

Flood Impact on Food Production and Security Status of Some Selected Farming Households in Jigawa State, Nigeria

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Abstract

Original Research Article

Approximately two-thirds of rural households in Nigeria rely primarily on crop and livestock production for their livelihoods. These households are highly susceptible to persistent food shortages driven by climate variability and inadequate food production for household consumption. The food security of smallholder farmers, particularly those residing in floodplain regions, faces escalating threats from natural disasters, given their dependence on agriculture for both subsistence and income. Examining how floods affect smallholder farmers' food security is thus essential for informed planning and effective disaster mitigation. This study evaluates the food security status of rural farming households in selected communities within Jigawa State. It also investigates the determinants of food security and the agricultural challenges faced by respondents in achieving food sufficiency. Data were obtained from 344 randomly selected rural farmers across 23 communities utilising a semi-structured survey and analysed using a binary logit regression model. The findings demonstrate that variables such as gender, age, household size, educational attainment, farming experience, engagement in off-farm activities, income levels and flood exposure significantly impact the food security status of smallholder farmers. Notably, flooding was associated with increased risks of food shortages (59.9%) and poor harvests (28.8%). The study advocates for the immediate implementation of vocational training and skill development programs, given that many households lack participation in off-farm economic activities. Such interventions could mitigate overreliance on agriculture and reduce vulnerability to flood-related disruptions.

Keywords: Flood, Food security, Food production, Smallholder Farmers.

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INTRODUCTION

Flooding represents the most prevalent natural hazard in Nigeria, inflicting significant impacts on property and human lives (Aderogba, 2012; Komolafe *et al.*, 2015; Alfa *et al.*, 2018). The primary etiological factors are linked to the inability of river channels to contain surplus

floodwaters, often resulting in the inundation of extensive terrestrial areas (Alfa *et al.*, 2018). This issue is especially evident in the Hadejia-Jama'are river system, where limited capacity for runoff discharge during peak rainy seasons has led to the flooding of substantial agricultural land and the submergence of several settlements



along the river corridor over recent decades (Iliyasu, 2017).

Flood disasters have led to the destruction of over 1.9 million hectares of land and have adversely affected food production along floodplains (Anugwara and Emakpe, 2013). These events are recurrent, particularly in floodplain regions where farmers depend on rivers for irrigation during dry seasons but are vulnerable to flooding during rainy periods. Obalola and Tanko (2016) emphasized that the heavy reliance of agriculture on rainfall is increasingly risky in the climate change context. In rain-fed agricultural economies, unpredictable rainfall and unexpected floods pose significant threats to food security and livelihoods.

Flood disasters linked to climate change have frequently led to decreased crop yields and disruptions in agricultural production, especially in the most vulnerable and least prepared nations. Projections indicate that climate change implications on agriculture will worsen due to heightened climate variability, and an increased frequency and severity of extreme events associated with shifts in average climatic conditions. These developments are anticipated to modify the global distribution of agricultural land (Adeola, 2014).

In general, food security refers to the steady availability of a sufficient supply of basic foods required to meet rising consumption demands and act as a buffer against changes in output and pricing. According to Maharjan and Chhetri (2006), food insecurity refers to households' or individuals' incapacity to meet necessary consumption levels in the face of fluctuations in production, prices, and income, while food security is defined as everyone's constant access to enough food to support an active lifestyle. When everyone in a country has physical and financial access to enough safe, nourishing food to meet their dietary needs and preferences for an active and healthy life, there is food security. Access to food that is sufficient in quantity, safe, and culturally suitable to satisfy individual needs is necessary at the household level (Ingawa, 2002). Food security has been a major issue in the developmental sciences in recent decades. Availability, accessibility, utilization, and quality and safety are the four main factors that

determine its evaluation (Henneberry and Carrasco, 2014). While utilization encompasses both the sufficiency and sustainability of food access, availability refers to the actual presence of enough food quantities (Omonona and Agoi, 2007).

