



DETERMINANTS OF FLOOD ADAPTATION STRATEGIES AMONG ARABLE CROP FARMERS IN SEMI-ARID AREAS OF BAUCHI STATE, NIGERIA

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ABSTRACT

This study examined the determinants of flood adaptation strategies among arable crop farmers in semi-arid areas of Bauchi State, Nigeria. A multistage sampling technique was employed to select 401 respondents for the study. Data were collected using a structured interview schedule and analyzed using descriptive and inferential statistics. The results revealed that the mean age, household size and farming experience of the farmers were 45.95 years, 16 persons and 4.37 years, respectively. The results also showed that mean years of formal education was 8.83, while the average farm size, annual farm income and non-farm income were 2.61 hectares, ₦1,366,347 and ₦773,965, respectively. In addition, the results revealed that the mean extension contact, access to credit and access to subsidies were 0.09, 0.14, and 0.02, respectively. The results further revealed that access to flood early warning information recorded a mean value of 0.46. The results also showed that the farmers adopted agronomic (Mean = 0.31), institutional (mean=0.25) structural (Mean = 0.26), and behavioral flood adaptation strategies (Mean = 0.12), with an overall adaptation index of 0.25, indicating a low level of adaptation. The results of regression analysis revealed that education ($P < 0.05$), household size ($P < 0.01$), two-generation household structure ($P < 0.01$), access to credit ($P < 0.05$), extension contact ($P < 0.01$), and access to flood early warning information ($P < 0.01$) significantly influenced farmers' adaptation strategies. The study concluded that education, household size, extension contact, two generation household structure and access to flood early warning information were the determinants of flood adaptation strategies in the study area. The study recommended strengthening agricultural extension services, improving access to affordable credit and insurance schemes, and enhancing flood early warning systems to provide timely information and technical guidance, thereby promoting effective and sustainable flood adaptation among arable crop farmers in the study area.

Keywords: Flood, Arable, Crop, Adaptation, Strategies

INTRODUCTION

The alarming frequency and intensity of flood events under modern-day climate change issues represent one of the most important threats to global agricultural productivity, rural livelihoods, and food system stability. Flooding has emerged as the major global hydro-meteorological hazard, with severe implications for smallholder agriculture in developing economies where institutional adaptive capacity remains structurally scarce. According to the IPCC (2022), flooding is among the most destructive climate-related risks, systematically reducing crop yields, degrading farmland, and disrupting food supply chains at multiple scales. Smallholder farmers, who constituted the bulk of global food production, experienced disproportionate exposure to the adverse effects of climate change. This was compounded by their limited access to early warning systems, climate information services, and adaptive technologies. (FAO, 2021). As flood disasters become increasingly frequent and severe, the generation of substantial empirical evidence regarding the socioeconomic, institutional, and behavioural determinants of flood adaptation strategy adoption among smallholder farmers is no longer merely an academic imperative. Instead, it has become a fundamental component in achieving global food security and sustainability goals, including SDG 2 and SDG 13. (UNDP, 2023). In sub-Saharan Africa, recurrent flooding has been identified as a structural impediment to agricultural productivity.



This phenomenon has been associated with widespread land degradation, nutrient depletion, and significant crop destruction. A recent study has documented a growing threat to food security across the region. This threat is characterized by frequent flooding, which has been shown to destroy infrastructure, erode topsoil, and reduce agricultural productivity. The result of these phenomena is a decrease in food output and an increase in food insecurity (Aryee *et al.*, 2024; Murtala *et al.*, 2026). Farmers across the region have responded through a diverse portfolio of adaptation strategies, these include: seasonal planting adjustments, drainage infrastructure construction; flood-tolerant crop variety adoption; and farm plot relocation. Until now the uptake of these strategies remains uneven and context-dependent (Niang *et al.*, 2022). The implementation of climate-smart practices remains limited, particularly among smallholder farmers, due to insufficient access to knowledge, financial resources, and institutional support (Ayanlade & Radeny, 2020). Projections indicate intensified flood-related agricultural challenges across Africa by the year 2050. Therefore, it is imperative to identify the specific determinants that constrain or enable the adoption of adaptation strategies. This is a critical precondition for designing effective, equity-sensitive climate risk governance frameworks. (World Bank, 2023).

