Asian Journal of Advances in Agricultural Research

Volume 25, Issue 9, Page 52-60, 2025; Article no.AJAAR.143465
ISSN: 2456-8864

Effects of Flood on Income Security Status among Arable Farmers in Mokwa Local Government Area of Niger State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors Abdullahi, A and SJ designed the study, wrote the proposal, participated in data collection and processing, performed the data analyses and wrote the final draft of the manuscript. Authors Abdullahi, A, SH and AH managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajaar/2025/v25i9670

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/143465

Original Research Article

Received: 03/07/2025
Published: 13/09/2025

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Cite as: *Abdullahi, A., Sallawu, H., Abdullahi, A., Abdulazeez, H., and Salihu, J. 2025. "Effects of Flood on Income Security Status Among Arable Farmers in Mokwa Local Government Area of Niger State, Nigeria". Asian Journal of Advances in Agricultural Research 25 (9):52–60. https://doi.org/10.9734/ajaar/2025/v25i9670.*

ABSTRACT

Introduction: Flood is an overflowing or eruption of a great body of water over land not usually submerged. It is an extreme weather event naturally caused by rising global temperature which results in heavy downpour, thermal expansion of the ocean and glacier melt, which in turn result in rise in sea level, thereby causing water to inundate coastal lands.
Aim: The study evaluates the effects of flood on income security status among arable crops farmers in Mokwa Local Government Area of Niger State, Nigeria.
Study Design: A multi-stage sampling procedure was employed in selecting respondents for the study, the data were collected from 117 arable crop farmers using structured questionnaire.
Place and Duration of Study: The study was conducted from the Department of Agricultural Economics and Farm Management in 2023 using Mokwa local government in Niger state, Nigeria as study area.
Methodology: A multistage sampling technique was used for the selection of respondents for this study. The first stage was purposive selection of Mokwa LGAs because the LGA have always been a victim of flood experience over the years. Second stage involves random selection of three wards in the LGA. Third stage involved random selection of three villages from each ward and at the fourth stage, thirteen farming households were selected from each village. In all a total of 117 farmers were selected for this study. Data were collected from the arable crop farmer with the use of a questionnaire. The data were analyzed using descriptive statistics, probit regression and farm budgeting technique.
Results: Results show that most (93.2%) of the farmers were male and with mean age of 38years. It was revealed that 75% of the farmers had one form of education or the other with secondary education constituting 53%. The average years of farming experience was 10 years and 65% of the farmers had 2 hectares or less of farm size. The results of the profitability showed that before flood, arable crop farmers recorded net farm income of N174,704.50 per hectare with a gross margin of N191,160.00 and after flooding the arable crop farmers recorded net farm income per hectare of N100,436.50 with gross margin of N116,892.00. which implied that arable farmers were more income secured before the flood than after the flood in the study area. The result further shows that emergency dam break ($\overline{X}$ = 4.5), groundwater flooding ($\overline{X}$ = 4.4) and flash Flooding($\overline{X}$ = 4.0) were the three common types of floods in the study area. The results also revealed that Gini coefficient increased from 0.43 before the flood to 0.78 after the flood incidence among arable crop farmers in the study area. More so, the findings revealed that the coefficient of total crop loss to flood, age, access to credit and marrital status had a significant relationship with income security of farmers.
Conclusion: The study concludes that total crop loss to flood, access to credit and marital status had inverse relationship with income security by arable crop farmers in the study area. Deforestation, bush burning, inadequate maintenance of water ways, inadequate soil conservation measures, uncontrolled grazing and change in agricultural practices were the major factors promoting flooding in the study area. The study recommended that the government, relevant agencies and stakeholders should place concerted efforts to increase smallholder farmers' access to credit and invest in proactive flood management systems. There is also need for social protection measures such as crop insurance schemes, farmer cooperatives, disaster relief funds, and targeted support for vulnerable groups (smallholders, women, and aged farmers) should be implemented to cushion the negative impact of floods and reduce inequality among farmers.

Keywords: Flood; security; income security status; disaster relief funds; arable famers and income status.

