is thus a combination of hazard (potential damage), vulnerability (probability of flooding occurrence) and impact of exposure.

According to the United Nations Office of Disaster Risk Reduction (UNISDR, 2020), flood risk is the product of the flood hazards, the vulnerability and the exposure. Flood risk basically revolves around two main elements; hazard and vulnerability (Ward *et al.,* 2019; De Moel *et al.*, 2021; Kreibich *et al.,* 2020). On the other hand, for effective flood risk analysis, it is important to understand the degree of susceptibility of elements to flood hazards. While the concept of vulnerability is still being studied, it remains an important element in risk analysis and disaster control measures (Herman, 2019).

Hazard is the susceptibility of a place to any human and physical risk. In this case, we look at flood hazards as all the areas that are at risk of flood occurrence. The concept of flood hazard would be more appropriate to include localized flooding due to inadequate drainage, flooding from small streams, flooding in urban areas located on major river banks and urban areas experiencing coastal flooding (Benjamin, 2018).

Hence**,** floods are the most frequent natural disasters globally, affecting over 2.8 billion people and are responsible for over 200,000 deaths over the past 3 decades (Hashizume, 2013). The riverine areas are naturally prone to flooding. The occurrence of environmental hazards such as flooding is not new. However, what is new is the increasing level of damages to lives and properties witnessed as a result of high magnitude and highly frequent floods experienced in the developing countries such as Nigeria. Studies on water, poverty and flood have observed that there was an increasing rate of flood occurrences and severity in recent years; resulting in loss of lives, injuries, homelessness, damage to environment and infrastructure as well as impacting on agriculture, health and education (Efobi & Anierobi, 2013). In recent

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years, the ravaging effects of flooding in Nigeria became so drastic that it was seen as a national disaster. Among the 36 states of the federation, Adamawa state was among the 34 states that had a bitter experience of the flood (NEMA, 2012). Measures of tackling floods have been suggested (Uzoma & Abdulkadir, 2019; Ozoh, 2020). However such measures are often resisted as a result of the increasing levels of poverty and/or cultural considerations, and the lack of sufficient interest on the side of governments. In Ibaji in Kogi State and Loko area of Adamawa State, for example, the government intervention in the flood disaster was only partially successful as some of the people rejected the re-settlement project; Since then the government has scarcely embarked upon any serious measures beyond the usual distribution of relief materials to cushion the impacts. Thus, floods have now become a yearly event to contend with by the people.

2.1.2 Prevalence of Flood in Ibaji Local Government Area, Kogi State

Floods are one of the most common natural disasters globally. Their prevalence is influenced by factors such as climate change, geographical location, urbanization, and weather patterns. Globally, Shukri (2023) observed that floods affect nearly all regions of the world, with certain areas more prone due to topography, river systems, and climate conditions. In recent decades, the frequency and intensity of floods have increased, largely due to climate change, which is causing more extreme weather events, such as heavy rainfall and storm surges. Regions prone to flooding in Asia include countries like India, Bangladesh, China, and Vietnam experience annual flooding due to monsoon rains and river overflow. Bangladesh, for example, is especially vulnerable because much of its land lies below sea level. In North America, The U.S. experiences frequent flooding, particularly along the Mississippi River, Gulf Coast, and in areas affected by hurricanes like Florida, Texas, and Louisiana. In Africa, flooding in sub-Saharan Africa occurs along the Nile, Niger, and Congo Rivers. Many regions are also experiencing flash floods due to heavy seasonal rains. In Europe, Central and Eastern Europe, particularly countries like Germany, France, and the UK, face regular flooding from rivers, especially during heavy rain or snowmelt. In Oceania, Australia also faces flooding, especially in the northern regions, due to heavy rainfall during the wet season (Marino *et al.*, 2023).

According to Jimoh et al., (2021), urban areas worldwide are increasingly at risk of flooding due to rapid urbanization, poor drainage systems, and the rising frequency of intense rainfall. Cities such as Jakarta, Bangkok, and New York City have seen significant flood events in recent years. Rising sea levels and increased storm intensity contribute to coastal flooding, while more erratic rainfall patterns can lead to flash floods in areas that were previously not prone to flooding. Extreme weather events like hurricanes, typhoons, and cyclones are becoming more frequent, resulting in more widespread flooding, particularly in low-lying coastal regions (Mwakyusa, *et al.*, 2023).

Smita *et al.,* (2023) stated that many floods are linked to specific climate phenomena, such as El Niño and La Niña events, which can cause alterations in weather patterns, leading to droughts or excessive rainfall, both of which can contribute to floods. The increasing prevalence of floods is expected to continue as climate change exacerbates weather extremes, and regions vulnerable to flooding will need to invest in better flood control and mitigation strategies.

2.1.3 Effect of Flood on Rice Productivity

Flooding can highly affect rice productivity in both positive and negative ways, depending on the timing, intensity, and duration of the flood event. Rice is an important crop grown in areas prone to flooding, particularly in countries like Nigeria, China, India, Bangladesh, and Vietnam. Mohd *et al.*, (2024) identified negative effects of flooding on rice productivity to include crop damage and yield loss through submergence where flooding, especially when it leads to prolonged submergence, can drown rice plants.

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Rice is generally grown in flooded fields (paddy fields), but excessive flooding beyond the tolerance of the plants can damage or kill them. Long durations of submergence (more than 2–3 weeks) can greatly reduce rice yield. Marino *et al*., (2023) noted that flooding can deprive rice plants of oxygen, causing root rot and overall plant stress. Rice roots need oxygen for proper growth, and prolonged flooding can suffocate them, hindering nutrient and water uptake. Excess water can wash away important soil nutrients, leading to nutrient deficiencies in rice plants and reduced growth. This can result in poor yields. Flood conditions create a favorable environment for fungal, bacterial, and viral diseases, such as rice blast, sheath blight, and bacterial blight. These diseases can reduce rice yields and quality. Flooding can also delay the harvest by making fields inaccessible or too wet to safely harvest rice. This delay can result in grain loss or spoilage due to over-ripening or rotting in the field (Apuyor *et al*., 2021).

Omar *et al*. (2024) observed that if floodwater does not drain away quickly, the fields can become waterlogged, leading to the same problems of oxygen deprivation and root damage. Waterlogging can also create soil compaction, making it harder for the rice plants to grow properly. Therefore, flooding can lead to the deterioration of grain quality. Waterlogging or prolonged wetness can cause grains to be discolored, shriveled, or otherwise affected, reducing marketability and profitability for farmers (Omar *et al.*, 2024).

On the other hand, Michael, *et al.*, (2023) pointed out that flood also has positive effects on rice productivity as it serves as a natural irrigation system. In some cases, flooding from seasonal rains or overflow from rivers can act as a natural irrigation system, especially in regions where irrigation infrastructure is limited. Controlled floods can replenish water sources for rice cultivation and may help improve productivity by providing an adequate water supply. Rice varieties adapted to flood-prone areas, like flood-tolerant rice such as varieties from the submergence-tolerant group, like IR64 and Swarna Sub1, are bred to withstand temporary flooding and can benefit from such natural flood events. John and Eric, (2022) noted that floods can deposit fertile sediment from riverbanks onto the rice fields, enriching the soil with nutrients like phosphorus, nitrogen, and potassium. This natural fertilization can improve rice productivity in the following growing season. Floods can help control weeds and some pests, as inundated fields can drown weed seedlings and disrupt pest populations. This reduces the need for chemical herbicides and pesticides, which can lower farming costs and reduce environmental impact.

Echendu, (2022) stated that timing and duration of floods matter. Hence, if flooding occurs before planting, it may prevent farmers from preparing the fields or planting at the optimal time. However, it can also create favorable conditions for rice sowing in regions where rice fields depend on seasonal flooding. The growth stage is particularly sensitive to flooding, as prolonged submergence during flowering or ripening can severely affect yield and grain quality. While flooding after the rice has been harvested typically does not impact rice productivity, it can still affect post-harvest processing or cause storage issues (Echendu, 2022).

Conclusively, floods can have devastating effects on rice productivity, especially when they are severe or prolonged. However, rice varieties that are flood-tolerant and careful management of flood risks can help mitigate some of the negative impacts.

2.1.4 Types of flood mitigation strategies available to rice farmers

Flood mitigation strategies for rice farmers aim to reduce the impact of flooding on rice production and ensure sustainable crop yields. There are various approaches, both structural and non-structural, that can help rice farmers manage flood risks. Omar *et al.* (2024) mentioned flood-resistant rice varieties like rice varieties that can survive prolonged flooding, such as the Swarna Sub1 and IR64 Sub1, are essential for flood-prone areas. These varieties have been bred to tolerate waterlogging and submergence, allowing them to thrive in conditions where other varieties might fail. Some rice hybrids are designed to withstand

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both drought and flood conditions. These varieties are more resilient and offer farmers the flexibility to grow rice in areas with varying water availability. Jimoh *et al*., (2021) identified water management techniques in areas where flooding is predictable, controlled flooding is often used as a form of irrigation. Proper management of water levels in paddy fields can help ensure that rice plants receive the water they need for optimal growth while preventing submergence and damage. For areas with moderate flooding, shallow water management ensures rice plants can be kept submerged for optimal growth, but not to the extent that they are drowned or stressed. Creating slight slopes or maintaining proper drainage systems in rice fields helps control floodwaters. It reduces the risk of water accumulation that could lead to waterlogging and damage to crops (Jimoh *et al*., 2021).

