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ASSESSMENT OF FLOOD OCCURRENCES AND ADAPTATION STRATEGIES BY RICE FARMERS IN KOGI STATE, NIGERIA

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ABSTRACT

This study analysed flood occurrences and adaptation strategies among rice farmers in the flood-prone communities of Kogi State, Nigeria. The specific objectives were to: describe the farmers' socioeconomic characteristics; assess the type and frequency of flooding; identify adaptation strategies used. Primary data were collected from a sample of 117 rice farmers selected through a multi-stage sampling technique. The data were analyzed using descriptive statistics (frequency, percentage, mean and standard deviation). The findings revealed that the farming population was predominantly male (58.97%), young (mean age 32.29 years), and highly literate, with 95.72% having attained secondary or tertiary education. Riverine flooding was identified as the most significant decadal threat (reported by 91.45%), while other flood types occurred more frequently on an annual basis. The most widely adopted adaptation strategy was the introduction of new crops (88.89%). Introduction and increased animal production with application of inorganic fertilizer (76.07%) ranked 2nd strategy while Dry season farming (irrigation) (74.36%) ranked 4th adaptation strategy among others engaged by rice farmers in the study area. Key recommendations include developing gender-sensitive extension, enhancing farmer training, strengthening cooperatives, and improving access to financial services and climate insurance.

Keywords: *flood occurrences, adaptation strategies, rice farmers*

INTRODUCTION

Background to the study

Agriculture plays a crucial role in the national economy, accounting for 88% of the export revenue and 70% of the country's workforce. The agricultural sector generates approximately 27.1% of the gross domestic product (GDP) and represents approximately 40% of this contribution (World Development Indicators, 2020). Cereals are of paramount importance in the crop production subsector, mainly led by maize, sorghum, and rice.

Rice is very important in Nigeria, based on the various ways it can be used. The capability to produce more rice has aided in development of numerous communities, while its failure has led to the spread of starvation, death and political uncertainty in many countries including Nigeria (Oludare, 2014). The acceptance of rice as food has witness an upsurge lately by becoming a major crop in many countries in America and Africa (Seck *et al*., 2012).

Climate change is a global challenge that affects agriculture in many tropical regions, where it tends to be weather sensitive (Qiao *et al*., 2022; Ikpe and Omede, 2025; Vinaya and Gadde, 2025). Climate change is predicted to affect several aspects of rural livelihoods, such as sustainable agricultural production, food safety, and food quality (Gezie & Tejada Moral, 2019). Specifically, climate predictions indicate increasing trends in severe and moderate drought events by 2060, resulting in a 40% crop yield loss (Ahmed, 2020).

Smallholder farmers are unable to understand the potential impacts of climate change on their farming systems and anticipate sustainable adaptations. Climate predictions suggest that floods, droughts, aridity, and changes in rainfall will compromise agriculture (Serdeczny *et al*., 2017).

Nigeria is susceptible to climate risks because the majority of the populace (about three-quarter) depends on rain-fed agricultural systems for their livelihood. The National Adaptation Strategy and Plan of Action on Climate Change for Nigeria states that if nothing is done to manage climate change-related hazards and shocks in Nigeria (Opaluwa, *et al*, 2020).

Climate change negatively impacts rice productivity in different parts of Africa. As a matter of necessity, farmers

must respond to changing the climate by choosing adaptation strategies that increase their productivities (Ajibade, *et al*, 2024). Adaptation is very important in managing risks posed by climate change to rice farming. The climate change adaptation strategies employed by rice farmers to mitigate the effect of climate change include varying land size, sales of crops, and varying planting and harvesting dates; soil and water conservation techniques; and mulching (Bairagi *et al*., 2021).

Sustaining the rice grain yield under climate change conditions is a significant challenge at local, regional, and global level. So, adaptation strategies become imperative and are mandatory for reduction of the climate susceptibilities. The adversative impact of climate warming can be lessened by evolving of heat tolerance, demanding higher growing degree days cultivars and some modifications in current rice crop management practices and technologies. Adaptation strategies deliver the valuable information for the researchers, academia, as well as farming community for the mitigation of the adverse impact of climate warming. Floods are a climatic risk that can result in significant yield losses for smallholder farmers (Bunuo *et al*., 2024).

Problem statement

One of the most severe flooding events in Nigeria occurred in August 2012 which had its effects across the nation including Kogi State. This natural disaster resulted from the overflow of rivers, particularly in Northern Benin, worsening the economy of local communities (Bonou *et al*., 2024). A prior flooding event occurred in 2010, with a nationwide area of farmland lost equalling approximately 50,764 ha and a decrease in food supply of up to approximately 2 million tons (World-Bank, 2011).

Rice cultivation typically occurs in favourable wet environments that are prone to both floods and droughts. Nevertheless, the impacts of flooding on yield reduction are significantly more pronounced than those of droughts (Meng and Qian, 2024). Moreover, because the majority of the favourable agroecological regions are located near rivers, lakes, or other water bodies, they are more susceptible to flooding promoted by climate change. Consequently, understanding the severity of the repercussions associated with climate change, such as flooding, is imperative for devising local adaptation strategies.

It is against this background that the study is designed to provide answers to the following research questions:

(1) What are the socioeconomic characteristics of rice farmers in the study area?

(2) What are the type and frequency of flooding event experienced by rice farmers in the study area?

(3) What are the various adaptation strategies used by rice farmers in the area?