1. INTRODUCTION

"Flood is an overflowing or eruption of a great body of water over land not usually submerged" (Daniel & Udo, 2019). "It is an extreme weather event naturally caused by rising global temperature which results in heavy downpour, thermal expansion of the ocean and glacier melt, which in turn result in rise in sea level, thereby causing water to inundate coastal lands. Flooding causes inundation and harm to plants and animals, including man, buildings and infrastructure" (Ujene & Oguike, 2020). However, flooding is a global natural hazard that has

affected lives, led to the loss of properties and extinction of species in the environment. In fact, flooding is a threat that affects the quality of the environment. Given the issues relating to flooding, it is regarded as a factor that is used in defining environmental quality of residential neighborhoods. Other environmental hazards include drought, desert encroachment, soil erosion and tsunamis.

"In Nigeria, flooding has remained a prevalent environmental problem. Available studies have shown that there is frequent occurrence of flooding" (Ejenma et al., 2014; Komolafe et al., 2015; Nkwunonwo, 2016; Yusufu, 2016; Sule et al., 2016; Onwuemele, 2018; Bamidele & Badiora, 2019). Specifically, "flooding has affected the lives, properties and sustainability of the environment as noted in available studies. Notably, flooding being a natural hazard has negative implications not only on the environment but also from the economic point of view. For instance, flooding affects housing, roads and other physical structures making such areas not to be attractive to residents. Flooding is the most common type of disaster causing serious economic losses in various parts of the world" (Ramakrishna et al., 2014). "It has been described as a condition of complete or partial inundation of normally dry areas due to overflow of tidal, inland water or rapid accumulation of runoff" (Islam & Wong, 2017). The concept of income distribution establishes the basis for richness and poverty since there are differences in the share of income between different people who purchased items from a common market. According to author (Rufa'I, 2020), "the distribution of a nation's income indicates what proportion of the income goes to the rich and what proportion goes to the poor. It also shows that the rich can purchase many, rather than few goods and services. Hence, the more share a person gets as his/her income, the richer the person. How rich or poor a person also affects his / her purchasing power and consumption pattern. Income distribution therefore relates to how these resources are shared between individuals, occupations, and various income groups and classes in a society within a given period of time" (Rufa'I, 2020).

The issue of income inequality is seriously fingered in most conflicts amongst ethnic groups, social class and governance. For instance, the unequal distribution of income among farmers shows that farm income amongst farming households varies in such a manner that some farmers are rich enough to acquire their required farm input for production while others cannot. However, studies to assess the effects of flooding on income distribution among farmers in the study area is scanty, thus this research work will help farmers to be informed on the best way to manage and mitigate the drastic effect of flood. Aside its educational value, this study will also help policy makers and other agricultural stakeholders to plan, strategize and develop policies, interventions and technologies that can be used to detect, mitigate or help farmers recover quickly from the effect of this natural disaster, thus helping farmers maintain a consistent and continuous productivity which will help keep their income secure all-round the production season. Thus, this study seeks to ascertain the extent of flood related losses in arable crop farming in the study area, assess the profitability of arable crop farming, determine the drivers of flood in the study, and examine the effects of flood on income security status of arable crop farmers in the study area.

2. METHODOLOGY

2.1 Study Area

The study was conducted in Mokwa local government area of Niger State of Nigeria. It covers a land area of approximatly1500 square kilometers with River Niger as the boundary to the south. It is located between Latitude 'N'.8' North and Longitude 5^{o}3East. With a population of 416,600 projected to Nigeria National population commission (NPC) (NPC, 2006). According to (Mohammed et al., 2021), farming and trading are the major occupation of the residents in these communities. The major crops cultivated include Maize, groundnut Cowpea, Melon and Sorghum.

2.2 Sampling Procedure

A multistage sampling technique was used for the selection of respondents for this study. The first stage was purposive selection of Mokwa LGAs because the LGA have always been a victim of flood experience over the years. Second stage involves the random selection of three wards in the LGA. Third stage involved random selection of three villages from each ward and at the fourth stage, thirteen farming households were selected from each village. In all a total of 117 farmers were selected for this study. Data

were collected from the arable crop farmers with the use of a questionnaire.

2.3 Analytical Techniques

The data were analyzed using descriptive statistics, probit regression and farm budgeting technique. The extent of flood related losses in arable crop farming and drivers of flood in the study area were ascertained using achieved using descriptive statistics such as frequency, percentage and mean.