Muyinatu and Liesbeth, (2024) suggested flood control infrastructure by constructing dikes, levees, or embankments along the edges of rice paddies can help prevent river or monsoon floodwaters from inundating fields. These structures can be particularly effective in areas where river systems flood during the rainy season. Flood gates and canals help control the flow of floodwaters into rice fields. Farmers can open and close flood gates to either let water in when needed or prevent excess water from entering during a flood event. Canals can also help with irrigation and drainage, reducing the risk of waterlogging. In coastal or low-lying areas, polder systems like enclosed land areas with flood barriers can be used to protect rice fields from tidal or river flooding. Polders are useful in managing water levels and preventing saltwater intrusion. Atubiga & Alobit, (2022) stated that in areas with uneven terrain or where floodwaters are unpredictable, rice terraces or raised beds can help avoid submergence. By elevating the rice fields, farmers can protect their crops from flooding while still maintaining a system for water management. In sloped areas, contour farming like planting rice along the natural contours of the land helps reduce soil erosion and manage water runoff during floods, preventing excessive water from accumulating in one area.

Jimoh *et al.*, (2021) mentioned flood forecasting and early warning systems through weather forecasting where modern flood forecasting systems use satellite data and weather models to predict rainfall, flood risks, and water levels. Early warning systems give farmers time to prepare for potential floods by adjusting their cropping schedules, applying flood-resistant measures, or harvesting earlier than planned. Also, by mapping areas that are most vulnerable to flooding, farmers can better plan for high-risk flood events, such as moving crops to safer areas or investing in flood-prevention technologies.

Awang (2023) suggested crop diversification and agro-ecosystem management through diversified cropping systems where farmers can reduce flood risk by diversifying the crops they grow. This may involve planting flood-tolerant crops or crops with different flooding tolerance levels, thus reducing the dependency on a single rice crop. Integrating trees or other vegetation with rice farming can help reduce the impact of floods by stabilizing the soil, reducing erosion, and absorbing excess water. Tree roots can also help in preventing soil compaction, which can improve drainage and water infiltration. In flood-prone regions, capturing excess water through water harvesting methods like ponds or rainwater collection systems can be used to store water for irrigation during dry spells, thus balancing water availability for rice farming throughout the year. Implementing soil conservation practices, such as using organic mulches, cover crops, and crop rotation, can help maintain soil structure and reduce the risk of erosion and nutrient loss during flooding. Flooding can wash away essential soil nutrients. Using flood-tolerant, slow-release fertilizers and applying them strategically can help rice plants grow stronger, even under adverse conditions. Mwakyusa, *et al*., (2023) noted post-flood recovery strategies such as rice replanting. Hence, after floods, farmers can sometimes replant rice if the initial crop has been destroyed. This requires careful management of soil and water conditions to ensure that the second planting can be successful. Also, building flood-resistant rice storage systems can prevent post-harvest losses. Elevated storage structures or waterproof silos protect harvested rice from spoilage due to flooding or excess moisture.

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Mohd *et al.,* (2024) mentioned government and community support programs through insurance and financial support where governments can offer crop insurance, financial aid, or relief funds to support rice farmers affected by floods. These programs help farmers recover from losses and invest in flood mitigation strategies. Collaborative efforts within farming communities can help share knowledge, resources, and strategies to prepare for and respond to floods effectively. Farmers can learn about shared irrigation systems, flood forecasting tools, and cooperative flood control initiatives.

In a nutshell, a combination of these strategies, depending on the severity and frequency of flooding in the area, can greatly reduce the risks posed by floods to rice farming.

2.1.5 Coping strategies employed to combat the effect of flood and enhance food security among rural rice farming communities

Coping strategies employed by rural rice farming communities to combat the effects of floods and enhance food security focus on resilience-building, adaptive management, and diversifying farming practices. These strategies aim not only to minimize the immediate damage from floods but also to ensure that communities can recover quickly, maintain food production, and protect their livelihoods.

Shukri (2023) found intercropping and crop rotation where rural communities often diversify their crop production by incorporating non-rice crops that are less vulnerable to flooding. This includes growing vegetables, legumes, or flood-tolerant varieties. Crop rotation also helps to break pest cycles and improve soil health. Also, farmers are increasingly adopting flood-resistant rice varieties, such as Swarna Sub1, IR64 Sub1, or Nerica varieties, which can withstand short-term submergence without significant yield loss. This strategy enhances the overall resilience of the rice crop to floods. In addition to rice, rural farmers may also engage in livestock rearing, fishing, or agroforestry, which provides an additional food source and income during flooding events when rice yields may be low (Shukri, 2023). In areas with predictable flood seasons, controlled flooding in rice paddies is used as a traditional irrigation method. Farmers manage the water level in their fields to ensure that rice plants have adequate water without the risks of excessive flooding (Smita *et al.*, 2023). Constructing or maintaining drainage systems helps to manage floodwater, allowing for faster runoff and preventing waterlogging. This minimizes damage to rice crops by reducing the duration of submersion. In flood-prone regions, farmers build embankments, levees, or small dikes to prevent river or floodwater from inundating their rice fields. These structures provide a buffer against floodwaters and protect crops from damage. Some rural communities harvest floodwaters during the rainy season to store for dry periods. This technique helps balance water resources for rice cultivation, ensuring water availability during off-seasons or droughts (Jimoh *et al.,* 2021).

An improved agricultural practice through soil conservation techniques is another way. Farmers use soil conservation methods, such as mulching, contour farming, and planting cover crops, to reduce erosion and soil degradation caused by floods. Healthy soil can retain moisture and nutrients, even in flood-prone conditions. Proper and efficient fertilizer use, including slow-release fertilizers, can help mitigate nutrient leaching caused by flooding. Fertilizer management ensures that rice crops receive adequate nutrition for growth, even in flooded soils (Iortyer & Yio, 2023). After a flood, some farmers replant rice in flooded fields if conditions allow. This strategy is especially useful in areas where the first crop has been lost or severely damaged, but the soil and water conditions are suitable for a second planting. Farmers may switch to short-duration rice varieties or other fast-maturing crops such as maize or beans that can be harvested quickly, providing food and income before the next major flood season. To minimize loss from post-flood damage, rural farmers may use flood-resistant storage facilities such as raised granaries, waterproof silos to preserve harvested rice until it can be sold or consumed. Proper drying and storage techniques reduce spoilage and maintain food security (Echendu, 2022).

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Community-Based Disaster Risk Reduction plays a crucial role as in rural communities, farmers often work together to build and maintain flood control infrastructure such as dikes, levees, and canals. These collective efforts strengthen the community's ability to withstand floods and reduce individual vulnerability. Community-based early warning systems (EWS) provide timely alerts about impending floods. This allows farmers to take preventive measures, such as moving livestock and crops to higher ground, adjusting planting schedules, or evacuating vulnerable areas. Awareness and training programs on flood risks and mitigation strategies help farmers understand the effects of floods and how to prepare. Education initiatives may include flood-resistant farming techniques, the importance of water conservation, and the role of weather forecasting.

John and Eric, (2022) suggested access to financial support and insurance through microfinance and credit access. Many rural rice farmers rely on credit and financial support from microfinance institutions, cooperatives, or government programs to purchase inputs, recover after floods, and invest in flood mitigation measures. This helps reduce the financial impact of floods and provides farmers with the resources to rebuild their livelihoods. Insurance schemes specifically designed for flood-prone regions can provide compensation to rice farmers in the event of crop loss. This ensures that farmers have financial support to recover and replant in the following season. Post-flood relief programs offered by governments, NGOs, or international organizations provide emergency aid, such as food, seeds, tools, and temporary shelters. These initiatives help affected communities quickly recover and maintain food security during the aftermath of a disaster (Marino *et al.*, 2023).

Awang (2023) suggested climate adaptation and resilience building through climate-smart agricultural practices. By adopting climate-smart practices, rural rice farmers can better adapt to changing weather patterns and more extreme flooding events. These practices include water-efficient irrigation systems, diversifying crop species, and implementing agroforestry practices that protect ecosystems and reduce flood risks. Rural communities may adopt integrated approaches that involve managing water resources, soil, and natural ecosystems collectively to reduce flood risks and increase the sustainability of agricultural production. Constructing durable infrastructure, such as flood-resistant roads, bridges, and irrigation systems, enhances the ability of rural communities to maintain access to markets and recover more quickly after floods. Baharuddin (2021) emphasized access to market and food distribution through supply chain and food distribution networks. After floods, ensuring that there is access to markets and food distribution channels is crucial to maintaining food security. Rural farmers rely on accessible roads and market infrastructure to sell rice and other products, which help them recover from the economic effects of flooding. Some rural communities establish grain banks or food reserves to store surplus rice and other crops during good seasons. These reserves serve as a buffer in times of disaster, allowing farmers to access food when production is low (Omar *et al.* 2024).