OBJECTIVES

The broad objective of this study is to assess flood occurrences and adaptation strategies by rice farmers in flood-prone farming communities, Kogi State, Nigeria

The specific objectives are to:

(1) describe the socioeconomic characteristics of rice farmers in the study area;

(2) assess the type and frequency of flooding event experienced by rice farmers in the study area;

(3) reveal the various adaptation strategies used by rice farmers in the area.

Justification of the study

This study paves the way for possible environmental sensitive interventions to be implemented by experts and community development officers in order to minimize and strengthen household capacity in coping with flood risks and food insecurities.

This study therefore is useful to students, policy makers as it provides better understanding on climate change, adaptive strategies in the event of flood among rice farmer in the area and identifies the challenges, opportunities, lessons learnt will provide an important input in other similar projects.

Finding from this study will go a long way to guide farmers in handling flood cases and even extension agents in provision of relevant information to the farmers.

Conceptual framework

The generalized framework that guides research (Figure 1) was developed and serves as the conceptual framework. The first step includes a comprehensive review of rice crop production further the analyse the downscaled climate analysis. The abiotic stressors associated with climate change include changes in long term trends in temperature, rainfall, soil moisture contents and increasing trend in extreme events including heat, drought, salinity, and submergence/floods.

With all these stressors in place farmers adopt different strategies to mitigate the effects of climate change in rice production thereby improving rice output as presented in figure1 below.

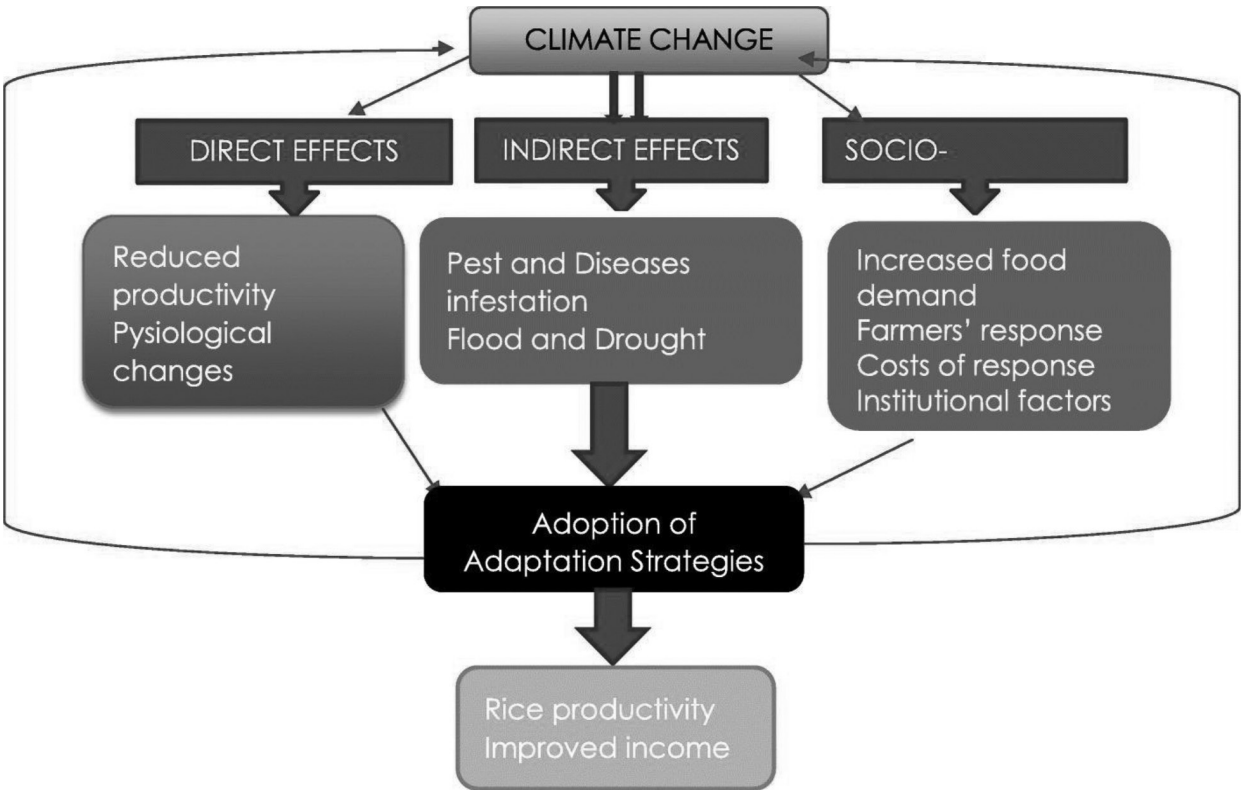

Fig. 1 : Conceptual framework showing the relationship between climate change, adaptative strategies and rice production (Adopted from ojo and baiyegunhi, 2020)

LITERATURE REVIEW

Overview of rice production in nigeria

According to Muhammed, (2019), rice is cultivated in virtually all the agro-ecological zones in Nigeria. Despite this, the area cultivated to rice still appears small. In 2000, out of about 25 million hectares of land cultivated to various food crops, only about 6.37% was cultivated to rice. During this period, the average national yield was 1.47 tons per hectare. Significant improvement in rice production in Nigeria occurred in 1980 when output increased to 1 million tons while area cultivated and yield rose to 550 thousand hectares and 1.98 tons per hectare respectively. Throughout the 1980s, rice output and yield increased. But in the 1990s, while rice output increased, the yield of rice declined, suggesting extensive rice cultivation. (Usman, 2014).