Nigeria presents a particularly compelling case for this inquiry. Floods account for 77% of climate-related disaster events in Nigeria, severely affecting subsistence agriculture, a key driver of food security in the country (Abu-hanifa 2025; Danhassan ., 2023; Escalante *et al.*, 2025). Nigeria depends heavily on agriculture for both food supply and economic growth, with approximately 70% of the national workforce engaged in the sector, which contributes roughly 25% of GDP (World Bank, 2022, as cited in Aryee *et al.*, 2024). However, this critical sector is increasingly imperilled. From June to September of 2024, a period of severe flooding in Nigeria resulted in 280 fatalities, 2,504 injuries, 122,330 residences destroyed, 6,800 hectare of agricultural land damaged, and approximately 641,500 individuals displaced (Global Voices, 2026). Notwithstanding these realities, a lack of a cohesive, overarching flood policy in Nigeria engenders a governance vacuum, marked by the absence of clearly delineated objectives for flood prevention, control, and management (Danhassan *et al.*, 2023). Notwithstanding this policy deficit, farmers growing arable crops across Nigeria's ecological zones have developed localised adaptation responses, including planting flood-resistant varieties, constructing field ridges, diversifying livelihoods, and relocating farming plots to elevated terrain, whose uptake is shaped by household-level factors such as age, educational attainment, access to credit, extension service contact, farming experience, and household size (Ojo *et al.*, 2021; Mbanasor *et al.*, 2024). Future research on the socio-economic barriers to adaptation, particularly among smallholder farmers, and the role of gender, land tenure, and market access in shaping adaptive capacity is essential for designing targeted interventions (Omokaro *et ai.*, 2025). This insight directly motivates the present study.

Bauchi State, located in Nigeria's semi-arid northeast and facing significant ecological vulnerability and agricultural exposure, represents a particularly pressing area of concern. The Food and Agriculture Organization has warned that Bauchi remains among the states at imminent risk of further flooding, with over 1.3 million hectares of land, including 558,000 hectares of cropland submerged nationally by September 2024, with floodwaters continuing to rise as rivers swell and dams approach maximum capacity (FAO, 2024, OCHA, 2024). Farmers in this state are responding through a range of adaptation measures, which altered planting calendars, constructing water channels, relocating to elevated plots, and adopting hardier crop varieties, still their adaptive capacity remains severely constrained by inadequate extension service provision, restricted credit access, limited availability of climate-smart technologies, and weak institutional coordination (Osman *et al.*, 2021; Magesa *et al.*, 2023). The semi-arid zones of Nigeria, which are characterized by fragile ecosystems, are at the forefront of the climate crisis. Researchers have documented significant losses in crop and livestock productivity in these zones, as well as the displacement of farming communities due to environmental degradation. (Omokaro., 2025).

Despite the growing intensity and frequency of flood events in Bauchi State, farmers' adaptation responses remain inconsistent, poorly documented, and often inadequate relative to the scale of climate risk they face. This discrepancy prompts fundamental inquiries into the socioeconomic, institutional, and informational determinants that influence the capacity and willingness of smallholder farmers to adopt effective flood adaptation strategies. The extant literature establishes that household



characteristics, including educational attainment, farm size, income level, and access to climate information, significantly influence adaptive decision-making. (Ojo *et al.*, 2022; Ojo *et al.*, 2021), empirical evidence remains limited by region-based focus, with unique ecological and socioeconomic conditions potentially driving adaptation behaviour in ways not captured by existing studies (Alhassan and Haruna, 2024; Murtala *et al.*, 2024; Hassan *et al.*, 2023). Furthermore, although adaptation practices such as flood-tolerant variety adoption, planting date adjustment, drainage channel construction, and livelihood diversification are documented in other regions, the extent to which such strategies are known, accessible, and adopted by arable crop farmers specifically in Bauchi State's semi-arid context remains insufficiently characterised. This knowledge gap materially impedes the ability of policymakers, extension agencies, and climate risk managers to design targeted, evidence-based interventions capable of strengthening farmers' resilience to flooding.