Food insecurity remains a major challenge in Nigeria, especially in the North and Sahel regions, which show the highest levels of undernutrition (FAO, 1998). Around 66% of the Nigerian population lives below the poverty line, as indicated by their food security status. Small-scale farmers, who make up about 95% of all food crop producers, are responsible for approximately 90% of the country's food output. The gap between food production and demand has widened, reflecting a growing disparity between domestic supply and overall food needs, alongside rising food prices caused by a persistent supply shortfall despite imports (Federal Ministry of Agriculture, FMA, 2008). In this context, the present study investigates the impact of flooding on food production and the food security of smallholder farmers in selected communities of Jigawa State, Nigeria.

Methodology

Description of the Study Area

The research took place in Local Government Areas (LGAs) situated along the Hadejia River, which is part of the Lake Chad Basin Hydrological Area designated as HA-VIII by the Nigeria Hydrological Services Agency (NIHSA) (2014). This region lies within the Sudano-Sahelian zone of Northern Nigeria. The river basin encompasses approximately 30,569 square kilometres. Rainfall in the study region varies from 349 to 956 millimetres, exhibiting a spatial and temporal variation that increases from north to south. The wet season persists for approximately four to six months. The area's climate is influenced by two predominant air masses: the Northeast (NE) and Southwest (SW) trade winds. Approximately 80% of the landmass is arable, making agriculture the primary economic activity. About 82% of the population comprises smallholder farmers managing plots of less than 2.5 hectares. Agricultural production is predominantly reliant

on seasonal rainfall, with crops such as millet, maize, sorghum, cowpea, and groundnut regularly cultivated.