2.2 Empirical Review on Flood Mitigation Strategies

Muyinatu and Liesbeth, (2024) examined Weather-related shocks, livelihood assets and coping strategies of water-insecure smallholder rice farmers using a descriptive survey approach. Findings show that addressing gender-specific needs and designing specific agricultural intensification interventions for larger farms could enhance the mitigation of shocks and coping strategies of rice farming households. Supportive policies through women empowerment, increased participation of women in decision-making, and community networks as well as approaches that place gender equality at the center of implementation are more effective in addressing inequalities, climate change, and fostering inclusive societies can mitigate the challenges faced by elderly and female-headed households in agriculture.

Marino *et al.*, (2023) did an attempt to link flood risk mitigation and food security using Land-Use Change

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in the Metropolitan Area of Rome. Findings show a net negative change in ES supply, caused mainly by urbanization at the expense of agricultural land. This decrease in ES supply is not offset by other LULCC transitions. In addition, the analysis of synergies and trade-offs between flood mitigation ES and agricultural production ES (in arable land, orchards, vineyards, and olive groves) shows that the reduction of agricultural land negatively affects both ES. The innovative contribution of this work lies in setting an integrated methodology that is able to investigate how LULCC influences both hydraulic safety and food security. Findings can be useful to support planning of enhancing the role of agriculture in metropolitan areas.

Iortyer & Yio, (2023) did a study titled Flood and Food Security in the Benue Valley: Stylized Facts using descriptive survey design. Findings revealed that there is always a gross inadequacy of food supply during the years of devastating floods compared to years of normal annual rainfall. Prices of agricultural products increased by almost 200% and household income declined significantly during the flood disaster years. Findings also revealed that private organizations sometimes render more aids to flood victims than the public sector. To arrest the danger of annual devastating floods in the Benue Valley, the paper recommends better water infrastructure management strategies like the construction of more dams and dredging of River Benue.

Mwakyusa, *et al.,* (2023) examined Flood-tolerant rice for enhanced production and livelihood of smallholder farmers of Africa using review of related literature. Findings show that while some strides have been made, the region's achievements remain limited, underscoring the critical importance of flood-tolerant rice varieties for improving productivity and ensuring food security. The scattered nature of information on developing flood-tolerant rice varieties highlights the need for effective coordination and thorough documentation. Despite the limited number of flood stress-tolerant varieties currently available in the region, it is imperative to ensure their widespread dissemination in flood-prone rice cultivation areas.

Michael, *et al*., (2023) evaluated Floods stress in lowland rice production: experiences of rice farmers in Kilombero and Lower-Rufiji floodplains, Tanzania using used a mixed-methods approach that involved household surveys, key informant interviews, and transect walks to collect data from 180 rice farmers and 14 experts and community leaders. Findings show that floods affect the livelihoods of rice farmers by forcing them to abandon, rent, or sell their farms. Coexistence of floods with other biotic and abiotic stresses such as crop diseases and droughts also limited the use of short maturing high yielding rice varieties. Farmers have adopted on-farm strategies such as adjusting planting schedules, using different varieties of rice, changing to other crops or activities after the floods to cope with floods, but these practices face numerous challenges. The study recommends the development of early warning systems, breeding for flood-tolerant rice varieties, introgression of tolerance traits to multiple stresses and improving crop establishment methods to enhance the resilience of farmers to floods and other extreme climate events.

Smita *et al.*, (2023) did a study titled Overcoming barriers to adapt rice farming to recurring flash floods in haor wetlands of Bangladesh using descriptive survey approach. Findings showed that the lack of availability of submergence tolerant variety (a rice variety that can survive and continue growing after being completely submerged in water for several days) is the major barrier to farmers' adaptation to flooding events followed by limited market access and lack of access to inputs. A total of 85% of respondents reported encountering moderate to severe barriers to adapt to flash flooding. Besides, some socio-economic traits, including annual family income, extension media exposure, and perception on climate change have been identified to be influencing farmers' adaptation behaviour to adapt their rice farming system to recurring flash flood events. This study elaborated pathways and suggested policy recommendations to adapt to flash flooding and to ensure sustainability in the agricultural system in the

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haor wetlands of Bangladesh.

Jimoh *et al.* (2021) in a study titled Multidimensional approach to mitigating flood risks and impact: a case study of rice farming in Nigeria used literature review approach. Findings show that appropriate policy formulation, implementation, and support for rice farmers would increase the rice production capacity of Kwara state and Nigeria. It is believed that at full production capacity, Nigeria would be self-sufficient in rice production for its over 200 million people and be able to export. Increased yields from the adoption of improved rice varieties would result in farmer's sufficiency, job creation, improved economy, increase in tax generation, and foreign exchange earnings.

Echendu (2022) in a study titled Flooding, Food Security and the Sustainable Development Goals in Nigeria used an integrative review that explores the link between Nigeria's flooding, food security, and the SDGs. Findings show that, despite the impact of flooding on food security, it is not recognized as a threat by policymakers, as evidenced by the lack of mention of disasters in the current Nigeria Agriculture Promotion Policy (APP). Attention is drawn to this oversight in this work by highlighting the interconnections between flooding, food security, and sustainable development. Recommendations on flood mitigation and adaptive practices that can alleviate the negative impact of flooding on food security to enhance the success rate of the SDGs are proffered.

Atubiga & Alobit (2022) in analyzing food security through flood recession farming: a case study of the Upper East Region, Ghana" made use of Qualitative approach wherein 30 respondents were selected to participate in the study. In-depth interviews, focus group discussions and field observation was how data was collected. The data obtained from the field were analyzed using qualitative data analysis. From the study, it was observed that the nature of the soil in the Sudan ecological zone contains nutrients that promote both wet and dry seasons of farming. Flood recession farming was identified to provide more crop yield than the wet season as it has the potential to ensure food security in the region. Based on that it is recommended that more attention should be given to flood recession farming to ensure all year-round farming in the area as a measure of ensuring food security.

Mohd *et al.* (2024) unravelled the multidimensional food security challenges in flood-prone Malaysia with Maqasid Syariah employing a content analysis methodology. Literature Review Several studies in the global context have applied the concept of maqasid syariah to address food security challenges, particularly flood disasters during the challenging times of the COVID pandemic. These studies place significant emphasis on the production of Fatwa and legal decrees to address issues related to halal and tayyib food products in Malaysia. For instance, Awang (2023), explored the importance of maqasid syariah in formulating legal decrees and Fatwa rulings related to food issues, particularly in promoting halal and tayyib food products to address food security challenges in Malaysia. Another good example of dealing with food security from the perspective of drought, floods and desertification is Omar *et al*. (2024), which reflects the imperative of maqasid syariah to produce the optimal sustainable practice for addressing climate change challenges. In the midst of a flood disaster in Malaysia, Shukri (2023), detailed and tackled the disaster risk reduction strategy for food security within the Sendai Framework. Baharuddin (2021), also assembled the literature of maqasid syariah in a global context, including Malaysia. The development of maqasid syariah literature in Malaysia has continued to grow exponentially up to the present day.

John and Eric (2022) conducted a study exploring the impact of floods on rural communities on emerging food security challenges in Ghana using descriptive survey design. From the finding, it was realized that rural communities' livelihood activities were vulnerable to flooding and over the years several households have lost their source of livelihood to the floods. This has resulted in food insecurity. The result of the impact of the flood on livelihood activities has resulted in coping strategies being adopted by the

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respondents in the area to reduce the impact of the flood on their livelihoods.

Connor *et al*. (2022) evaluated the impact of flooding on food security across Africa using a literature review approach. Findings show that food security status is affected by flooding. Furthermore, flooding and its associated meteorological conditions can simultaneously degrade food security locally while enhancing it at regional spatial scales, leading to large variations in overall food security outcomes. Dedicated data collection at the intersection of flood events and associated food security measures across different spatial and temporal scales are required to better characterize the extent of flood impact and inform preparedness, response, and recovery needs.

Apuyor *et al.,* (2021) examined socio-economic characteristics of rice farmers in flood prone areas of Niger State, Nigeria using a multi-stage sampling technique that was used to select respondents for the study. A sample size of 234 registered rice farmers obtained was used for the study. Data collected were analyzed using descriptive statistics. Findings show that the average age of the respondents is 38years, male dominated in rice farming in the area. Majority (89.7%) of the farmers were married, average household size was nine (9) persons, 59% of rice farmers had formal education at various levels while 41% were illiterate. Further, the majority (72.2%) of the farmers were peasant farmers. While 1.3% practiced commercial farming in the area. The study concluded that floods may have adversely affected farmers' social status in the study area.

2.3 Theoretical Framework

2.3.1 Food Security Theory

Food security theory was propounded by Amartya Sen in 1981. Food security was first formally recognized in the 1940s during the formation of the Food and Agriculture Organization (FAO) of the United Nations in 1945. The FAO aimed to ensure that food production and distribution met global needs.