Climate change and rice production

Climate change negatively impacts rice productivity in different parts of Africa. As a matter of necessity, farmers must respond to changing the climate by choosing adaptation strategies that increase their productivities.

Floods are a climatic risk that can result in significant yield losses for smallholder farmers. Decrease in rice yield is usually accompanied by an increase in flooded farm proportion. The expected rice yield for a 10% flooded rice land was 7.20 tons/ha throughout the year. Additionally, an increase in the proportion of flooded rice land from 10% to 20% resulted in a decrease of 1.19 tons/ha of rice yield. During the wet season, floods negatively impacted rice yield, irrespective of their severity. Conversely, flooding benefited rice production in the dry season following flooding. These findings offer policymakers insight into appropriate protection plans and adaptation strategies (Bunuo *et al.,* 2024).

Consequently, future climate events are expected to affect the yield of tropical crops, raising concerns regarding food insecurity, particularly in rural households (Palazzo *et al*., 2017). Furthermore, reductions in rice yields can be attributed to changes in atmospheric conditions. In 2018, the total rice yield loss in the Long Xuyen Quadrangle was estimated at 15,729 tons. This resulted in an economic loss amounting to approximately 1.47% of the total gross regional domestic product of the Long Xuyen Quadrangle in the Vietnam Mekong Delta (Bui & Nguyen, 2024). Consequently, adapting farming systems to climate change will require a thorough understanding of its impacts on the livelihoods of agricultural households (Devkota & Bhattarai, 2018).

Adaptative strategies and their effects on rice yield

Adaptation is very important in managing risks posed by climate change to rice farming. The climate change adaptation strategies employed by rice farmers to mitigate the effect of climate change include varying land size, sales of crops, and varying planting and harvesting dates; soil and water conservation techniques; and mulching. Other adaptation strategies include the rearing of improved livestock varieties, and mixed cropping, combined effects of climate change adaptation strategies and some socioeconomic characteristics such as age, gender, education, farming experience, access to credit, access to information, membership of farmers in agricultural based cooperative and location of rice farmers

The importance of adaptation in climate change management cannot be overemphasized. The vulnerability of rice production to climate change has received attention from researchers. Terdoo and Feola (2016) observed rice production, especially in sub-Saharan Africa, is highly sensitive to climate change. Therefore, there is an urgent need to reduce the vulnerability of the rice sector to climate change. Adapting rice production to climate change is necessary to increase farmers' yields and food security. There are several local adaptation practices used by farmers in managing climate risks in different parts of the world. Some of the local adaptation practices include minimum tillage, drainage and bond, combined use of organic and inorganic fertilizer, crop diversification, improved rice varieties, use of nursery, use of pesticides, livelihood diversification and changing planting and harvesting dates (Oselebe *et al*., 2016

Several researchers have noted the importance of minimum tillage in controlling flood and erosion, enhancing soil fertility and climate resilience as well as conserving the environment (Verhulst *et al*., 2014).

The combined use of organic and chemical fertilizer is also an important climate change adaptation strategy in agricultural production. Climate change depletes soil fertility through increased flooding, erosion, runoff and washing away of soil nutrients (Brevik, 2013) thereby adversely affecting soil pH, water holding capacity, bulk density and other soil properties. Correct use of organic and chemical fertilizers (in terms of getting the fertilizers from the right sources, using the right rate and applying the fertilizer at the right time and place) enhances soil fertility and increases yield thereby reducing farmers' vulnerability to climate change. Similarly, improved rice varieties have been used by many farmers in managing climate risks. Early maturing rice varieties, for instance, are better suited for managing delayed onset and early cessation of rain that now characterize agricultural production in many parts of Nigeria. The construction of local drainages and bunds for managing climate risks in agricultural systems has received considerable attention by researchers (Aryal *et al*., 2017).

Crop diversification reduces the impacts of climate change on farmers and contributes to their buffer capacity (Belay *et al*., 2017). Crop diversification contributes to climate change adaptation in rice production because production and income risks are spread through planting different crops, which in turn leads to minimization of farmers' vulnerability.

Climate change adaptative measures

Adaptation is an essential response action for minimizing the vulnerability of farmers to climate change. Many countries in the world have focused on strategic adaptation plans and actions to reduce the vulnerability of sectors, communities and regions (Egwu, 2014).

The climate change adaptation strategies employed by rice farmers to mitigate the effect of climate change include varying land size, sales of crops, and varying planting and harvesting dates; soil and water conservation techniques; and mulching. Other adaptation strategies include the rearing of improved livestock varieties, and mixed cropping, combined effects of climate change adaptation strategies and some socioeconomic characteristics such as age, gender, education, farming experience, access to credit, access to information, membership of farmers in agricultural based cooperative and location of rice farmers (Onyeneke, ٢٠٢٠)

METHODOLOGY

Study area

The study area is flood-prone area of Kogi State, Nigeria. Kogi is popularly called the *"Confluence State"* because of the confluence of river Niger and river Benue at its capital, Lokoja, which is the first administrative capital of modern-day Nigeria. The state is divided into three senatorial districts (Kogi East, Kogi Central and Kogi West) and structured into 21 local government areas (Ponchang *et al*., 2017). It is situated between latitudes 6°33'N and 8°44'N and longitudes 3°22'E and 7°49'E with a total land area of 29,833 Sq. km and an estimated population of 4,473,500 (National Population Commission, 2016). About 172,000 farm families, 70% of who lives in the rural areas and are actively engaged in crop production and rearing of animals (Ibitoye, 2021).