To address these gaps, this study had the following objectives:

- i. describe the socioeconomic profile of smallholder arable crop farmers in the study area;
- ii. examine the flood adaptation strategies currently adopted by respondents; and
- iii. determine the socioeconomic and institutional factors influencing flood adaptation strategies in the study area.

METHODOLOGY

The Study Area

This study was conducted in Bauchi State, northeastern Nigeria, which lies between latitudes 9° 3' and 12° 3' N and longitudes 8° 50' and 11° E, a core region of the Sudan Savanna agro-ecological zone. The State is projected to have a population of approximately 9,281,000 by 2025 (Xplorer, 2025). The area is characterized by a unimodal rainfall pattern (May–September) that sustains rain-fed agriculture but also drives recurrent flooding through the Gongola and Jama'are River basins (Salami, 2025). These rivers create fertile fadama (floodplain) lands, which are paradoxically the most productive for arable farming, dominated by maize, sorghum, millet, and rice and the most vulnerable to inundation. Bauchi State is predominantly agrarian, with most of the population engaged in smallholder subsistence farming (Kafi, 2026). The study focuses on communities in highly flood-prone Local Government Areas (e.g., Katagum, Itas/Gadai, Gamawa, Shira) situated within these active floodplains. The State represents a classic high-productivity, high-vulnerability system where farmers are economically incentivized to cultivate fertile floodplain soils yet are systematically exposed to catastrophic hydrological shocks.

The state has a documented history of severe floods (e.g., 2012, 2022, 2024), making it an ideal case for investigating the microeconomics of climate impacts (ICIR, 2025; Ibrahim, 2024, August). The findings from this context are directly relevant to similar fadama based agricultural systems across the Sudano-Sahelian region of West Africa.