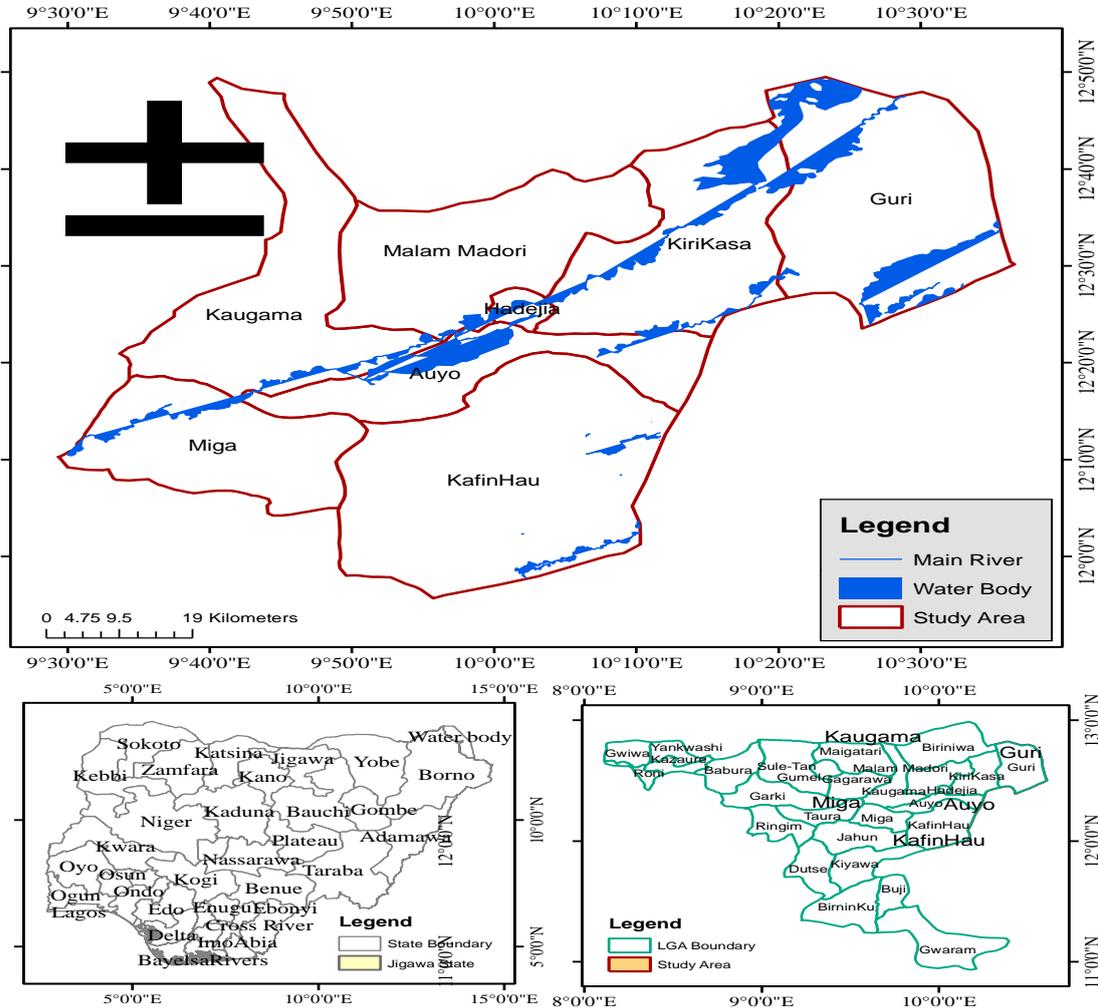


Figure 1: Map of the study area

Source: Dept. of Environmental Sciences, F.U.D 2020)

Method of data collection

Secondary sources provided important information for the study. Descriptive statistics were used to analyze a semi-structured questionnaire that addressed important aspects of food production. Using the Statistical Package for Social Science (SPSS) version 20, logistic regression analysis and the food security index were used to analyze the quantitative data.

Sampling techniques and procedures

A total of 302 communities were identified along the Hadejia River and its tributaries. These communities were stratified into three groups

based on their distance from the river channel and its tributaries: less than 3 km, 3 to 4 km, and 4.1 to 5 km. The buffer zone of less than 3 km comprises 121 communities, the 3–4 km buffer zone includes 55 communities, and the 4.1–5 km buffer zone consists of 35 communities. Stratified random sampling was employed within the three buffer strata to ensure unbiased representative samples of communities. For the study, 66 communities in all were selected. Equation (i) below describes how Cochran's formula was used to get the sample size:

$$n_o = \frac{Z^2pq}{e^2} \dots\dots\dots (i)$$

Where:

n_o is the Cochran’s sample size

e is the desired level of precision (i.e., margin of error) for which 0.05 was chosen

p is the (estimated) proportion of the communities along the Hadejia River that are vulnerable to flooding. Thus, 90% was assumed, making the p value as 0.9

q is $1-p = 1-0.9 = 0.1$

Z at 95% confidence level on the Z -table is 1.96

A systematic sampling technique was employed to select communities for questionnaire administration and interviews. In total, 23 communities located within a 0-5 km buffer zone to the Hadejia River were included in the study. A total of 344 samples were collected from communities situated in the three designated buffer zones (<3 km, 3-4 km, and 4.1-5 km).

Method of data analysis

The expenditure method was utilized to determine each household's score on the food security index, as applied by Omonona and Agoi (2007) and Zubairu and Maurice (2014), in order to evaluate the level of food security among smallholder farming households in the study area. This indicator was used to categorize households into food secure and food insecure groups, as shown in equation (ii).

$$F_i = \frac{\text{percapita food expendit for the } i^{th} HH}{2/3 \text{ mean percapita food expendit to fall}} \dots\dots\dots (ii)$$

Where F_i = food security index.

When: $F_i > 1$ = food secure i th household.

$F_i < 1$ = food insecure i th household.

HH = households

If a household's monthly per capita food expenditure exceeds or is equivalent to two-thirds of the average per capita food expenditure, it is considered food secure. On the other hand,, if a household's monthly per capita food expenditure is less than two-thirds of the average per capita food expenditure, it is considered food insecure.

Additionally, the number of food-secure and food-insecure households within the study area was ascertained by calculating their respective frequencies. The headcount ratio (H) of food security was determined to quantify the proportion of households that are food secure or insecure. The formula for the headcount index is presented in equation (iii) as:

$$\text{Headcount index (H)} = \frac{M}{N} \dots\dots\dots (iii)$$

Where M = number of food-secure/insecure households

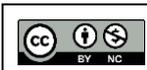
N = the number of households in the sample

Selection of variables

The variables included in the logit model include individual characteristics (e.g., gender, age, and educational status), household characteristics (e.g., household size, annual income and off-farm activities), and institutional factors (e.g., credit availability and extension services), all of which have an impact on the food security status of smallholder farming households in the study area and their corresponding prior expectations. Table 1 provides an overview of these variables.