The state is characterized by a tropical climate with distinct dry season between November and March and a wet

season between April and October. Majority of the population are predominantly farmers who are into both crops farming and animal rearing.

Kogi State has a total population of 4,473,500 which is made up of 1,691,737 males and 1,586,750 females, with an average of 172,000 farm families (National Population Commission, 2016). The State is located between latitude $6^0$30'N, and $8^0$50N, and Longitude $5^0$51'E and 8^0.00'E Kogi State Economic Empowerment and Development (KOSEEDS, 2014). It shares common boundaries with Niger, and Nasarawa States and the Federal Capital Territory to the North and Benue State to the East. To the West, it is bounded by Kwara, Ekiti and Ondo States and to the South by Enugu, Anambra, and Edo States. With a total land mass of about 30,354.74 square kilometers. About 2 million hectares of her land is cultivable, but only 0.5 million hectare is currently under cultivation (KOSEEDS, 2014). It is well supplied with river valleys and swamp lands for dry season farming. Annual rain fall stands between 1016mm and 1524mm. it has a minimum temperature of 33.2°C and average temperature of 22.8°C, with an average humidity of 70% it has a land area of 154.3Km^2 (NPC, 2016).

The major occupation of the people is farming. A few people are in the civil service, trading and the crafts. The farmers practice several farming systems such as sole cropping, mixed cropping and mixed farming. There is strong land tenure system in the State. Land belongs to the community, clan and the family. Community and clan land are available for common projects in the community. Family land is used mainly for farming and such land is passed from father to son through inheritance. Important food and cash crops grown in the state are rice, cassava, yam, cocoyam, sweet potato, maize, sorghum, millet, cowpea, pigeon pea, bambara ground nuts, groundnuts, beniseed, melon, banana/ plantain and cotton. Fruits and leafy vegetables such as okro, pepper, fluted pumpkin and spinach are highly cultivated Tree crops grown in the state are cashew, cocoa, coffee, oil palm and citrus. Cattle, sheep, goats and poultry are the major animals reared.

Fish farming is coming up among the elite farmers. Fishermen carry out fishing activities on rivers Niger and Benue, their tributaries and other inland water bodies.

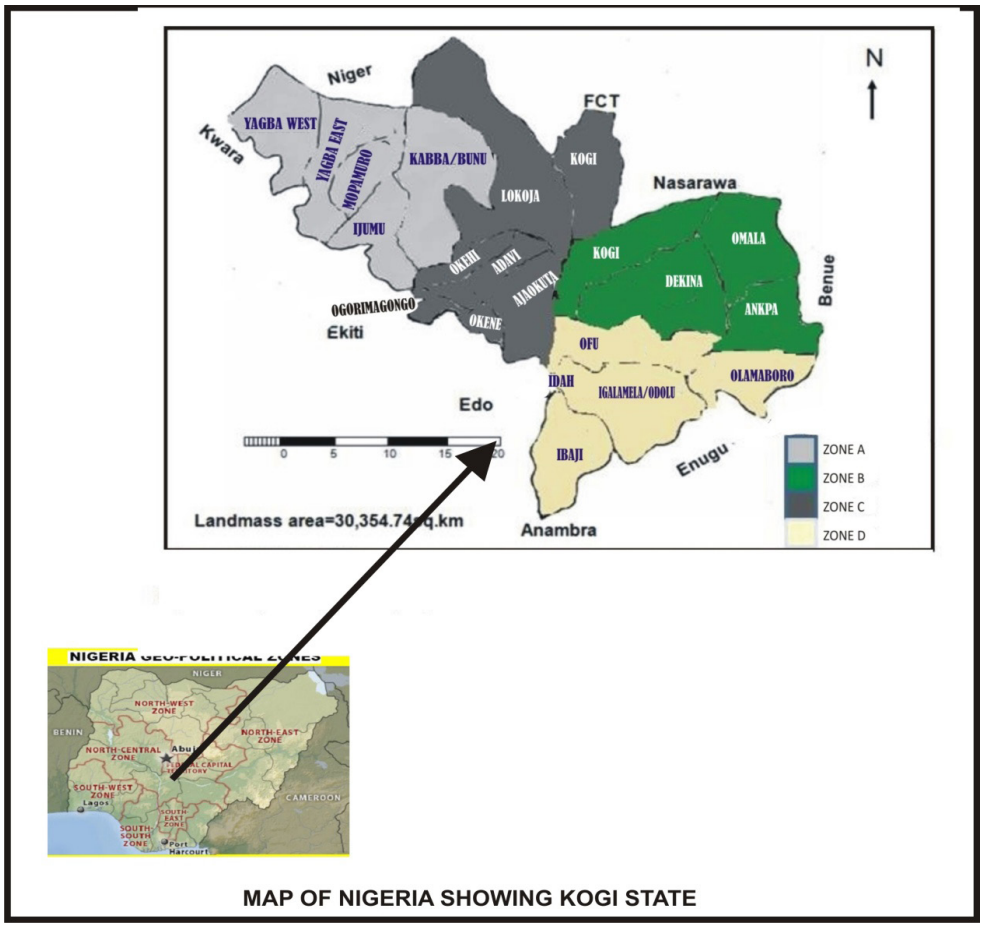

Figure 2: Map of Nigeria Showing Kogi State
(Source: Ksu Geography Department Gis Lab)

Population of the study

The entire rice farmers in flood-prone farming communities in Kogi State Nigeria constitute the population of the study.