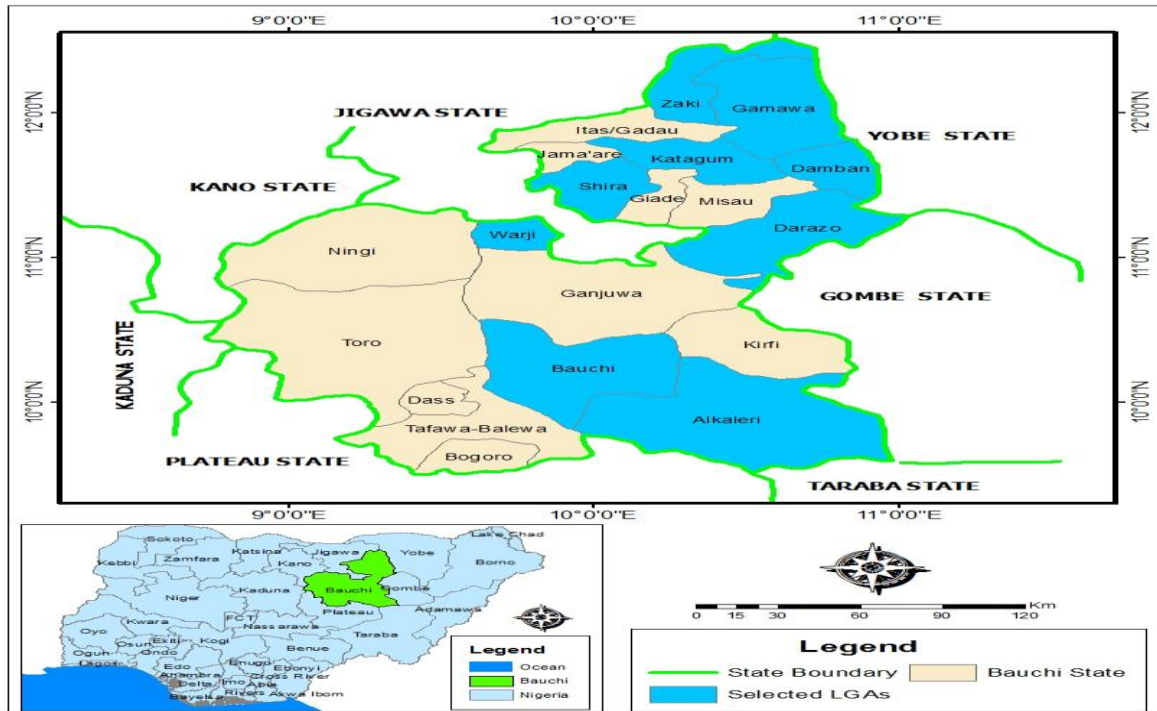


Figure 2: Map of the Study Area

Sampling Procedure and Sample Size

Multi-stage sampling procedure was employed for the study. In the first stage, all the flood affected areas identified in a reconnaissance survey were categorized based on agro-ecological zones (northern, central and western) they fall in. In the second stage, 16 Local Government Area (L.G.A) were identified out of which 50% of the L.G.As that fell within each zone were purposively and proportionately selected based on the concentration of the affected arable crop farmers, these comprises Gamawa, Shira, Katagum, Zaki and Dambam in northern zone, Warji and Darazo in central zone and Bauchi and Aikaleri in western zone. In the third stage, Yemane formular was used in selection of the respondents for the study from the sample frame of 224,365 flood affected arable crop farmers and spread across the L.G.A using the sample ratio formular, making 401 arable crop farmers for the study.

Method of Data Collection

Data were collected using scheduled interview in September 2025 using well-trained enumerators by the team of researchers. Data collected were the socio-economic and institutional characteristics and adaptation strategies of the arable crops farmers captured in the interview.

Method of Data Analysis

The data collected for this study were analyzed using both descriptive and inferential statistics. Specifically, Objective i, which described the socio-economic characteristics of the respondents, was analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviations. Similarly, Objective ii, which examined the adaptation strategies adopted by flood-affected arable crop farmers, was analyzed using descriptive statistical tools including means and adaptation indices to summarize and explain the patterns of responses. To achieve Objective III, which determined the factors influencing farmers' flood adaptation strategies, inferential statistical analysis (multiple regression) was employed.

RESULTS AND DISCUSSION

Socioeconomic and Institutional Characteristics of the Arable Crops Farmers

The results in Table 1 showed the average age of the respondents was 45.95 years, meaning that most of the participants were in their working years. This matches what Mbanasor *et al.* (2024) found, noting that middle-aged farmers mainly handle agricultural production in areas prone to



flooding, playing key roles in labor and decision-making. The broad age range of 18 to 85 years also indicates a blend of young and older farmers, similar to Ayanlade and Oni's (2021) observations that both youth and aging individuals stay active in rural farming despite challenges from climate change. The results revealed that farming is dominated by male (96%), which reflects unequal access to land and farming resources based on gender. This trend aligns with Kadafur and Shehu (2023), who mentioned that men make up most farmers in northern Nigeria due to cultural beliefs about land ownership and outdoor work. Additionally, 94% of those surveyed were married, supporting Yusuf and Mohammed (2022) findings, that married farmers often depend on family labor beneficial during regular growing seasons but challenging after disasters due to household needs. On average, farmers had 8.83 years of formal education, indicating a moderate level of literacy among them. This supports Shehu *et al.*'s (2023) findings that rural farmers with basic education can better understand climate alerts and adopt improved practices for coping. However, the education range of 0–19 years shows that some farmers lack formal schooling, which could hinder their ability to respond effectively to disasters and use new technologies.