Basic assumption of theory of food security is that a sufficient supply of food must be available within a given region, country, or globally. This includes both local food production and imports to meet the population's needs as it assumes that agricultural production, distribution systems, and storage facilities are functional and reliable. On food accessibility, individuals and households must have the economic, social, and physical ability to acquire food because access depends on income, purchasing power, market access, and equitable distribution of food resources. Consumed food must meet nutritional needs and promote health. It assumes that people have knowledge of proper dietary practices, access to clean water, adequate sanitation, and health services for proper digestion and absorption of food. Food systems must remain stable and resilient over time, ensuring access to food during crises such as natural disasters, economic shocks, or conflicts. Long-term stability assumes consistent policies, functional infrastructure, and risk mitigation strategies. These assumptions highlight that food security is not just about producing more food; it also involves ensuring fair access, effective use, and sustainability for current and future generations.

Strengths of the Theory of Food Security

Theory of Food Security integrates multiple dimensions through food availability, access, utilization, and stability. This holistic approach allows for a broader understanding of the issue. The theory emphasizes equitable access to food, recognizing that food insecurity is often due to social, economic, and political inequalities rather than a lack of food production; It draws from various fields such as economics, sociology, agriculture, and public health, allowing for diverse solutions; By framing food security as a fundamental human right, it advocates for policies that prioritize vulnerable and marginalized populations. The theory is applicable at multiple levels local, national, and global making it relevant for a range of contexts and stakeholders. It emphasizes the importance of resilience in food systems, addressing the need

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for stability during crises, climate change, and market disruptions. The theory provides a foundation for international organizations and governments to design programs and policies aimed at combating hunger and promoting sustainable agriculture.

Weaknesses of the Theory of Food Security

Traditional applications of the theory often focus heavily on increasing food production, sometimes neglecting issues of access, utilization, and distribution. The multidimensional nature of the theory can make it challenging to operationalize. Addressing food security requires coordination across sectors, which can be logistically difficult. It may not adequately address systemic inequalities, such as land ownership disparities, gender inequality, or exploitative trade practices, which are root causes of food insecurity. Food security is difficult to measure accurately due to its multifaceted nature. Indicators like caloric intake may not capture the full scope of issues such as nutrition quality or social access. While the theory acknowledges global interdependence, reliance on international trade can sometimes undermine local food sovereignty, making communities vulnerable to external shocks. Although it highlights sustainability, the theory often lacks a strong focus on the environmental impacts of agricultural practices, such as deforestation, soil degradation, and water resource depletion. Policies based on the theory may prioritize immediate food relief over long-term solutions like infrastructure development, education, or empowerment of local farmers.

2.3.2 Flood Risk Management Theory

Flood Risk Management Theory was propounded by David Crichton in 1973. The development of Flood Risk Management (FRM) evolved from traditional flood control practices to integrated, adaptive, and holistic frameworks, with contributions from numerous researchers, policymakers, and organizations worldwide.

Basic assumptions of Flood risk management theory

Flood Risk Management (FRM) theory is based on a set of foundational assumptions that guide its principles and practices. These assumptions help integrate multiple dimensions of risk, resilience, and sustainability in managing flood hazards. It assumes the likelihood and intensity of flooding events such as rainfall, river overflow and storm surges. The presence of people, property, infrastructure, and ecosystems in flood-prone areas with the susceptibility of exposed elements to harm, influenced by social, economic, and physical factors. Flood Risk Management assumes that reducing any of these components can lower overall flood risk. Flood Risk Management recognizes that it is impossible to completely eliminate the risk of flooding due to natural variability, climate change, and uncertainties in predicting flood events. Instead, the focus is on managing risks to minimize impacts on people, property, and ecosystems. Flood risk cannot be managed effectively through structural measures like dams and levees alone. Non-structural measures, such as early warning systems, land use planning, and public awareness, are equally critical. Hence, Flood Risk Management assumes the need for integration across disciplines, scales such as local, regional, national, and stakeholders like governments, communities and private sector.

Strengths of Flood Risk Management Theory

One major strength of this theory is that it combines structural and non-structural measures, ensuring comprehensive risk reduction. It integrates social, economic, environmental, and technical aspects, offering a multi-dimensional solution. Risk-based decision-making focuses on reducing the components of risk such as hazard, exposure, and vulnerability as it helps prioritize actions and allocate resources efficiently based on risk assessments. It emphasizes community participation as it actively involves communities in decision-making, fostering ownership and enhancing local resilience; Recognizes that

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local knowledge is crucial for effective flood risk management; Incorporates adaptive management, allowing strategies to evolve as risks change due to urbanization, climate change, or socio-economic factors. Moves beyond flood prevention to building the capacity of communities and ecosystems to absorb, recover from, and adapt to floods. It encourages nature-based solutions, such as wetland restoration and floodplain management; Brings together stakeholders from various fields such as engineering, urban planning, ecology and social sciences to address complex flood issues. The theory also recognizes the inherent uncertainties in flood events and incorporates flexible strategies to address them, enhancing long-term preparedness.

Weaknesses of Flood Risk Management Theory

The holistic nature of Flood Risk Management requires coordination across multiple sectors and scales, making implementation challenging. Balancing the interests of diverse stakeholders can lead to delays or conflicts. Comprehensive risk assessments, infrastructure improvements, and community engagement require significant financial, technical, and human resources. Poor or under-resourced regions may struggle to implement effective flood risk management strategies. Effective flood risk management relies heavily on accurate and up-to-date flood hazard, exposure, and vulnerability data. Data gaps or uncertainties in modeling can limit the effectiveness of strategies. While community involvement is a cornerstone, ensuring equitable participation across socio-economic groups can be difficult. Power imbalances may lead to marginalization of vulnerable populations in decision-making processes. The flood risk management theory overemphasis on structural solutions in practice. Despite its theoretical focus on integration, many flood risk management implementations still prioritize structural measures, which can cause environmental degradation; lead to a false sense of security and increased vulnerability downstream.

3. RESEARCH METHODS

3.1 Research Design

This study adopted descriptive survey design as the choice of survey design because the study aimed to explore flood mitigation strategies to enhance food security among rural rice farming communities in Ibaji Local Government, Kogi State, Nigeria. A survey research, according to Nworgu (2006) is “a design in which the researcher studies a representative sample of the population by collecting and analyzing data on them”.

3.2 Description of Study Setting

This study was carried out in Ibaji Local Government Area of Kogi state which was created from Idah Local Government Area in 1996. The Local Government is situated in the southern part of the State. It is located on latitude 7°08`33”N of the equator and longitude 7°06′67″E of the Greenwich meridian separated from Edo State to the west by the River Niger and bordering Delta State in the south. Its headquarters is in the town of “Onyedega”. Ibaji means “beside water”, Onyedega means “Lion is in the stream” . The Local Government has an area of 1,377km^2 and a population of 128,129 at the 2006 census. Ibaji Local Government Area has ten wards which are: Odeke ward, Ejule ward, Aya ward, Ujeh ward, Iyano ward, Onyedega ward, Analo ward, Akpanyo ward, Unale ward and Ojila ward.

The major socio-economic activities in the area are farming of cash crops like rice, yam, cassava and maize. The rice farms dominate its land use due to its closeness to rivers and water logged nature of land. The predominant ethnic group in Ibaji is Igala. Other ethnic groups also represented in the area include Yoruba, Hausa, Igbo, Idoma, Ibira, Okun, amongst others. The area is made up of religious worshippers from different beliefs which include Christianity, Islam and African Traditional Religious worshippers. Culturally, there is an annual Igala festival that takes place in the area which attracts many Igala men,

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women, boys and girls from the town and neighbouring villages in the area. This is usually accompanied with displays of masquerades from different fractions of the Igala ethnic group.

3.3 Population of the Study

The population for this study were the vulnerable farmers and residents of Ibaji, Kogi State with a total population of 128,129 as estimated by the National population commission in 2006. The population is hereby projected to 199,209 in 2024 using 2.63% annual growth rate. The method of Metha (2004) population projection has been adopted. The formula is stated as thus;

$P_n = P(1+R/100)^n$ Where;

$P_n =$ Current population

$P_0 =$ Population in the base year (2006)

n - Number of intermediate years (18 years)

R- Annual growth rate (2.63%)

3.4 Sample Size and Sampling Technique

3.4.1 Sample Size

3.4.1.1 Sample Size Determination

The sample size for this research work was derived using Taro Yamane's formula based on the population of 199,209 in Ibaji.

The formula is stated thus:

$$n = \frac{N}{1 + N(e)^2}$$

Where; n = Sample size

N = Total population (199,209)

e= Level of significance

$$n = \frac{199,209}{1 + 199,209\ (0.05)^2}$$

$$\frac{199,209}{1 + 199,209\ (0.0025)}$$

$$\frac{199,209}{1 + 498}$$

$$\frac{199,209}{499}$$

$n = 398.6$

$n = 399$

Therefore, a total of three hundred and ninety nine (399) questionnaires were administered by the researcher for the purpose of this study.