Sampling procedure and sampling size

A multistage sampling procedure was used for the study. Firstly, Ibaji, Idah and Kotokerfi Local Government Areas (LGAs) of the state was purposively selected due to their involvement in rice production and their flood-prone nature. Secondly, 2 flood-prone communities were selected randomly from the selected LGAs to give a total of 6 communities in all. Thirdly, random selection of 2 farming settlements from each of the communities making a total of 12 farming settlements. Fourthly, 10 rice farmers were randomly selected from the list of registered farmers in each settlement, making a total sample size of 120 respondents.

Method of data collection

Primary data was used for this study. The data were collected using a well-structured questionnaire. The questionnaire was designed to capture information based on the stated objectives.

association and land acquisition.

Method of data analysis

In analysing the data, descriptive statistics like frequency distribution, mean and inferential statistic was used.

OBJECTIVES

(1) (the socioeconomic characteristics of rice farmers) was attained using descriptive statistics

(2) (type and frequency of flooding event experienced) was achieved using descriptive statistics

(3) (identify the various adaptation strategies adopted) was achieved using mean score from a 5 point Likert type of scale.

RESULTS AND DISCUSSION

Socioeconomic characteristics of rice farmers

The distribution of respondents according to their socioeconomic characteristics is presented in Table 1 The socio-economic characteristics presented here are gender, age, marital status, household size, education, farm size, farming experience, other occupation, extension access,

Table 1: Socioeconomic characteristics of the respondents (n=117)

Sr. No.	Socioeconomic Characteristics	Frequency	Percentage	Mean±SD
1	**Gender**			
	Male	69	58.97	
	Female	48	41.03	
2	**Age (years)**			
	15 – 30	59	50.43	32.29±6.99
	31 – 45	55	47.01	
	46 – 60	03	2.56	
3	**Marital Status**			
	Married	65	55.56	
	Single	51	43.59	
	Divorced	01	0.85	
4	**Household Size (number)**			
	1 – 5	57	48.72	
	6 – 10	58	49.57	6±2
	11 – 15	02	1.71	
5	**Level of Education**			
	No formal education	01	0.85	
	Primary education	04	3.42	
	Secondary education	67	57.26	
	Tertiary education	45	38.46	
6	**Farm Size (hectares)**			
	0.1 – 2.5	23	19.66	
	2.6 – 5.0	89	76.07	8.5±5.8
	5.1 – 7.5	01	0.85	
	7.6 – 10.0	04	3.42	

Sr. No.	Socioeconomic Characteristics	Frequency	Percentage	Mean±SD
7	**Farming Experience (years)** 1 – 10 11 – 20 21 – 30	 92 22 03	 76.83 18.80 2.56	3.6±1.7
8	**Other Occupation** Yes None	 113 04	 96.58 3.42	
9	**Major Labour Source** Family Hired Family and Hired Machinery	 07 88 15 07	 5.98 12.82 75.21 5.98	
10	**Extension Access** Access No access	 108 09	 92.31 7.69	
11	**Membership of Association** Yes No	 102 15	 87.18 12.82	
12	Farm Land Acquisition Inheritance Purchase Lease/Rent Gift	 77 29 09 02	 65.81 24.79 7.69 0.85	

Source: Field Survey, 2025 *Note: SD is standard deviation*

(1) Gender

The results in Table 1 showed that the majority of the rice farmers, representing 58.97%, were male, while 41.03% were female. This finding showed that while rice farming in the flood-prone communities of Kogi State is a male-dominated activity, there is substantial involvement of women. The significant participation of women suggests that their roles, access to resources, and decision-making capacity cannot be overlooked when designing and implementing flood adaptation strategies. This distribution is consistent with the findings of Ahmad *et al*. (2021), who noted that agricultural labour in many developing regions is gendered, which in turn affects the adoption of specific adaptation strategies. Similarly, a study by Hoque (2023) in Bangladesh emphasized that women farmers face unique vulnerabilities to floods and often develop distinct adaptation strategies, highlighting the need for gender-sensitive support systems.

(2) Age

The results in Table 1 showed that the farmers in the study area were relatively young, with a mean age of 32.29 years. The largest age group was 15–30 years (50.43%), followed by the 31–45 years category (47.01%), while only a small fraction (2.56%) were in the 46–60 years range. This demographic profile suggests a youthful, energetic, and potentially dynamic farming workforce. The youthfulness of the respondents could imply a greater willingness to embrace innovation and adopt new technologies for flood adaptation. However, it might also indicate a lack of long-term, experience-based traditional knowledge for managing extreme weather events. This finding aligns with research by Amaechina *et al*., (2022) in Southern Nigeria, which also identified a predominantly young farming population facing climate-related challenges. In contrast, a study by Qazlbash *et al*., (2021) found that older, more experienced farmers were sometimes more likely to adopt certain long-term adaptation measures due to their accumulated knowledge of local climate patterns.

(3) Marital status

The results in Table 1 showed that a majority of the respondents (55.56%) were married, while 43.59% were single, and a very small percentage (0.85%) were divorced. The high proportion of married individuals is significant because marital status is often linked to household responsibilities and labor availability. Married farmers may have larger households, providing a potential source of family labor for implementing labor-intensive adaptation strategies, such as constructing levees or replanting after a flood. This family support system can be a critical asset in

resource-constrained settings. The findings are comparable to those of Adadu *et al*. (2024) in Benue State, Nigeria, who also reported a high percentage of married farmers and linked it to household stability and collaborative decision-making in managing flood impacts on livelihoods.