The results also revealed that the average farm size was 2.61 hectares, suggesting a focus on smallholder farming systems. Akinkuolie *et al.* (2025) reported that many Nigerian farmers manage less than three hectares, making them more vulnerable during severe weather events due to limited funds for adapting. The significant variation in farm sizes noted in this study mirrors Shehu and Kadafur (2023) documentation of notable differences in land ownership patterns across northern Nigeria. The old-age dependency ratio averaged at 0.06, indicating few elderly dependents in most households. Hassan and Lawal (2021) found that households with lower dependency ratios usually dedicate more labor to agriculture, enhancing their ability to recover from climate-related threats. However, the highest ratio of 3 suggests some families bear considerable caregiving responsibilities, which may weaken their resilience.

In addition, the household size of the respondents were notably large, averaging 15.94 people, confirming Shehu *et al.*'s (2024) findings that families in northern Nigeria often live in extended or polygamous setups. While these large households can provide plenty of labor, they also face increased food security challenges following flooding events. The wide range of family sizes observed (1–90 persons) further illustrates this variability. Also the findings reported an average of 24.37 years of farming experience, consistent with Kadafur *et al.* (2020) and Madaki *et al.*, (2025) earlier research indicating long-term experience is common among rural farmers; this helps them gather valuable knowledge about coping strategies. Still, as Madaki *et al.* (2025) pointed out, having extensive experience does not always ensure resilience when climate changes exceed historical trends. Furthermore, the results showed that income indicated a lot of variation in how flood-affected farmers earning in the study area. The average annual farm income is ₦1,366,347, indicating that growing crops is still a key way these farmers support themselves. However, the large gap between the lowest (₦25,000) and highest (₦15,000,000) incomes shows that there is significant inequality among them. The average non-farm income of ₦773,965 suggests that many farmers take on additional work to help offset the losses caused by floods. This approach aligns with research by Osabohien *et al.* (2020) and Ayanlade *et al.* (2022), which found that non-farm income helps protect against climate-related shocks in areas prone to flooding. The high standard deviations for both types of income further indicate that farmers face unstable earnings, making it harder for them to invest in long-term strategies to adapt to floods.

Health factors also play a role in how well farmers can adapt. The low average scores for physical disability (0.02) shows that only a small number of farmers have physical challenges. This means most farmers are physically capable of doing demanding farm work; however, even a few cases of disability can greatly affect the amount of labor available at home, especially during recovery after floods. Research has shown that health issues can worsen vulnerability to climate threats by reducing productivity and increasing dependency ratios in households (Li *et al.*, 2023; Suleiman & Balogun, 2023). Therefore, even though health problems are not common, they can still have serious effects on affected families. The household structure indicates that most farmers live in one- or two-generation households, with an average of 1.6 generations per household. This suggests there is moderate labour



available at home, which is important for handling flood-related challenges like replanting and restoration of the land and drainage systems. Larger households often have better capacity to adapt because they share labor and spread out risks (Mamun *et al.*, 2021). In contrast, smaller households may find it hard to respond effectively when sudden floods occur, especially when labor needs are high during recovery times.

Indicators about institutional support show generally low access levels for flood-affected farmers. The average values for extension contact (0.09), access to credit (0.14), and agricultural subsidies (0.02) revealed that many farmers do not get formal assistance from institutions. Limited access to extension services restricts their access to better information and technologies for adapting to floods while poor access to credit and subsidies makes it hard for them to invest in resilient farming methods like improved seeds or irrigation systems. These findings agree with studies by Abraham & Fonta's (2018) and Yusuf *et al.* (2023), which found that weak institutional support significantly hinders farmers' ability to adapt in flood-prone areas of Nigeria. On the other hand, access to early warning information about floods seems relatively good, with an average value of 0.46 showing that nearly half of the respondents receive some type of advance notice about flooding. This level of access is promising since timely information allows farmers to make quick decisions like changing planting dates or moving supplies away from danger zones. According to Cobbinah *et al.* (2021) and Perera *et al.* (2019), early warning systems are among the most cost-effective ways to lessen the impact of floods on farming livelihoods. However, without additional support from institutions such as credit options and extension services, farmers may struggle to act effectively based on the information they receive.