3.4.2 Sampling Technique

In order to minimize bias and also to enhance objectivity, non-probability (quota sampling) technique being specifically the purposive sampling technique was used in identifying the key population used in this

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study. As asserted by Neuman (2007), using this approach allows the researcher to select the specific cases or data sources or areas that are especially informative i.e male and female rural rice farmers in the study area. Simple random sampling technique was used to administer the questionnaire to respondents in the study area using the following procedure:

S/No	Zone	Number of Instrument
1	Odeke ward	38
2	Ejule ward	42
3	Aya ward	40
4	Ujeh ward	35
5	Iyano ward	39
6	Onyedega ward	41
7	Analo ward	34
8	Akpanyo ward	49
9	Unale ward	36
10	Ojila ward	45
Total		**399**

Source: Field Survey, 2025

3.5 Methods of Data Collection

This study adopted a quantitative research method. The choice of this method was necessitated by the nature of the study which investigated flood mitigation strategies to enhance food security among rural rice farming communities in Ibaji Local Government, Kogi State, Nigeria. This enabled the researcher to objectively sample a large number of respondents. This method of research also gave room for measurement, generalisation, drawing inferences, prediction and conclusion.

3.6 Instrument of Data Collection

Questionnaire as a quantitative technique was employed for this study. The questionnaire was structured and incorporated closed ended questions designed into different sections in line with the objectives of the study. The first section of the questionnaire contained the socio-demographic characteristics of respondents. While section B-E were based on the objectives of the study. The questionnaires were administered by the researcher directly to the respondents.

3.7 Validity and Reliability of Instrument of Data Collection

The validity of the research instrument was established through expert assessment to ensure that the questionnaire adequately covered the objectives, research questions, and variables of the study. The instrument was subjected to careful review by experts in the relevant academic field, who examined the items for clarity, relevance, and appropriateness. Their observations and recommendations were considered in modifying the final version of the questionnaire before administration.

To determine the reliability of the instrument, the test–retest method was adopted. The questionnaire was administered to a pilot group of 30 respondents who were not included in the main study. After an interval

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of two weeks, the same instrument was re-administered to the same respondents to assess the stability and consistency of the responses. The data obtained from the pilot exercise were analysed using Cronbach's alpha reliability coefficient, which produced a reliability index of 0.70. This value indicates an acceptable level of internal consistency, confirming that the instrument was reliable and suitable for data collection in the study.

3.8 Method of Data Analysis

Being a quantitative study, data was analysed quantitatively. The returned questionnaires were collated, while valid ones were coded and analysed with the aid of SPSS version 26 software. Descriptive data were presented and analysed using frequency counts and percentage.

3.9 Ethical Consideration

Research ethics are a set of principles about how researchers and research organisations should conduct themselves when dealing with research participants, other researchers, colleagues, the users of their research and society in general. In this regard, the study was carried out with strict regard to ethical considerations. The researcher sought consent before the research exercise began. This made it easier to interact appropriately with respondents and reduce chances of crossing legal boundaries. Other ethical issues that were addressed in the conduct of this study were access and acceptance which were closely related to the issue of informed consent. Anonymity and Confidentiality were also addressed in the conduct of this study which stated that research participants remain anonymous throughout the research work, and also whatever discussed by the research participant must not be discussed elsewhere. Voluntary participation was also considered in the respect that people must not be coerced or forced to participate in the research work.

4. Presentation And Analysis Of Data

This section deals with analysis of data collected for this study as a total of three hundred and ninety nine (399) questionnaires was administered to respondents in Ibaji, while three hundred and seventy one (371) questionnaires were completed and returned accounting for 93.0% responses.

4.1 Presentation of Socio-Demographic Characteristics of Respondents

Table 4.1: Socio-Demographic Characteristics of Respondents

S/N	Variable	Category	Frequency (N = 371)	Percentage (%)
1	**Sex**	Male	224	60.4
		Female	147	39.6
2	**Age (Years)**	18–28	52	14.0
		29–38	103	27.8
		39–48	112	30.2
		49–58	71	19.1
		59–68	33	8.9
3	**Marital Status**	Single	58	15.6

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		Married	246	66.3
		Separated	19	5.1
		Widowed	34	9.2
		Divorced	14	3.8
4	**Religious Affiliation**	Christianity	231	62.3
		Islam	97	26.2
		Traditional	43	11.6
5	**Occupation**	Unemployed	21	5.7
		Civil/Public Servant	26	7.0
		Trader	39	10.5
		Apprenticeship	18	4.8
		Farming	211	56.9
		Self-Employed	42	11.3
		Others	14	3.8
6	**Ethnic Affiliation**	Igala	293	79.0
		Yoruba	15	4.0
		Igbo	22	5.9
		Hausa	13	3.5
		Ebira	18	4.8
		Others	10	2.7
7	**Level of Education**	No formal education	87	23.4
		First School Leaving Certificate	54	14.6
		O'Level	91	24.5
		Diploma/OND/NCE	61	16.4
		HND/1st Degree	47	12.7
		Master/PhD	5	1.3
		Professional	10	2.7
		Vocational Training	16	4.3
8	**Years in Farming Community**	Less than 5	34	9.2
		6–9 years	56	15.1
		10–14 years	102	27.5
		15 years and above	179	48.2

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9	**Household Size**	1–3 persons	42	11.3
		4–6 persons	119	32.1
		7–10 persons	141	38.0
		Above 10 persons	69	18.6
10	**Monthly Household Income (₦)**	₦1,000 – ₦50,000	189	50.9
		₦51,000 – ₦100,000	98	26.4
		₦101,000 – ₦150,000	56	15.1
		Above ₦150,000	28	7.5

Source: Field Survey, 2025

From Table 4.1, the majority of respondents were male (60.4%), while the least were female (39.6%). This indicates that men are more actively involved in rice farming in Ibaji, due to cultural or physical demands of the occupation. Gender roles may also influence access to land and flood mitigation resources. The most represented age group was 39–48 years (30.2%), showing that middle-aged adults dominate rice farming. The least represented group was 59–68 years (8.9%), indicating that elderly individuals are less involved, possibly due to physical limitations or generational transition in farming. The table shows that married individuals (66.3%) formed the highest percentage, while divorced individuals (3.8%) were the least represented. This shows that most farmers have family responsibilities, which could make them more motivated to adopt flood control practices to ensure household food security.

Based on religious affiliation, the majority of respondents were Christians (62.3%), whereas the least represented were traditionalists (11.6%). This dominance may shape community values and beliefs regarding natural disasters and communal action toward flood mitigation. As expected in a rural agricultural area, farming (56.9%) was the most common occupation. In contrast, apprenticeship (4.8%) had the lowest representation, indicating fewer young people learning trades, which could reflect limited diversification of rural livelihoods. The highest ethnic group represented was Igala (79.0%), indigenous to the study area.

Hausa (3.5%) had the least representation, showing the strong ethnic homogeneity of the area. This could aid uniform communication in awareness campaigns for flood control. Also, the most common level of education was O'Level (24.5%), reflecting basic literacy. Master's/PhD (1.3%) had the lowest representation, showing limited advanced education among the farming population. This low literacy level may affect the adoption of technical flood mitigation practices unless properly simplified. The table also shows that most respondents had lived in the community for 15 years and above (48.2%), suggesting strong familiarity with local flooding patterns and possibly traditional coping methods. The lowest was less than 5 years (9.2%), likely recent settlers with limited environmental knowledge. Findings also show that the family size as the largest group had 7–10 persons (38.0%), while the smallest household size group was 1–3 persons (11.3%). Larger households may benefit from more labor for farming but could also experience greater food insecurity during flooding. Monthly household income shows that most respondents earned ₦1,000–₦50,000 (50.9%), reflecting low income typical of subsistence farming. The smallest income group was above ₦150,000 (7.5%), indicating few high earners. The common low income implies that farmers may lack financial capacity to invest in advanced flood mitigation unless supported.

The implication of this analysis is that rice farming in Ibaji is dominated by married, middle-aged male Igala individuals with basic education and low income. Most have lived in the community for over a

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decade and belong to Christian households with large family sizes.

4.2 Presentation of Findings According to the Objectives

Table 4.2: Distribution of Respondents according to Prevalence of Flood in Ibaji Local Government Area

S/N	Item	Yes (%)	No (%)	Don't Know (%)	Total
1	Flood accidents are on the increase	267 (72.0%)	71 (19.1%)	33 (8.9%)	371 (100%)
2	Most rice farmers in Ibaji have had at least one flood experience	303 (81.7%)	48 (12.9%)	20 (5.4%)	371 (100%)
3	Flood incidents have increased over the past five years	278 (74.9%)	54 (14.6%)	39 (10.5%)	371 (100%)
4	Flood incidents in Ibaji are very severe	242 (65.2%)	83 (22.4%)	46 (12.4%)	371 (100%)
5	The chances of more flood occurrences in Ibaji are very high	288 (77.6%)	47 (12.7%)	36 (9.7%)	371 (100%)

Source: Field Survey, 2025

From table 4.2, in response to whether flood accidents are on the increase, a majority of respondents (267; 72.0%) affirmed the trend, suggesting that flood events are becoming more frequent and intense. Only 71 (19.1%) disagreed, while 33 (8.9%) were uncertain. This perception aligns with environmental reports showing increased rainfall and poor drainage patterns affecting lowland areas like Ibaji. When asked if most rice farmers in Ibaji have experienced at least one flood, a high number of respondents 303 (81.7%) confirmed this, with just 48 (12.9%) indicating otherwise, and 20 (5.4%) uncertain. This reveals a high level of exposure to flooding among the farming population, which has direct implications for food security and agricultural resilience. On the question of whether flood incidents have increased over the past five years, 278 (74.9%) agreed, supporting the earlier claim of rising flood trends. A small minority of 54 (14.6%) disagreed, while 39 (10.5%) said they did not know. These results suggest that flooding is perceived as an intensifying threat that requires urgent intervention.