Table 1: Variables influencing households’ food security status

Variable	Description	Measurement	priori expectation
Gender	Gender of household head	Male=1, Female=2	+



Age	Age of household head	Years	+/-
H/H Size	Household size	Number	-
Educ level	Educational status	Years	+
Farm size	Hectare	Number	+
Experience	Farming experience	Years	+/-
Off Farm	Off farm activities	Yes=1, No=0	+/-
Cooperative	Member of cooperative	Yes=1, No=0	+
Credit	Credit accessed	Yes=1, No=0	+
Income	Annual income	Naira	+
Natural disaster	Experience of flood	Years	+/-

Field Survey, 2021

Result and Discussions

The impacts of flood events, as illustrated in Figure 2, encompass physical, economic, and emotional dimensions. The study area data indicate that the majority of households (92.2%) experienced destruction of their farmlands due to flooding, while a significant proportion (68%) encountered water contamination following flood episodes. Flood-related pollution remains a

persistent issue, primarily because a substantial number of households rely on wells for their drinking water. Additionally, the study reveals that flooding has adversely affected the primary sources of income for approximately 67.7% of households, leading to increased indebtedness and consequently, emotional trauma for some (33.4%). Furthermore, 37.5% of respondents reported abandoning farmland or migrating as a result of flooding.

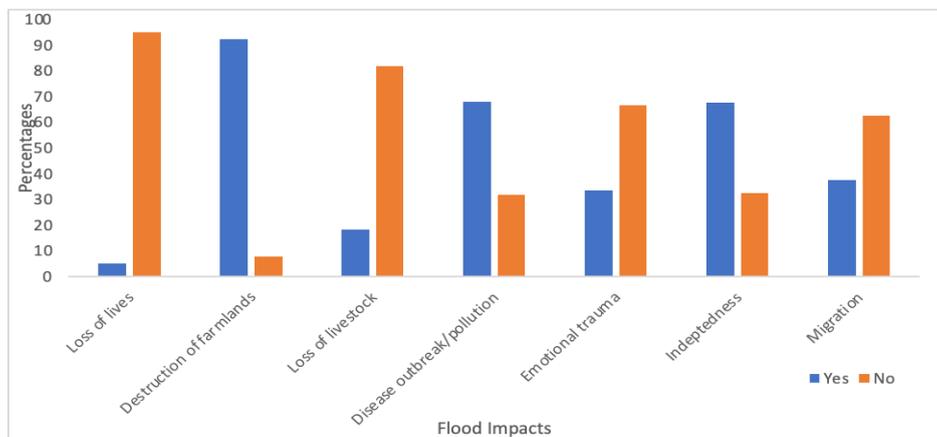


Figure 2: *Impacts of flood events on the livelihood of smallholder farmers*
Field survey, 2021

Loss of lives and livestock was also observed as a consequence of flooding, affecting 4.9% and 18.3% of households, respectively. The study’s findings clearly demonstrate that flooding acts as a stressor with adverse effects on households, including destruction of farmland and crops, outbreaks of disease, and increased indebtedness. Consequently, flooding negatively

impacts the livelihoods of most households in the study area, which are largely agrarian. This aligns with Akukwe (2019), who reported that 93.3% of households in Southeastern Nigeria experienced farmland destruction due to flooding, which also compromised their income sources and led to emotional trauma in 88.3% of cases.

Perception of Farmers on the Impact of Floods on Food Production

Figure 3 illustrates the emergence of gullies in farmlands, the deterioration of soil fertility, poor harvests, and an increased risk of food insecurity as the primary impacts of flooding on food production within the study area. The data indicate that the majority of respondents believed flooding contributed to heightened food shortages (59.9%) and reduced crop yields (28.8%). This suggests that flooding adversely

affects agricultural productivity by destroying food crops, thereby elevating the risk of food scarcity in the region. These findings are consistent with those of Adedapo *et al.* (2020), who reported that 65% of respondents in Chikun Local Government Area of Kaduna State, Nigeria, recognized flooding as a cause of poor harvests, food insecurity, and increased poverty. Consequently, the results imply that flooding exerts a deleterious effect on food production in the study area.