(4) Household size

The results in Table 1 showed that households in the study area were fairly balanced in size, with 49.57% having 6–10 members and 48.72% having 1–5 members. A small percentage (1.71%) had larger households of 11–15 members. The mean household size was 6 persons. A larger household can be both an asset and a liability in flood-prone areas. On one hand, it provides a larger pool of labor for farm activities and post-flood recovery. On the other, it increases consumption pressure and the number of dependents to care for, which can strain household resources and food security, especially after a devastating flood. This observation is supported by the work of Yang *et al*. (2021), who found that household size was a key determinant of livelihood vulnerability, as larger families had higher consumption needs but also more labor to diversify their income sources as an adaptation strategy. Similarly, Ahmad and Afzal (2022) noted that larger households in flood-prone areas of Pakistan had a greater capacity for labor-intensive coping strategies.

(5) Level of education

The results in Table 1 showed a high level of literacy among the respondents. The majority had completed secondary education (57.26%) or tertiary education (38.46%). A small number of farmers had completed only primary education (3.42%), and a negligible percentage (0.85%) had no formal education. This high educational attainment is a significant finding, as education is strongly correlated with a farmer's ability to access, process, and apply complex information related to climate change, early warning systems, and modern agricultural practices. Educated farmers are more likely to seek out and effectively utilize information on flood-resistant rice varieties and other adaptation technologies. This result is consistent with research by Padhan and Madheswaran (2022), which identified education as a positive determinant for the adoption of farm-level adaptation strategies against floods. Furthermore, Faruk and Maharjan (2022) found that higher education levels empowered farmers to participate more actively in community-based organizations, which facilitated the collective adoption of flood adaptation measures.

(6) Farm size

The results in Table 1 showed that the vast majority of respondents (76.07%) cultivated farm sizes ranging from 2.6 to 5.0 hectares, while 19.66% cultivated smaller plots of 0.1–2.5 hectares. A few farmers operated on larger scales, with 3.42% cultivating 7.6–10.0 hectares and 0.85% on 5.1–7.5 hectares. The mean farm size was 8.5 hectares. This suggests that most farmers in the area are small to medium-scale producers. Farm size is a critical indicator of a household's production capacity, income potential, and ability to absorb shocks. While larger farms can generate more income, they also represent a greater potential loss during a flood. For smallholder farmers, the loss of even a small plot can be catastrophic for their livelihood. This finding resonates with the study by Michael *et al*. (2023) in Tanzania, which highlighted that smallholder rice farmers were particularly vulnerable to flood stress due to their limited land resources.

(7) Farming experience

The results in Table 1 showed that a large proportion of the farmers (78.63%) had between 1 and 10 years of farming experience. A smaller group (18.80%) had 11–20 years of experience, and only 2.56% had 21–30 years of experience. The mean experience was 3.6 years. This finding, which aligns with the young age profile of the respondents, suggests a farming community with relatively limited long-term, firsthand experience in managing recurrent and severe flooding events. While these farmers may be physically active, their limited experience could hinder their ability to rely on traditional, time-tested coping mechanisms. This highlights the importance of institutional support, such as extension services, to bridge this knowledge gap. This contrasts with findings from Oladapo (2021) in Kwara State, Nigeria, where more experienced farmers were found to have a wider array of coping strategies based on years of observing flood patterns. The relative inexperience of the farmers in Kogi State may make them more dependent on external information and support for effective adaptation, as also suggested by the findings of Ajibade *et al*. (2024) in a similar context in Benue State.

(8) Other occupation

The results in Table 1 showed that majority of the rice farmers (96.58%) were engaged in other occupations, while only 3.42% had no other occupation. This showed a high degree of livelihood diversification among the respondents. Relying on non-farm income sources is a crucial adaptation strategy in flood-prone areas, as it provides a safety net when agricultural production fails due to floods. It spreads economic risk and enhances the overall resilience of farming households. This finding is strongly supported by Mohammed and Favretto (2025), who studied livelihood diversification in Nigeria's flood-resilient drylands and found it to be a key strategy for women farmers to manage climate risks. Similarly, Yang *et al*. (2021) identified livelihood

diversification as one of the most effective strategies for reducing farmers' vulnerability to climate-related disasters.

(9) Major labour source

The results in Table 1 showed that the predominant source of labor was a combination of family and hired labor (75.21%). Exclusively hired labor was used by 12.82% of farmers, while smaller, equal proportions relied on family labor only (5.98%) or machinery (5.98%). The reliance on a mix of labor sources suggests that while family labor is important, rice farming in the area is intensive enough to require external assistance, particularly during peak seasons like planting and harvesting. In the context of flooding, the ability to mobilize hired labor quickly can be critical for recovery efforts, such as clearing debris or replanting. The findings of Adadu *et al*. (2024) in Benue State also pointed to the importance of both family and hired labor in managing the agricultural workload, especially when flood impacts create additional labor demands.

(10) Extension access

The results in Table 1 showed that a very high percentage of respondents (92.31%) had access to extension services, compared to 7.69% who had no access. This is a positive indicator for building adaptive capacity, as extension agents are key conduits for disseminating information on climate-resilient agricultural practices, early warning systems for floods, and government support programs. Regular contact with extension services can significantly enhance farmers' knowledge and skills, enabling them to make informed decisions about which adaptation strategies to adopt. This widespread access is encouraging and aligns with the arguments made by Muhammad *et al*. (2025), who emphasized the critical role of early warning information, often disseminated through extension services, in enabling farmers in Jigawa State, Nigeria, to implement timely flood adaptation measures.