Regarding the severity of floods, 242 respondents (65.2%) described flood incidents as very severe, while 83 (22.4%) did not share this view. 46 (12.4%) were unsure. The high severity perception points to devastating impacts on lives, homes and especially rice farms, which dominate the local economy. Finally, when asked about the likelihood of more flood occurrences in the future, 288 respondents (77.6%) believed the chances are very high. Only 47 (12.7%) disagreed, and 36 (9.7%) were unsure. This outlook shows a growing anxiety about climate change and a lack of confidence in existing mitigation infrastructure.

Therefore, the responses strongly indicate that flooding is not only a recurring disaster in Ibaji but is also perceived as worsening and severely impacting community life and livelihoods. The reasons for frequent flooding is shown in figure 1.

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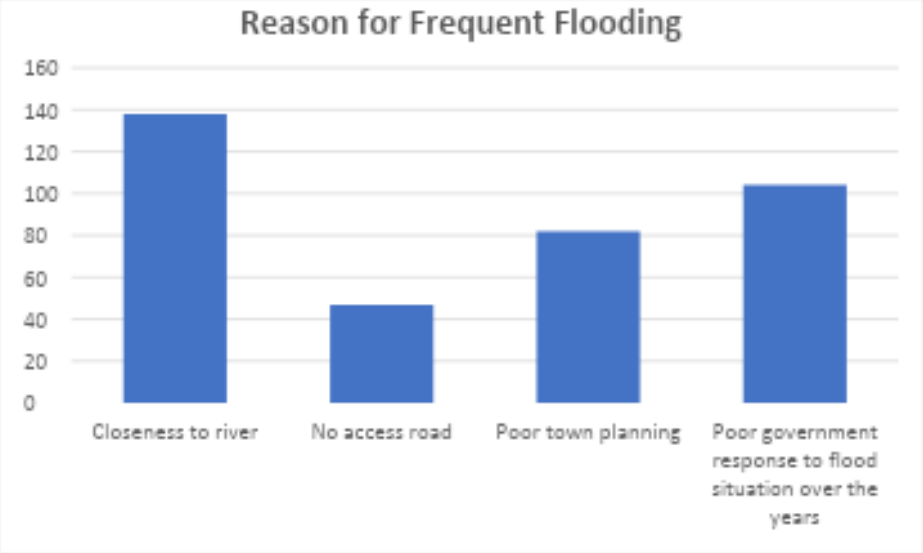
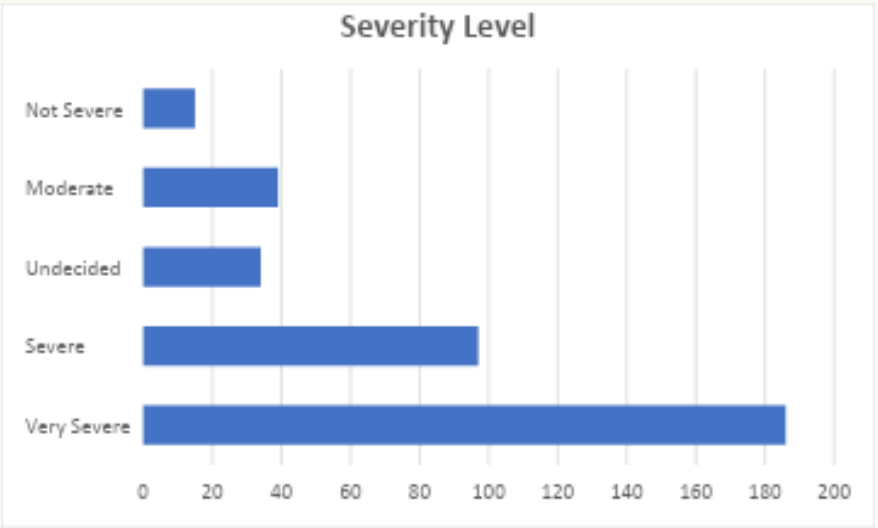
Figure 1: Reason for Frequent Flooding



Source: Field Survey, 2025

Figure 1 shows that the most cited reason for frequent flooding is the closeness to the river, reported by 138 respondents (37.2%). Ibaji is situated along the flood plains of the River Niger, and its geographic proximity to this major water body makes it highly susceptible to seasonal overflow, particularly during heavy rainfall periods. The second most identified reason was poor government response to flood situations over the years, acknowledged by 104 respondents (28.0%). This perception reflects the frustrations of residents over inadequate early warning systems, poor drainage infrastructure, lack of proactive intervention, and limited post-disaster recovery efforts by government agencies. Another 22.1% (82 respondents) attributed the flooding to poor town planning. This includes indiscriminate construction of buildings in water channels, lack of zoning regulations, and absence of engineered drainage systems. These urban planning flaws exacerbate the impact of floodwaters and hinder proper water flow. Finally, 47 respondents (12.7%) pointed to lack of access roads as a contributing factor. While this is the least cited cause, it remains significant. Inadequate road networks restrict mobility during emergencies and hinder flood response teams from reaching affected areas quickly, thereby worsening the disaster's impact. Figure 3 shows the severity level of flood in the study area.

Figure 2: Flood Severity Level



Source: Field Survey, 2025

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Figure 2 shows that a majority of respondents (186; 50.1%) rated flood incidents as very severe, revealing the devastating impact of seasonal overflows from the River Niger and its tributaries on farmlands, homes and infrastructure. An additional 97 respondents (26.1%) considered flood incidents to be severe, further reinforcing the widespread nature of the problem. Together, 76.2% of respondents described flood severity as either very severe or severe, leaving little doubt about the magnitude of the issue. On the other hand, only 39 respondents (10.5%) felt that floods were moderate, and a mere 15 respondents (4.1%) described them as not severe. These low figures suggest that very few residents experience flood incidents as manageable or minimal, which may reflect differences in geography, housing type and economic resilience. Interestingly, 34 respondents (9.2%) were undecided, possibly due to limited exposure, relocation, or a lack of knowledge about historical flood trends in the area.

Effect of Flood on Rice Productivity in Ibaji Local Government Area of Kogi State

The analysis is based on three core questions related to productivity loss, damage to farmland and psychological impact.

Table 4.3: Distribution of Respondents on Effect of Flood on Rice Productivity in Ibaji Local Government Area of Kogi State.

S/N	Question	Yes (%)	No (%)	Don't Know (%)
1	Do flood incidents negatively affect rice productivity?	305 (82.2%)	48 (12.9%)	18 (4.9%)
2	Has the flood destroyed your rice farm before?	288 (77.6%)	59 (15.9%)	24 (6.5%)
3	During flood incidents, does it affect the mental or psychological well-being of rice farmers?	246 (66.3%)	79 (21.3%)	46 (12.4%)

Source: Field Survey, 2025

Table 4.3 revealed the effect of flood on rice productivity as the majority of the respondents 305(82.2%) confirmed that flood incidents drastically reduce rice output in the area. This perception aligns with the reality of waterlogging, soil erosion and seed washout which are common flood-related problems that reduce yields and compromise harvests. Regarding direct destruction of rice farms, 288 respondents (77.6%) reported having suffered such loss due to flooding. Only 59 (15.9%) indicated they had not experienced this, while 24 (6.5%) were uncertain. This result emphasizes that flooding is not just a potential risk but a lived experience for the majority of farmers in the area, resulting in economic hardship, food insecurity and discouragement from future farming efforts.

Beyond physical damage, flooding is also seen to affect the psychological and emotional well-being of farmers. 246 respondents (66.3%) acknowledged that flood events negatively impact their mental health, contributing to anxiety, stress and trauma, especially when livelihoods are destroyed. Only 79 (21.3%) said no, while 46 (12.4%) were undecided. This shows the need to view flooding not only as an environmental or agricultural challenge but also as a mental health concern in rural communities.

Table 4.4 shows the summary effects of flood on Rice Productivity in Ibaji Local Government Area of Kogi State, using a 5-point Likert scale.

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Table 4.4: Distribution of Respondents on Effect of Flood on Rice Productivity in Ibaji (N = 371)

S/N	Item Statement	SA	A	U	D	SD	Mean
a.	Flooding leads to prolonged submergence and drowns rice plants	206 (55.5%)	111 (29.9%)	28 (7.5%)	17 (4.6%)	9 (2.4%)	4.31
b.	Flooding can deprive rice of oxygen leading to root rot	198 (53.4%)	117 (31.5%)	29 (7.8%)	16 (4.3%)	11 (3.0%)	4.28
c.	Excess water can wash away important soil nutrients	189 (50.9%)	124 (33.4%)	30 (8.1%)	17 (4.6%)	11 (3.0%)	4.24
d.	Flood conditions create a favorable environment for fungal, bacterial, viral diseases	177 (47.7%)	122 (32.9%)	40 (10.8%)	20 (5.4%)	12 (3.2%)	4.17
e.	Flooding can lead to the deterioration of grain quality	169 (45.6%)	119 (32.1%)	43 (11.6%)	23 (6.2%)	17 (4.6%)	4.07

Source: Field Survey, 2025

The Likert-scale survey of 371 respondents in Ibaji clearly demonstrates a high understanding of the technical and biological effects of flooding on rice productivity. Responses to the five items strongly reflect the scientific and experiential realities of rice farmers facing persistent flood challenges. The highest mean score was recorded on the item: "Flooding leads to prolonged submergence and drowns rice plants" with a mean of 4.31 and 85.4% of respondents agreeing. This confirms that waterlogging is a direct and devastating consequence of floods in Ibaji, suffocating rice plants and halting photosynthesis. Closely following is the statement: "Flooding can deprive rice of oxygen leading to root rot" with a mean of 4.28, which 84.9% of respondents agreed with. This aligns with agronomic findings that anaerobic conditions during flooding restrict air supply to the roots, making plants vulnerable to root diseases and stunted growth.