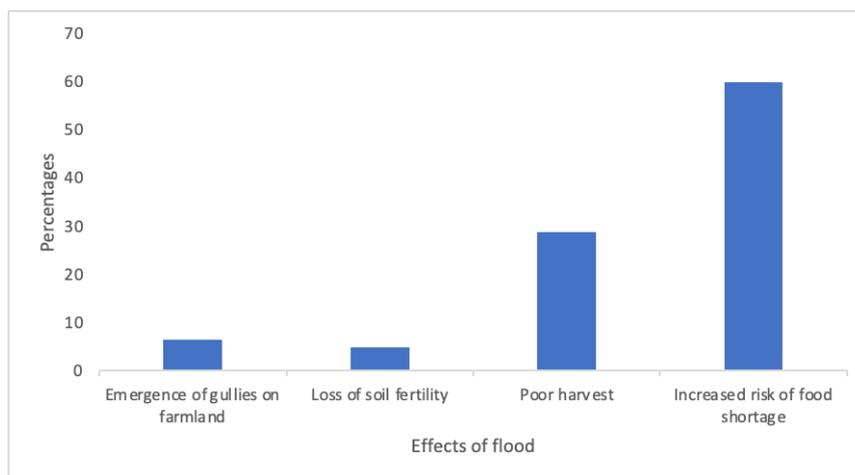


Figure 3: Impact of flood on food production (%)
Field survey, 2021

Food Security Status of the Smallholder Farmers

Table 2 summarizes the household food security situation of smallholder farmers in the study area. The results show that about 41.3% of respondents were food secure, whereas the majority (58.7%) were food insecure. Specifically, according to the headcount ratio, 59% had per capita food expenditures less than N26,543 (equivalent to two-thirds of the average per capita food expenditure of the study area), while 41% had per capita food expenditures equal to or more than this amount.

This finding supports Wiggins and Keats (2013), who reported that approximately 67% of the global food-insecure population can be attributed

to smallholder farming households, given that smallholder farmers tend to be net buyers rather than sellers of food. This conclusion aligns with the research of Agwu and Oteh (2014), which found that the majority of households in Abia State, Nigeria, experience food insecurity. It is also consistent with the FAO (2011) report indicating that over 70% of rural populations in Africa face food insecurity. Furthermore, Babatunde *et al.* (2007) found that 64% of smallholder households in Nigeria are food insecure. Conversely, the findings of Haddabi *et al.* (2019) contradict this findings, as they reported that the majority of households in Mubi North LGA of Adamawa State, Nigeria, are food secure.

Table 2: Summary statistics of food security status in the study area

Food security status	Food secure	Food insecure
Food security index N26,543		
No. of households	142	202
% of households	41.3	58.7
Headcount ratio (H)	0.41	0.59

Field survey, 2021

Factors influencing the food security status of smallholder Farm Households in the Study Area

A number of socioeconomic factors were regressed against their food security indices in order to analyze the factors that influence food security in smallholder households. Table 3 presents the findings, outlining the variables affecting household food security. Eight of the eleven variables were in line with a priori assumptions, and the model performed well

overall. To determine the model's statistical significance, the p-value was compared to critical thresholds, most likely 0.01, 0.05, and 0.1. Food security in the study area was significantly influenced by a number of significant factors, including gender, age, household size, educational status, farming experience, off-farm activities, income, and flood experience. Membership in cooperative was not statistically significant, although it did meet preliminary expectations.