Table 1: Distribution of Respondents Based on Socioeconomic Characteristics n= 401

Variable	Description	Mean	Std. Dev.	Min.	Max.
<i>Socio-economic Characteristics</i>					
Age	Age of the flood affected farmers in years	45.95	13.135	18	85
Sex	Sex of the flood affected farmers Male=1, otherwise=0	0.96	0.202	0	1
Marital status	Marital of the flood affected farmers, Married=1, otherwise=0	0.94	0.247	0	1
Education	Years of formal education of the flood affected farmer	8.83	5.17	0	19
Farm size	Size of the cultivated land by the flood affected farmers in hectares	2.611	2.111	0.3	16
Ageing	Old age dependency ratio of the flood affected farmers. It is unitless	0.06	0.206	0	3
Household size	Household size of the respondents in years	15.94	12.391	1	90
Farming experience	Farming experience of the respondents in years	24.37	14.074	3	65
Farm income	Annual farm income of the flood affected farmers	1366347	1660189	25000	15000000
Non-farm income	Annual non-farm income of the flood affected farmers	773965.1	1119632	27000	8300000
<i>Health factor</i>					
Disability	Physical challenge status of the flood affected farmers Physically challenged=1, otherwise=0	0.02	0.156	0	1
<i>Socio-cultural factor</i>					
Household Structure	The type of generation of the flood affected farmers' household, one generation= 1, two generation= 2, three generation= 3	1.6	0.697	1	3
<i>Institutional factors</i>					
Extension contact	Whether the flood affected farmer received extension contact =1, otherwise= 0	0.09	0.293	0	1
Access to credit	Whether the flood affected farmer accessed credit =1, otherwise= 0	0.14	0.344	0	1
Access to agricultural subsidy	Whether the flood affected farmer accessed agricultural subsidy =1, otherwise= 0	0.02	0.131	0	1
Access to Flood Early Signs	Whether the flood affected farmer accessed early warning sign information =1, otherwise= 0	0.46	0.499	0	1

Source: Field Survey (2025)

Adaptation Strategy of Flood Affected Arable Farmers in Bauchi State

The results in Table 2, shows the different adaptation strategies that flood-affected farmers in the study area used. The results revealed that these farmers applied a combination of agronomic, structural, informational, and behavioral strategies. However, the overall Adaptation Index (Mean = 0.25) indicates a generally low level of adaptation. This trend matches earlier research from sub-Saharan Africa, which found that many small-scale farmers do not have enough technical knowledge, financial resources, or institutional support to implement effective flood-resilience measures (Bamdadi *et al.*, 2020; Eze *et al.*, 2025). Farmers' use of climate-resilient farming practices (medium adaptive strategy) had an average score of 0.25, showing that only 25% of them engaged in these methods. This low adoption rate agrees with findings from Danso-Abbeam *et al.* (2021), who noted that many rural farmers stick to traditional techniques due to limited support from extension services. The average score for



planting flood-tolerant crops was 0.34, indicating moderate adoption. This is consistent with Ali *et al.* (2021), who observed that farmers tend to choose stress-tolerant varieties when seeds are easily available and affordable. Moving agricultural activities to higher ground which also a medium adaptive strategy had mean score of 0.40 and were one of the most common agronomic strategies used. This supports Aboye *et al.* (2023) findings that relocating is a popular option among Nigerian farmers facing frequent floods. On the other hand, improving food storage received a mean score of 0.27, showing it was not widely practiced due to structural and financial constraints highlighted by Speranza (2018), who pointed out that proper storage facilities are often too costly for smallholders.