The profitability of arable crop farming was assessed using cost and return technique,

The net farm income model is specified in equation (1) as:

$$NFI = GR - (TFC+TVC) \quad (1)$$

Where:

NFI = Net farm income (₦);
GR = Gross revenue (₦);
TFC = Total fixed costs (₦); and
TVC = Total variable costs (₦).

$$GM = GFI - TVC \quad (2)$$

$$RRI = \frac{GM}{TVC} \quad (3)$$

Where:

GI= Gross margin (₦);
TVC = Total variable cost (₦).

$$OR = \frac{TVC}{GI} \quad (4)$$

Where:

OR is the operating ratio;
TVC is total variable cost; and
GI is the gross income.

Gross ratio: It measures the ultimate solvency of the farm business as specified in equation 5:

$$GR = \frac{TFE}{GI} \quad (5)$$

Where:

GR is the gross ratio; TFE is the total farm expenses; and GI is the gross income. A lower and less than one ratio is preferable.

The effects of flood on income security status of arable farmers were examined using Binary Probit regression. All assumptions of the model were met, as such it was adopted for the study. Implicitly, the model is stated as:

$$Y = f(X_1, X_2 - - - - - X_{12}) \quad (6)$$

Explicitly it was expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 - - - - - - \beta_{13} X_{12} + ei \quad (7)$$

Where:

Y = Income security status of arable crop farmer (1 = income secure; 0 if otherwise)
X_1 = Crop loss due to flooding (1 if yes; 0 if otherwise)
X_2 = Days farm submerged (Number)
X_3 = Percentage of farm submerged (percentage)
X_4 = Complete crop loss due to flooding (1 if yes; 0 if otherwise)
X_5 = Flooding affected the yield of your arable crops (1 if yes; 0 if otherwise)
X_6 = Flood affect the availability of water for irrigation (1 if yes; 0 if otherwise)
X_7 = Flooding increases the spread of pests and diseases (1 if yes; 0 if otherwise)
X_8 = Types of flood (number)
X_9 = Age (years)
X_{10} = Education (years)
X_{11} = Household size (number of persons)
X_{12} = Access to credit (dummy)
X_{13} = Marital status (1 if married; 0 if otherwise)
X_{14} = Farming experience (years)
X_{15} = Membership of cooperative (dummy)
X_{16} = Extension contacts (numbers of visit)
ei = Error term.

3. RESULTS AND DISCUSSION

3.1 Extent of Flood Related Losses

The result in Table 1 presents the extent of flood related losses in the study area. The result that revealed that arable crop farmers perceived flooding to increase the spread of pest and diseases ($\bar{X}$ = 4.5), displaced due to emergency flooding ($\bar{X}$ = 4.4), highly affected by flooding in the past ($\bar{X}$ = 4.4), cause high damage to crops ($\bar{X}$ = 4.4), affecting the yield ($\bar{X}$ = 4.4) and affecting the quality of harvested crop ($\bar{X}$ = 4.4). The perception that flooding intensifies the spread of pests and diseases aligns with the well-established connection between water

Table 1. Extent of flood related losses

Flood related losses	WS	WM	Rank	Remark
To what extent has flooding increase the spread of pest and diseases	533	4.5	1st	High
To what extent have you been displaced due to emergency flooding	512	4.4	2nd	High
To what extent has your farm been affected by flooding in the past year	505	4.4	2nd	High
How would you rate the damage caused by flooding to your crops	519	4.4	2nd	High
How has flooding affected the yield of your arable crops	503	4.3	5th	High
To what extent has flooding affected the quality of your harvested crops	471	4.0	6th	High
How has flooding affected the overall income generated from your arable farming activities	382	3.3	7th	High
To what extent has flooding influenced your decision on crop selection	348	3.0	8th	High
To what extent have you lost agricultural equipment or infrastructure due to flooding	340	3.0	8th	High
Have you observed any changes in the soil structure or fertility as a result of flooding	301	2.5	10th	Low
Flood affect the availability of water for irrigation	280	2.3	11th	Low
To what extent has flooding affected the planting season on your farm	290	2.4	12th	Low

Source: Field survey, 2023.