(11) Membership of association

The results in Table 1 showed that a large majority of the farmers (87.18%) were members of a farmers' association or cooperative, while 12.82% were not. Membership in such groups facilitates social learning, collective action, and access to resources like credit, inputs, and information. These social networks can be instrumental in organizing community-based adaptation efforts, such as maintaining drainage channels or lobbying for government support. Social capital is a powerful tool for enhancing community resilience to disasters. This finding is strongly corroborated by Galarza-Villamar *et al*. (2024), whose study in Ecuador highlighted the strategic role of social capital and farmer groups in disaster risk reduction and enhancing livelihood resilience among rice farmers. Likewise, Faruk and Maharjan (2022) demonstrated that participation in community-based organizations in Bangladesh significantly increased the adoption of flood adaptation strategies.

(12) Farm land acquisition

The results in Table 1 showed that the primary method of land acquisition was inheritance (65.81%), followed by purchase (24.79%). Smaller percentages acquired land through lease/rent (7.69%) or as a gift (0.85%). The prevalence of inherited land indicates a strong connection to ancestral farming traditions and may influence land tenure security. Secure land tenure is often a prerequisite for farmers to invest in long-term, land-based adaptation strategies, such as building soil conservation structures or planting flood-tolerant perennial crops. Farmers are less likely to make significant investments on rented or leased land where their tenure is insecure. The findings resonate with the broader context of land ownership in rural Nigeria, where inheritance remains a dominant mode of transfer, as noted in the study by Oladapo (2021), which implicitly links land ownership patterns to the types of farming investments and coping strategies employed.

Type and frequency of flooding event experienced by rice farmers

The analysis of the types and frequency of flooding events experienced by rice farmers, presented in Table 2, provides critical insight into the nature of the environmental challenges they face. The results showed that riverine flooding was the most significant type of flood, with an overwhelming 91.45% of respondents reporting its occurrence on a decadal cycle. In contrast, very few experienced it weekly (3.42%) or monthly (5.13%), and none reported it as a strictly annual event. This pattern suggests that while major riverine floods likely associated with the overflowing banks of the Niger and Benue rivers—are relatively infrequent, their magnitude is significant enough to be the defining hazard in the collective memory of the community. This long-term, cyclical nature of major floods aligns with the experiences documented in other major river basins in Nigeria. For instance, studies by Adadu *et al*. (2024) and Ajibade *et al*. (2024) in Benue State, another area heavily impacted by river systems, also describe flooding as a recurring but not necessarily annual disaster, whose severity dictates the scale of livelihood disruption. This infrequency of catastrophic events can pose a unique challenge for adaptation, as the urgency to maintain costly flood defences or adhere to early warnings may diminish during the long intervals between major floods.

Beyond riverine floods, the findings showed a more complex pattern of recurring hazards. A substantial portion of farmers reported experiencing urban floods (36.75%), landslide floods (27.35%), sturm surge floods (32.48%), and tidal floods (21.37%) on an annual basis. Although the majority of respondents still classified these events within a decadal timeframe—61.54% for urban, 65.81% for landslide, 62.39% for sturm surge, and 69.23% for tidal floods—the annual occurrences point to a persistent, lower-level threat that farmers must contend with regularly. The weekly and monthly occurrences for these flood types were reported by a very small minority, indicating that these are not constant issues but rather seasonal or event-driven shocks. This dual risk profile, characterized by rare, high-impact riverine events and more frequent, moderate-impact localized floods, complicates the adaptation process. Farmers must develop strategies that address both sudden, annual disruptions and prepare for long-term, catastrophic inundation (Yang *et al*., 2021).

The varied frequencies of different flood types imply that a single, one-size-fits-all approach to adaptation is unlikely to be effective. The strategies needed to cope with an annual landslide-induced flood, which might involve changes in cultivation techniques on slopes, are different from those required for a decadal riverine flood, which might necessitate household relocation or the construction of major community-level embankments. This complexity is supported by the work of Amaechina *et al*., (2022), who found that farmers in Southern Nigeria face a multitude of climate-related losses from different types of water-related hazards, each requiring specific responses. The data from Kogi State suggests that farmers are not just dealing with "flooding" as a single problem, but a spectrum of flood events, each with its own rhythm and character. Effective adaptation, therefore, must be multi-faceted, addressing the persistent annual risks while also building resilience against the less frequent but more devastating decadal events.

Table 1: Type and frequency of flooding event experienced by rice farmers in the study area

Type	Weekly	Monthly	Annual	Decade
Riverine flood	4 ((3.42)	6 (5.13)	0	107 (91.45)
Urban flood	0	2 (1.71)	43 (36.75)	72 (61.54)
Landslide flood	5 (4.27)	3 (2.56)	32 (27.35)	77 (65.81)
Sturm surge flood	3 (2.56)	3 (2.56)	38 (32.48)	73 (62.39)
Tidal flood	5 (4.27)	3 (2.56)	28 (21.37)	81 (69.23)

Source: Field survey (2025)

4.2 Various adaptation strategies used by rice farmers

The adaptation strategies employed by rice farmers in the study area are diverse, reflecting a pragmatic approach to managing the complex risks of flooding, as detailed in Table 3. The results showed that the most widely adopted strategy was the introduction of new crops, practiced by 88.89% of the farmers. This approach allows farmers to spread risk across different crops that may have varying levels of tolerance to waterlogging and different maturation periods. Closely following this were strategies of integrating animal production and applying inorganic fertilizer, both adopted by 76.07% of respondents. Rearing livestock provides an alternative source of food and income that is less directly vulnerable to short-term crop loss from floods, while fertilizer application can help boost the recovery and yield of surviving crops. These findings align with studies such as Rahman *et al*. (2025), which identify crop and livelihood diversification as fundamental coping mechanisms for rice farming households in flood-prone areas of Bangladesh. Similarly, Darma *et al*. (2025) note that resilient farming systems often combine multiple agricultural activities to buffer against shocks.