Participation in training or awareness programs (short term adaptive strategy) was very low (Mean = 0.08), suggesting weak outreach from institutions. This aligns with Usman *et al.*'s (2023) findings about poor access to formal climate-risk training in rural areas of developing countries. Similarly, planning for savings or insurance showed limited adoption (Mean = 0.14), emphasizing ongoing challenges with access to agricultural insurance as noted by Mbaiorga and Amodu (2022). A moderate number of farmers (Mean = 0.34) were part of cooperatives or farmer groups. According to Yusuf *et al.* (2021), such social networks can significantly boost collective resilience and improve access to adaptation knowledge. However, the average score indicates that cooperative membership is not being fully utilized as a way to build resilience. Using sandbags, plastic barriers, or other materials for flood protection which is medium adaptive strategy had a mean scored of 0.26, reflecting a moderate level of immediate protective action. This finding is similar to studies like Touch *et al.*'s (2024), which indicated that farmers often opt for temporary barriers because they are cost-effective and require little technical skill. The construction of water channels or drainage systems had one of the lowest scores at 0.10, likely due to costs and land-use issues; this supports Chidi-Igbokwe *et al.* (2023) conclusion that infrastructural adaptations are limited among smallholders due to resource shortages. Interestingly, the most commonly used adaptation strategy involved using radio, TV, or mobile phones for weather or flood updates (Mean = 0.45). This backs up Madaki *et al.* (2025) findings that digital information services are becoming a primary means of adaptation for rural farmers because they are accessible and affordable. The percentage of farmers considering relocation scored low at 0.12, indicating limited planned migration among them. This corresponds with Abraham & Fonta's (2018) study showing that despite growing flood risks, many Nigerian farmers are hesitant to move because they feel attached to their ancestral land and face livelihood challenges.

Table 2: Distribution of Respondents Based on Adaptation Strategy Used n=401

Adaptive Strategy	Mean	Std. Deviation	Minimum	Maximum
Agronomic strategies				
I adopted climate-resilient farming practices after floods	0.25	0.435	0	1
I planted flood-tolerant crop varieties	0.34	0.473	0	1
I moved some of my farm activities to higher ground	0.4	0.491	0	1
I improved food storage to protect against flood losses	0.27	0.447	0	1
Mean	0.31			
Institutional Adaptation Strategies				
I participated in training or awareness programs on flood risk	0.08	0.275	0	1
I planned savings or insurance to prepare for future floods	0.14	0.35	0	1
Membership in cooperatives or farmer groups for support	0.34	0.328	0	1
I use radio, TV, or mobile phone to get weather or flood updates	0.45			
Mean	0.25	0.498	0	1
Structural Adaptation Strategies				
I use sandbags, plastic, or other materials to block flood water	0.26	0.437	0	1
I construct water channels/drainages around farm	0.1	0.307	0	1
Behavioral Adaptation Strategies				
I am considering relocating due to repeated flood threats	0.12	0.475	0	1
Mean	0.12			
Adaptation_Index	0.25164	0.119523	0.091	0.909

Source: Field Survey (2025)

Note: *= multiple responses

Factors Influencing Adaptive Capacity of Flood Affected Arable Farmers

The results of regression analysis in Table 3 showed that only some variables had a positive and statistically significant effect on the ability of flood-affected farmers to adapt. These variables include education, two-generation household structures, access to credit, contact with extension services, and access to flood early warning information. The importance of these factors highlights how essential human capital, institutional support, and information access are for helping farmers manage and adjust to challenges caused by floods. The results revealed that education and household structure turned out to be key social and demographic factors affecting adaptive capacity. Education had a positive and significant effect ($\beta = 0.0026$, $p < 0.05$), meaning that as farmers' education levels increase; their ability to adapt also improves. Farmers who are educated tend to better understand climate-related information, evaluate risks, and adopt suitable strategies for dealing with floods. This matches what other studies have found: that education boosts decision-making skills, encourages innovation, and increases resilience among farming families in areas prone to flooding (Usman *et al.*, 2023; Ojo & Baiyegunhi, 2020). Similarly, household structure with two generations showed a positive and significant impact on adaptive capacity ($\beta = 0.0397$, $p < 0.01$). This indicates that households with a good mix of working members and dependents can more effectively gather resources and labor for adaptation efforts. Previous research has indicated that moderate dependency ratios improve adaptability compared to larger extended families (Sietz *et al.*, 2019; Tambo & Abdoulaye, 2022; Daikwo *et al.*, 2025).