Table 2. Cost and return of the respondents

	Before flood		After flood	
variables	**Cost**	**Percentage**	**Cost**	**Percentage**
Variable inputs				
Seed cost	1300000	55.3427	1151000	47.09878
Fertilizer	635000	27.03278	681000	27.86644
Herbicide	379000	16.13453	520000	21.27834
Insecticides	35000	1.489996	91800	3.756445
TVC	2349000	100	2443800	100
Fixed inputs				
Cutlass	288900	17.55644	288900	17.55644
Hoe	562850	34.20437	562850	34.20437
Wheelbarrow	580000	35.24657	580000	35.24657
Knapsack sprayer	13,750.0	8.355869	13,750.0	8.355869
Shovel	763.00	4.636748	76300	4.636748
TFC	164,5550	100	1645550	100
TCP	3994550		4089350	
Revenue				
Quantity of crop produce	214,650.00		141,330.00	
Gross margin	191,160.00		116,892.00	
Net-farm income	174,704.50		100,436.50	
M.E	5.373571		3.45605	

Source: Field survey, 2023

stagnation and increased pest activity (Joshua et al., 2015). Flood waters create favorable conditions for the proliferation of disease vectors and pests, jeopardizing crop health. Stagnant water serves as a breeding ground for insects and pathogens, leading to heightened infestations. Farmers witnessing such consequences would naturally attribute the surge in pest and disease prevalence to flooding events.

3.2 Profitability of Arable Crop Farming

The result of net farm income analysis for arable crop farmers before and after flood were presented in Table 2. From the Table, before flooding, arable crop farmer recorded net farm income of ₦174,704.50 with a gross margin of ₦191,160.00 and after flooding the arable crop farmers recorded net farm income per hectare of ₦100,436,50 with gross margin of ₦116,892.00. This reveals that arable crop production before the flooding was more profitable than after flooding. The positive net farm income and gross margin show that returns exceeded the cost which indicated that arable crop production is profitable in the study area. This result is in agreement with the authors of (Abdullahi et al., 2010) and (Abdullahi et al., 2022) who in their

separate findings stressed that arable crop production is a profitable enterprise.

3.3 Income Inequality Among the Farmers

The result in Table 3 indicates that Gini Coefficient increased from 0.43 before the flood to 0.78 after the flood incidence among arable farmers in the study area. This is increase of about 81.4%. The calculated Gini-coefficient after the flood of 0.78 which is closer to one suggested that there was inequality in the distribution of income among the arable crop farmers after the flood in the study area. The inequality in income distribution after flood could have led to varying degrees of crop losses among farmers. Those with more extensive damage to their crops might have experienced a significant decline in income compared to others, exacerbating existing economic disparities. This result is in line with the findings of (Alamgir et al., 2021) which revealed that agricultural income in Mymensingh is a primary driver of income differences among farm households and that extreme events like floods increase poverty rates. Also, the post-flood recovery phase may not have been uniformly distributed. Farmers with better access to resources, such as credit, agricultural inputs and support services (compensation), might have recovered more swiftly, while those facing resource constraints struggled to regain their pre-flood productivity. This uneven recovery process can contribute to divergent income outcomes. Several research on floods across the world all points to fact that corruption and bribery and Nepotsim/tribalism during the compensation process will worsen income inequality among victims' farmers after the compensation.

3.4 Drivers of Flood in Mokwa Local Government Area

The result in Table 4 presents the distribution of farmers according to perceived factors promoting flooding in Mokwa local government of Niger State. The result shows that some perception statements have their weighted mean of equal to or greater than 3 which is the mean cut. Table 4 further reveals that in the study area the farmers perceived that factors such as deforestation ($\bar{X}$ = 4.5), bush burning, ($\bar{X}$ = 4.5), lack of maintenance of water ways ($\bar{X}$ = 4.3), weak soil conservation measures ($\bar{X}$ = 4.3), uncontrolled grazing ($\bar{X}$ = 4.2) and change in agricultural practices ($\bar{X}$ = 3.0) were key factors promoting flooding in the study area. This suggests that deforestation marked by the widespread removal of trees, can significantly contribute to increased flooding. Trees play a crucial role in absorbing and regulating water levels so, removal of trees reduces the natural barriers that help control water flow, leading to increased surface runoff and, consequently, higher risks of flooding. Additionally, deforestation can alter local climate patterns, further exacerbating the likelihood of extreme weather events such as heavy rainfall. Other likely reason might be due to the heavy rainfall that characterized the previous seasons like 2011/2012, 2019 and 2023 cropping season. Report shows that most of the farmers in the study area lost their farm produces to flood and storm.