Table 3: Logistic regression estimates for the factors influencing food security status in the study area

Variables	Coefficients (β)	Standard Error	Wald	Sig.	Decision
Gender (X1)	1.440	0.325	4.050	0.045**	Significant
Age (X2)	-0.103	0.039	7.146	0.008***	Significant
Household Size (X3)	-1.095	0.836	11.173	0.001***	Significant
Education (X4)	1.367	0.681	12.087	0.001***	Significant
Farm Size (X5)	-0.090	0.127	5.093	0.179	Not significant
Farming Experience(X6)	1.096	0.581	2.021	0.06*	Significant
Off-farm Income (X7)	-0.874	0.518	2.894	0.091*	Significant
Membershipofcooperative(X8)	1.137	0.503	29.381	0.759	Not significant
Access to Credit (X9)	-0.494	0.477	1.090	0.999	Not significant
AnnualHouseholdIncome(X10)	0.488	0.002	6.324	0.053**	Significant
Flood Event Experienced(X11)	-1.966	0.260	8.842	0.07*	Significant
Constant	-10.405	2.739	14.432	0.021	

Field survey, 2021

*** significant at < 1 %; ** significant at < 5 %; * significant at <10%

The variables have been interpreted as follows:

Gender (X1)

The coefficient for the gender of the household head demonstrates a statistically significant positive association with household food security status at the 5% significance level (Table

3). This implies that households headed by men are more likely than those headed by women to be food secure. Traditional social conventions that view men as the heads of families may be the cause of this discrepancy. Furthermore, in male-headed households, the head and spouse usually work together to generate income, while in female-headed homes, the head who may be single or widowed is the only one responsible for supporting the family. These findings are in line with the study conducted by Haddabi *et al.* (2019), which found that among rural families in Mubi North, Adamawa, Nigeria, there was a positive correlation between the gender of the household head and the level of food security.

Age (X2)

From Table 3, the results show that the coefficient of age (X2) is negative (-0.103) and statistically significant at 1% level. This implies that food security and the age of the head of the household are inversely correlated. In particular, a one-year increase in the family head's age is associated with a lower likelihood of food security. Compared to their older and weaker counterparts, younger and more active household heads are typically more inclined to cultivate larger farms. Additionally, older household heads may face limitations in securing off-farm employment and income opportunities that are accessible to younger individuals. Consistent with these results, Bashir *et al.* (2012) observed that each additional year in the age of the household head in Pakistan reduces the likelihood of household food security by approximately 3%. Similarly, Titus and Adetokunbo (2007) reported a comparable relationship in Nigeria, employing a different statistical methodology. Oluwatayo (2012) also identified age as a key determinant of household food security in Ekiti State. Conversely, in the United States, it was found that each additional year in the age of the household head decreases the probability of household food insecurity by 2% (Onianwa and Wheelock, 2006).

Household size (X3)

Table 3 shows a statistically significant negative coefficient at 1% level for household size,

indicating that while smaller households are typically food secure, bigger households are more likely to experience food insecurity. There is a direct correlation between the number of people to be fed and the number of family members. This result is consistent with the studies of Babatunde *et al.* (2007) and Bashir *et al.* (2012), which found that a larger family increases food insecurity because more people share available food production and output. Furthermore, a study carried out in India by Sindhu *et al.* (2008) discovered that the likelihood of a household experiencing food insecurity rises by 49% for every extra family member.

Education (X4)

At 1% level, it was discovered that the household education coefficient was positive and statistically significant (Table 3). This indicates that households headed by educated individuals are more likely to achieve food security compared to those with uneducated heads. This can be attributed to better access to information among educated farmers, enabling them to adopt new technologies that enhance food security. These findings are consistent with those of Babatunde *et al.* (2007), who observed that higher educational attainment among household heads correlates with increased likelihood of food security in North Central Nigeria.

Farm Size (X5)

Table 3 shows that the farm size coefficient was negative (-0.09) and not statistically significant. This suggests that the majority of households possess small farms suitable for cultivation. The negative coefficient contradicts initial expectations and may be attributed to factors such as inefficiencies in land resource utilization. This finding contrasts with those of Okon *et al.* (2017) and Otunaiya and Ibidunni (2024), who reported positive coefficients for farm size and found significant associations between farm size and food security status among rural farmers in Akwa Ibom State and rural households in Ogun State, Nigeria, respectively.