The results revealed that access to credit and extension services also significantly and positively affected adaptive capacity. Access to credit had a positive coefficient ($\beta = 0.0432$, $p < 0.05$), showing how financial resources help farmers invest in flood-resistant tools, diversify their income sources, and bounce back from losses due to floods. This finding supports studies in Sub-Saharan Africa which suggest that having access to credit helps reduce financial pressures and makes farmers more responsive to climate risks (Paudel *et al.*, 2020; Abdul-Razak & Kruse, 2017). Contact with extension services had the strongest positive impact on adaptive capacity ($\beta = 0.1148$, $p < 0.01$), highlighting how crucial agricultural extension services are for providing timely information, technical advice, and climate-smart



practices. Evidence consistently shows that regular interactions with extension workers enhance farmers' understanding of adaptation strategies and boost their ability to adapt (Below *et al.*, 2012; Antwi-Agye & Stringer, 2021). Additionally, access to flood early warning information showed a positive and statistically significant link with adaptive capacity ($\beta = 0.0297$, $p < 0.05$). This means that farmers who receive timely flood alerts are better equipped to take preventive actions like changing planting schedules or protecting their livestock and assets during potential flooding events. Similar results have been noted in recent research emphasizing the importance of climate information services and early warning systems for improving proactive adaptation strategies while reducing vulnerability for smallholder farmers (IPCC, 2022; Oke *et al.*, 2023). Also, Madaki *et al.* (2025) had revealed institutional services to be influencing climate change adaptive strategies in semi-arid region of Nigeria.

Table 3: Logistic Estimates of Determinants of Adaptation Strategies

Variable	Coefficient	Robust S.E	T-value	P> t
Age	0.0008	0.0007	1.08	0.28
Sex	-0.0170	0.0360	-0.47	0.636
Marital status	0.0263	0.0204	1.29	0.199
Education	0.0026	0.0011	2.29	0.023**
Farm size	-0.0039	0.0035	-1.12	0.265
Ageing	-0.0026	0.0192	-0.13	0.893
Household size	-0.0017	0.0006	-3	0.003***
Farming experience	-0.0004	0.0007	-0.5	0.615
Disability	0.0352	0.0506	0.7	0.486
Household Structure				
Two generation	0.0397	0.0142	2.8	0.005***
Three generation	0.0324	0.0219	1.48	0.141
Access to credit	0.0432	0.0176	2.45	0.015**
Extension contact	0.1148	0.0326	3.52	0
Access to Agricultural subsidy	0.0310	0.0619	0.5	0.617
Flood early warning access	0.0297	0.0116	2.56	0.011***
Flood	0.0003	0.0002	1.89	0.059*
Constant	0.1704	0.0434	3.93	0
var(e.Adapt_Index)	0.0107	0.0012		
Log pseudolikelihood	339.332			
F(16, 383)	6.72***			
Pseudo R ²	-0.202			

Source: Field Survey (2025)

CONCLUSION AND RECOMMENDATIONS

The study concluded that education, two-generation household structures, access to credit, contact with extension services, and access to flood early warning information were the determinants of adaptation strategies among flood-affected arable farmers in the study area. Also, most of the farmers adopt a medium-term flood adaptive strategy. The findings highlight the importance of human capital development, family labor dynamics, and timely information in promoting effective adaptation.

The study recommended that relevant stakeholders particularly the Ministry of Agriculture, agricultural extension agencies, and non-governmental organizations should implement targeted training programs on climate-resilient farming practices and the use of flood-tolerant crop varieties. These programs should be coupled with improved access to affordable seeds, credit facilities, agricultural insurance and climate-risk information through digital platforms and cooperative networks, ensuring that farmers are equipped with both the knowledge and resources to adopt effective adaptation strategies.

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