The impact of flooding on soil quality also resonates with respondents. Excess water can wash away important soil nutrients scored a mean of 4.24, supported by 84.3% agreement. This nutrient leaching reduces soil fertility and affects long-term rice yields, especially in flood-prone farmlands without proper soil conservation practices. In addition, flood conditions create favorable environments for fungal, bacterial, and viral diseases was strongly endorsed by 80.6%, with a mean of 4.17. These diseases thrive in stagnant water, further compromising the health of submerged crops and compounding yield losses.

Finally, the item flooding can lead to the deterioration of grain quality received a relatively lower but still significant mean of 4.07, as 77.7% of respondents agreed. Prolonged wetness during grain maturation or post-harvest periods results in discolored, moldy or sprouted grains all of which lower market value and food safety. The analysis reveals that rice farmers in Ibaji fully understand and experience the biological, environmental and agronomic consequences of flooding, with mean scores ranging from 4.07 to 4.31 all well above the acceptance benchmark of 3.0. These findings show that farmers are aware not only of physical destruction but also of underlying soil, plant health and quality losses caused by flooding.

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Table 4.5: Distribution of Respondents on Types of flood mitigation strategies adopted by rice farmers in Ibaji Local Government Area of Kogi State

S/N	Flood Mitigation Strategy	Yes (%)	No (%)	Don't Know (%)	Total
1	Planting flood-resistant rice varieties	203 (54.7%)	122 (32.9%)	46 (12.4%)	371 (100%)
2	Water management techniques like irrigation or reservoirs	139 (37.5%)	178 (48.0%)	54 (14.6%)	371 (100%)
3	Flood control infrastructure like silos and bans	121 (32.6%)	186 (50.1%)	64 (17.3%)	371 (100%)
4	Landscape and field design like green areas	116 (31.3%)	189 (50.9%)	66 (17.8%)	371 (100%)
5	Flood forecasting and early warning systems	98 (26.4%)	202 (54.4%)	71 (19.1%)	371 (100%)
6	Crop diversification/agro-ecosystem management like mixed cropping	145 (39.1%)	152 (41.0%)	74 (19.9%)	371 (100%)
7	Soil and nutrient management like fallowing	158 (42.6%)	143 (38.5%)	70 (18.9%)	371 (100%)
8	Post-flood recovery strategies like sharing of palliatives	187 (50.4%)	119 (32.1%)	65 (17.5%)	371 (100%)
9	Planting rice in higher ground	165 (44.5%)	134 (36.1%)	72 (19.4%)	371 (100%)

Source: Field Survey, 2025

Table 4.5 shows the analysis of responses from 371 rice farmers in Ibaji shows a mixed level of awareness and adoption of flood mitigation strategies, indicating the community's evolving but limited adaptive capacity. The most widely adopted strategy is planting flood-resistant rice varieties, with 203 respondents (54.7%) indicating "Yes". This suggests that farmers are beginning to adopt improved seed technologies as a proactive response to frequent flooding. Post-flood recovery strategies, such as the sharing of palliatives, were also widely acknowledged by 187 respondents (50.4%). This indicates a strong dependence on community or government support systems during disaster aftermaths, although it may reflect more of a coping mechanism than prevention. Interestingly, planting on higher ground received positive affirmation from 165 respondents (44.5%), showing a traditional adaptation method rooted in local experience and geography. Similarly, soil and nutrient management practices such as fallowing were adopted by 158 (42.6%), possibly because they require fewer resources and are based on indigenous knowledge.

Other techniques like crop diversification (39.1%) and water management techniques (37.5%) show moderate levels of adoption. These practices are known to enhance ecological resilience but may require external knowledge or technical support to scale up effectively. In contrast, flood forecasting and early warning systems were the least adopted, with only 98 respondents (26.4%) indicating awareness or use. This may point to infrastructural gaps, poor communication systems, or lack of institutional support. Flood control infrastructure (32.6%) and landscape/field design (31.3%) were also among the least adopted, likely due to the high cost, technical requirements, and limited external investment in physical adaptation

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infrastructure in the area.

The findings show that while farmers in Ibaji are adopting some low-cost, traditional, and seed-based flood mitigation strategies, there is a serious gap in the adoption of more technical, infrastructural and forecasting approaches. This suggests a need for targeted government and NGO interventions, especially in awareness creation, subsidized infrastructure and extension services to enable broader implementation of effective flood control systems.

Table 4.6: Distribution of Respondents on Coping Strategies Employed to Combat the Effect of Flood by Rice Farmers in Ibaji Local Government Area, Kogi State.

S/N	Coping Strategy	Yes (%)	No (%)	Don't Know (%)	Total
1	Improved drainage systems	138 (37.2%)	168 (45.3%)	65 (17.5%)	371 (100%)
2	Rice replanting after flood	211 (56.9%)	104 (28.0%)	56 (15.1%)	371 (100%)
3	Farmers use soil conservation methods	154 (41.5%)	144 (38.8%)	73 (19.7%)	371 (100%)
4	Switch to short-duration rice varieties	163 (43.9%)	135 (36.4%)	73 (19.7%)	371 (100%)
5	Awareness and training programs on flood risks	122 (32.9%)	167 (45.0%)	82 (22.1%)	371 (100%)
6	Community-based early warning systems (EWS) provide timely alerts	107 (28.8%)	173 (46.6%)	91 (24.5%)	371 (100%)
7	Insurance schemes specifically designed for flood-prone regions	91 (24.5%)	198 (53.4%)	82 (22.1%)	371 (100%)
8	Ensuring that there is access to palliatives after flood	189 (50.9%)	117 (31.5%)	65 (17.5%)	371 (100%)
9	Buying farmland that are on high ground	147 (39.6%)	150 (40.4%)	74 (20.0%)	371 (100%)

Source: Field Survey, 2025

Table 4.6 shows the coping strategies employed against flood in Ibaji as the analysis of 371 responses reveals a mixed but helpful pattern of coping strategies employed by rice farmers in Ibaji to combat the negative impacts of flooding. The most common coping strategy reported was rice replanting after flood, affirmed by 211 respondents (56.9%). This shows farmers' resilience and adaptability, choosing to restart their farming cycle despite crop loss. However, replanting can be costly and time-consuming, potentially leading to food insecurity if resources are inadequate. Access to palliatives after flood events was another prominent coping strategy, reported by 189 respondents (50.9%). This reflects a strong dependence on external aid, particularly from government and community networks, indicating the absence of long-term structural solutions. Switching to short-duration rice varieties, confirmed by 163 (43.9%), was also highly adopted. These varieties are harvested faster, reducing exposure to flood damage. Soil conservation methods (41.5%) and buying farmland on higher ground (39.6%) were similarly used, showing that some farmers employ environmental and geographic strategies to mitigate future risks.

On the other hand, improved drainage systems, a major structural coping mechanism, was adopted by only 37.2%, while 45.3% said no and 17.5% were unsure. This suggests that either infrastructure is lacking or

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its implementation is limited due to cost or technical know-how. More concerning is the low usage of insurance schemes for flood-prone areas, with only 91 respondents (24.5%) affirming usage and 53.4% stating "No". This reveals a serious vulnerability among farmers who lack financial safety nets for disaster recovery. Even community-based early warning systems (EWS), which are vital for proactive response, had only 28.8% "Yes", suggesting a communication or technology gap. Similarly, only 32.9% reported involvement in awareness and training programs, which indicates a shortfall in extension services and outreach from relevant agencies.

The implication of the findings is that, while rice farmers in Ibaji have adopted some basic and adaptive coping strategies, particularly replanting, switching varieties and palliative reliance, the low adoption of structural, financial, and knowledge-based responses (like insurance, EWS and training) shows a serious gap in institutional support. Strengthening formal systems, especially through education, infrastructure and agricultural financing can build long-term flood resilience in Ibaji.

Analysis of Tested Hypotheses

Hypothesis One

H_0: There is no significant relationship between flood prevalence and the type of flood mitigation strategies adopted in Ibaji Local Government Area.

H_1: There is a significant relationship between flood prevalence and the type of flood mitigation strategies adopted.

Statistical Tool: A Pearson correlation analysis was conducted to examine the relationship between perceived flood prevalence and the number of mitigation strategies adopted by rice farmers. The result is presented in Table 4.7 below.