Beyond diversification, a significant number of farmers adopted specific on-farm management practices to mitigate flood impacts. The results showed that changing planting and harvesting dates, using organic manure, and practicing dry season farming through irrigation were all popular strategies, each adopted by 74.36% of farmers. Adjusting planting schedules is a direct attempt to avoid the peak flood season, while the use of organic manure can improve soil structure and health, potentially aiding post-flood recovery. The introduction of flood-resistant rice varieties was also a key strategy for 71.79% of respondents. This particular adaptation is crucial, as it directly addresses the primary threat to their main crop. The importance of flood-tolerant varieties is increasingly recognized across Africa and Asia as a vital tool for ensuring food security in vulnerable regions, a point strongly emphasized by Mwakyusa *et al*. (2023) in their work on smallholder farmers in Africa. The strategic use of such varieties is a cornerstone of building climate-resilient agricultural systems (Koppa & Amarnath, 2021).

Interestingly, some strategies that are widely promoted for resilience were less commonly adopted. For instance, income diversification was ranked last, with only 44.44% of farmers identifying it as a strategy, which seems to contrast with the earlier finding that over 96% had other occupations. This could suggest that while farmers have other jobs, they may not view them primarily as an agricultural adaptation strategy but rather as a separate part of their

household economy. Similarly, practices like inter-cropping (64.96%) and planting cover crops (67.52%) were among the less frequent choices, perhaps due to labor constraints or lack of specific knowledge. The overall pattern suggests that farmers prioritize immediate, tangible strategies like changing crop types and using inputs over more complex agroecological or financial planning approaches. This highlights the need for continued support and extension to not only provide options but also to help farmers integrate a wider range of strategies for building sustainable resilience to climate-induced shocks (Akinkuolie *et al*., 2025).

Table 2: The various adaptation strategies used by rice farmers in the area (n=117)

Sr. No.	Adaptation strategies	Frequency	Percentage	Remark
1	Introduced new crops	104	88.89	1st
2	Introduced and increased animal production	89	76.07	2nd
3	Application of inorganic fertilizer	89	76.07	2nd
4	Dry season farming (irrigation)	87	74.36	4th
5	Use of organic manure	87	74.36	4th
6	Changing planting and harvesting dates	87	74.36	4th
7	Natural regeneration	86	73.50	7th
8	Crop rotation	85	72.65	8th
9	Introduction of flood resistant variety	84	71.79	9th
10	Use improved seed varieties	83	70.94	10th
11	Practice contract farming	82	70.09	11th
12	Practice inter-cropping	76	64.96	14th
13	Income diversification	52	44.44	15th

Source: Field survey (2025)

CONCLUSION

The major findings showed that the rice farmers were predominantly male (58.97%), relatively young with a mean age of 32.29 years, and mostly married (55.56%). The farming households were of moderate size, with a mean of 6 persons. The respondents were highly literate, with a vast majority having completed secondary (57.26%) or tertiary (38.46%) education. Farmers operated on small to medium-scale farms (mean of 8.5 hectares) and were relatively inexperienced, with an average of 3.6 years in farming. Livelihood diversification was very high, with 96.58% of farmers engaged in other occupations. Access to institutional support was strong, as 92.31% had access to extension services and 87.18% were members of a farmer association. The most common form of land acquisition was inheritance (65.81%).

Regarding flood events, the study found that riverine flooding was perceived as the most significant long-term threat, with 91.45% of farmers experiencing it on a decadal basis. However, other types of floods, such as urban and landslide floods, were more frequent, affecting a substantial portion of farmers annually. In response, farmers adopted a range of adaptation strategies. The most common was the introduction of new crops (88.89%), followed by the integration of animal production and the application of inorganic fertilizer (both at 76.07%).

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

(1) Given that gender was a significant factor influencing the adoption of several key strategies, extension services should design and deliver programs that are specifically tailored to the needs of female farmers. This includes ensuring that training schedules, content, and delivery methods are accessible to women and address their specific constraints.

(2) The youthful and relatively inexperienced profile of the farmers suggests a need for targeted capacity building. Government and non-governmental organizations should establish training and mentorship programs that connect less experienced farmers with older, more knowledgeable ones, while also introducing modern, evidence-based flood management techniques and climate information services.

(3) Since a high percentage of farmers are already members of associations, these existing social structures should be leveraged as primary channels for disseminating flood warnings, distributing subsidized inputs like

flood-tolerant seeds, and coordinating community-level projects such as drainage maintenance.

(4) Policies should move beyond a one-size-fits-all approach and recognize the different types of flood risks farmers face. This requires developing integrated flood management plans that combine community-led initiatives for annual, localized floods with larger-scale government investment in infrastructure to mitigate major decadal riverine floods.

CONFLICT OF INTEREST

This is to declare that there is "No conflict of interest" among researcher.

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