Farming Experience (X6)

The findings presented in Table 3 indicate that farming experience has a positive, statistically significant effect at the 10% level. Households led by experienced farmers are likely to possess greater insights and skills to diversify their production, thus lowering the risk of food shortages. Additionally, such farmers tend to have better knowledge of pest and disease management and are more responsive to weather patterns. These findings align with previous research by Feleke *et al.* (2023) and Oluyole *et al.* (2009), who reported a positive correlation between farming experience and food security in southern Ethiopia and Ondo State, Nigeria, respectively.

Off-farm Income (X7)

As presented in Table 3, the coefficient of off-farm income was statistically significant at the 10% level and demonstrated a negative correlation with the food security status of rural households. This negative relationship may be attributed to limited non-farm employment opportunities and constraints in startup capital. These findings align with those of Mitik and Legesse (2014), who conducted their research in southwestern Ethiopia, indicating that off-farm income is inversely related to household vulnerability and food insecurity. Conversely, these results are inconsistent with the study by Robert *et al.* (2023) in the Sekyere-Afram Plains District of Ghana, which observed a positive coefficient for off-farm income, suggesting a positive association with food security. They argued that the capacity of households and their members to manage food insecurity largely depends on access to off-farm employment opportunities, which can serve as a livelihood diversification strategy.

Membership of cooperative (X8)

Membership in the cooperative exhibits a positive coefficient regarding the food security status of farming households within the study area, though this relationship is not statistically significant (Table 3). While this aligns with the a priori expectation that cooperative membership would be beneficial, such access to cooperative

loans should theoretically enhance household income and food production, thereby improving food security. These findings are consistent with those of Babatunde *et al.* (2007), who also observed a positive but non-significant relationship between cooperative membership and food security among farming households in North Central Nigeria.

Access to consumption credit (X9)

The coefficient of access to consumption credit was negative and not statistically significant among the farming households (Table 3). This outcome contrasts with the initial hypothesis, which may be attributable to the non-utilization of consumption credit for its intended purposes. These findings contradict those of Haddabi *et al.* (2019), who identified access to consumption credit as a statistically significant factor influencing food security status among rural households in Mubi North, Adamawa State, Nigeria.

Household Annual Income (X10)

Household income demonstrated a positive and statistically significant association with the food security status of households (Table 3). The analysis indicated that, *ceteris paribus*, a one-unit increase in income is associated with a corresponding increase in the likelihood of household food security at the 5% significance level. This positive relationship suggests that greater gainful employment and income for household heads enhance the probability of attaining food security. Increased income is also likely to boost household production and improve access to higher-quality, greater quantities of food. These findings align with those of Woche *et al.* (2022), who reported that rising income levels increase the probability of food security among households in Benue State, Nigeria. Similarly, the results are consistent with the studies of Jalil (2015) and Kuworno *et al.* (2013), which identified a positive correlation between household income and food security in the Northern and Central regions of Ghana, respectively.

Flood event experienced (X11)

The coefficient associated with the flood event experienced was found to be negative (-1.9) and statistically significant at the 10% level (Table 3). This indicates that a decrease in flood-related activities among farming households is associated with a higher likelihood of food security. These findings are consistent with those of Jonathan *et al.* (2020), who reported a negative coefficient for flood exposure among farming households in the Southern Guinea Savanna zone of Nigeria.

Conclusion

The Food Security Index result indicated that the majority of households within the study area, accounting for 58.7%, were food insecure. The primary impacts of flooding on smallholder farmers' food production included gully formation in farmland, reduced soil fertility, and poor harvest outcomes. Consequently, it can be inferred that flooding exerts a detrimental effect on the livelihoods of smallholder farmers by causing significant crop losses, thereby exacerbating food insecurity in the region. This phenomenon has led to the destruction of arable land, which is a principal source of economic empowerment for local communities. Like other agricultural stakeholders, crop farmers are particularly vulnerable to flood-related damages, as these events compromise their crops, farmland, and overall well-being.

Recommendations

Farmer groups and government should provide agricultural input to farmers at affordable prices to be able to increase farm size and food production.

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