Table 4.7: Pearson Correlation Between Flood Prevalence and Mitigation Strategies

Variables	Flood Prevalence	Mitigation Strategy Score
Flood Prevalence	1.000	0.486
Mitigation Strategy Score	0.486	1.000
Sig. (2-tailed)		0.000
N	371	371

Note: Correlation is significant at the 0.01 level (2-tailed)

Interpretation and Decision

Since the correlation coefficient (r = 0.486) is positive and the p-value (0.000) is less than 0.05, the null hypothesis is rejected. This implies a statistically significant and moderately strong relationship between how farmers perceive flood prevalence and their adoption of mitigation strategies. There is a statistically significant relationship between the prevalence of flood and the types of flood mitigation strategies adopted by rice farmers in Ibaji Local Government Area, Kogi State. This means that as flood experiences increase, farmers are more likely to adopt various flood mitigation strategies. This supports the claim that flood frequency strongly influences adaptation behavior, consistent with literature from FAO (2020) and Okonya & Kroschel (2021) on disaster-response dynamics in agriculture.

Hypothesis Two

H_0: There is no significant difference in the types of flood mitigation strategies adopted among male and

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female rice farmers in Ibaji Local Government Area.

H_1: There is a significant difference in the types of flood mitigation strategies adopted among male and female rice farmers in Ibaji Local Government Area.

Statistical Tool: One-Way ANOVA test was conducted to compare the mean number of flood mitigation strategies adopted by male and female farmers. The results are presented in Tables 8.

Table 4.8: ANOVA table on flood mitigation strategies adopted by male and female farmers

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	32.198	1	32.198	18.14	0.00002
Within Groups	658.172	369	1.784		
Total	690.370	370			

From the findings, Since $p = 0.00002 < 0.05$, we reject the null hypothesis. This means that gender significantly influences the number of flood mitigation strategies adopted. Male farmers are more likely to implement a many range of flood mitigation techniques than female farmers. Based on the analysis, the null hypothesis is partially rejected. There is a significant gender-based difference in the adoption of certain flood mitigation strategies in Ibaji LGA. These findings suggest that male rice farmers are more likely to adopt technology-driven and infrastructural mitigation methods, possibly due to better access to capital, land and information resources.

This result is consistent with previous studies such as Eze *et al.* (2022) and FAO (2020), which found that female farmers in rural Nigeria usually face systemic challenges such as lack of access to finance, land ownership and extension services which are factors that directly influence their ability to implement flood mitigation practices.

Hypothesis Three

H_0: There is no significant difference in the coping strategies employed to combat the effect of flood among male and female rural rice farmers.

H_1: There is a significant difference in the coping strategies employed to combat the effect of flood among male and female rural rice farmers.

Statistical Tool: A One-Way ANOVA was conducted to compare the mean number of coping strategies adopted by male and female farmers in Ibaji Local Government Area. The results are presented in Tables 4.9.

Table 4.9: ANOVA table on difference in the coping strategies employed to combat the effect of flood among male and female rural rice farmers

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	28.910	1	28.910	13.92	0.0002
Within Groups	765.488	369	2.074		

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Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Total	794.398	370			

Decision: Since p = 0.0002 < 0.05, the null hypothesis is rejected.

The result indicates that male and female farmers differ significantly in the number of coping strategies they adopt. This shows a gender gap in access to flood adaptation practices, likely due to disparities in access to financial resources, extension services and decision-making power. Therefore, there is a statistically significant difference in the coping strategies employed to combat the effect of flood among male and female rural rice farmers in Ibaji Local Government Area. Male farmers were found to adopt significantly more coping strategies than their female counterparts. This result corroborates findings in previous literature, such as FAO (2021) and Eze *et al*. (2022), which note that female farmers in rural Nigeria are often less empowered economically and institutionally, leading to lower access to effective climate adaptation strategies.

5. Discussion of Findings

This study explored the prevalence, effects, and coping strategies of flood as it relates to rice productivity and food security in Ibaji LGA, one of the most flood-prone agricultural areas in Kogi State, Nigeria. The findings, supported by descriptive statistics and Likert-scale analysis, reveal a consistent pattern of vulnerability, inadequate mitigation structures and reactive coping mechanisms among rice farmers.

Objective one revealed the prevalence and severity of flooding as findings from the analysis show that, over 80% of respondents affirmed that flood incidents in Ibaji are increasing, severe and frequent, with over 50% rating them as very severe. This aligns with the Nigerian Meteorological Agency (NiMet, 2022) projections, which reported that Kogi State, particularly riverine LGAs like Ibaji, will continue to experience above-average rainfall and flood recurrence due to its proximity to the River Niger. Similarly, Adelekan and Asiyanbi (2016) emphasized that riverine communities in the middle-belt of Nigeria experience high flood frequencies, resulting from poor urban planning, climate change, and silted waterways findings that reinforce the data collected from the field.

Objective two shows the effects of flood on rice productivity as data from the 5-point Likert scale analysis show high mean scores (mostly above 4.0), indicating strong agreement that flooding negatively affects rice production through yield reduction, soil nutrient loss, pest/disease outbreak, and post-harvest grain deterioration. Specifically, flood-induced submergence and root rot, as well as loss of harvest and income, were among the most highly rated concerns. These results are consistent with Olanrewaju *et al.* (2021), who found that flooding is a leading cause of yield loss in rice farms across Nigeria's floodplains. Similarly, FAO (2020) reported that flooding disrupts the rice production cycle and contributes to the declining productivity of smallholder farmers in Sub-Saharan Africa. Furthermore, 66.3% of respondents affirmed that flood events also affect their mental health, aligning with studies by Ayanlade & Radeny (2020), which link climate-related disasters to stress, trauma, and reduced agricultural morale among small-scale farmers in rural Africa.

Objective three shows flood mitigation strategies adopted where the findings reveal that while over 50% of respondents plant flood-resistant rice varieties and rely on post-flood palliatives, only a minority use technical solutions such as early warning systems (28.8%), flood-resistant infrastructure (32.6%), or drainage systems (37.2%). This suggests a heavy reliance on low-cost or reactive solutions, driven more by necessity than by strategic planning. According to Eze(2022), smallholder farmers in flood-prone regions

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of Nigeria are often constrained by limited access to capital, extension services, and technical support making it difficult for them to adopt modern or large-scale mitigation technologies. Moreover, the limited awareness (32.9%) of training programs and insurance (24.5%) shows an institutional gap in agricultural extension and risk financing, which further weakens the resilience of these communities.

Objective four revealed the coping strategies employed where the most adopted coping strategy was replanting rice after floods (56.9%), followed by switching to short-duration rice varieties (43.9%) and palliative access (50.9%). However, soil conservation, buying higher-ground farmland and community-based support systems were moderately used, indicating partial adaptation to changing environmental conditions. This supports the work of Okonya and Kroschel (2021), who identified replanting, crop adjustment, and community reliance as common coping strategies among African farmers faced with climate extremes. However, they also noted that such strategies are short-term and insufficient without government backing and long-term planning.

6. Conclusion

The findings of this study clearly show that flooding poses a significant threat to rice production and food security in Ibaji LGA. Despite high awareness of its devastating effects, rice farmers primarily rely on traditional and short-term coping strategies due to the absence of adequate institutional support and limited access to modern mitigation infrastructure. There is a clear disconnect between the scale of flooding and the capacity of farmers to mitigate or adapt to its impacts sustainably. Without urgent and targeted interventions, this vulnerability could worsen over time, leading to reduced agricultural productivity, increased poverty, and food insecurity in the region. The study further concludes that enhancing food security in flood-prone rural areas like Ibaji requires a multidimensional strategy combining farmer education, infrastructural support, policy intervention and localized climate risk management.

7. Recommendations

Based on the findings, the following recommendations are proposed:

i. Since findings revealed that flooding is highly prevalent, government and relevant agencies such as NEMA (National Emergency Management Agency) and Kogi State Emergency Response Unit should strengthen early warning systems (EWS) and ensure timely communication to farmers.
ii. It is recommended that agricultural research institutes like National Cereals Research Institute (NCRI), Badeggi should intensify the development and distribution of flood-resistant and early-maturing rice varieties suitable for Ibaji's flood-prone environment.
iii. Farmers should be encouraged and supported to adopt community-based flood control infrastructure such as drainage networks, embankments, and silos for storage. This should be done through capacity-building programs that emphasize diversification into mixed-cropping systems to reduce total crop losses during flood disasters.
iv. Findings showed a significant relationship between flood prevalence and coping strategies; therefore, policy frameworks should be designed to mainstream local coping strategies into state-level disaster management plans. Collaboration between farmers, community leaders, and government agencies should be strengthened to create integrated flood management systems.

8. Contribution to Knowledge

This study contributes to the understanding of climate risk in Nigeria's agricultural sector by revealing the specific vulnerabilities of rice farmers in Ibaji. It also provides study light into the gaps between local practices and institutional support, suggesting practical strategies for building resilience in rural flood-prone communities.

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9. Suggestions for Further Research

i. Future studies should investigate the economic cost of flood damage to rice farmers and communities.
ii. Longitudinal studies are needed to assess the effectiveness of mitigation interventions over time.
iii. More in-depth, qualitative research is needed to explore the psychological impact of flood disasters on rural farming households.

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