3.5 Effects of Flood on Income Security Status of Arable Crop Farmers

The result in Table 5 presents the estimates of the Binary Probit results on effects of flood on income security status of arable crop farmers. The result shows that the pseudo R-squared was 0.6975 which shows a relatively good fit for the model while the chi-square results show that the likelihood ratio statistics was statistically significant (*P= .01*), suggesting that the model has strong explanatory power of the variables included in the model. The coefficient of total crop loss to flood (.0001) was negative and statistically significant (*P= .05*) suggesting that an average increase in total crop loss to flood is associated with decrease in income security. This is because the damaging effects of floods on crops can result in reduced yields, diminished marketable produce and financial losses for farmers, contributing to income insecurity. This is in accordance with the findings of (Singh et al., 2021) indicated that "various practices and methods of flood recession farming system underpin not only the livelihood and food security of small and marginal farmers but also enrich the sustainability of the environment".

More so, flooding disrupts the normal agricultural cycle, leading to reduced productivity and income potential. The coefficient of age (.0287) was positive and statistically significant (*P=.01*) suggesting that as age increases, there is a corresponding tendency for income security to improve. This is because age often comes with experience and seasoned farmers may possess a deeper understanding of local agricultural practices, market dynamics and risk management strategies. This accumulated knowledge can empower older farmers to make

informed decisions, adapt to changing conditions and navigate challenges, ultimately enhancing their income security. Additionally, older farmers may have established social networks and relationships within the agricultural community, facilitating access to resources, information, and support. The positive coefficient underscores the potential role of experience and accumulated wisdom in contributing to the economic resilience of arable crop farmers in the face of various challenges, including those posed by flooding.

Table 3. Gini coefficient of arable crop farmers

Income inequality of the respondents	Gini coefficient index
Gini coefficient before the flood	0.43
Gini coefficient after the flood	0.78
Change in Gini coefficient	0.35
% change in income inequality	81.4

Source: Field survey, 2023

Table 4. Factors promoting flooding in the study area

Factors	Weighted sum	Weighted mean	Rank	Remark
Deforestation	525	4.5	1st	Agreed
bush burning	531	4.5	1st	Agreed
No maintenance of waterways	505	4.3	3rd	Agreed
inadequate soil conservation measures	500	4.3	3rd	Agreed
uncontrol grazing practices	495	4.2	6th	Agreed
Change in agricultural practice	349	3.0	7th	Agreed
lack of community preparedness	339	2.9	8th	Disagree
Uncontrol urbanization	338	2.9	8th	Disagree
stream and river channel modification	331	2.8	10th	Disagree
climate change impact	323	2.8	10th	Disagree
poor water management	320	2.7	12th	Disagree
Non-compliance with building regulations	276	2.4	13th	Disagree
Inadequate land use planning	256	2.2	14th	Disagree
inadequate early warning system	231	2.0	15th	Disagree
lack of floodplain management	119	1.0	16th	Disagree

Source: Field survey, 2023

Table 5. Effect of flood on income security status of arable farmer's

Variable	Coefficient	Standard error	t-value
Crop loss due to flooding	.0060	.0144	0.42
Days farms submerge	.0970	.0820	1.18
Percentage of farm submerge	.0209	.0220	0.95
Total crop loss to flood	-.0001	.00002	-2.05**
Pest and diseases infestation	-.0045	.0146	-0.31
Age	.0287	.0065	4.38***
Education	-.0129	.0099	-1.30
Household size	-.0728	.0225	-1.22
Access to credit	-4.13e-06	1.44e-06	-2.87***
Farming experience	.0131	.0155	0.84
Extension contact	-.0675	.1082	-0.62
Cooperative	-.0176	.0806	-0.22
Marital status	-.3864	.1004	-3.85***
Constant	.5388	.4853	1.11
Prob > chi2	0.0000***		
Pseudo R2	0.6975		

Source: Field survey, 2023

Furthermore, the coefficient of access to credit and marital status were negative and statically significant. This implies a unit increase in any of the variables is associated with decrease in income security of the farmers. For access to credit, this negative relationship suggests that arable crop farmers who face challenges in accessing credit may experience a decline in income security. Limited access to credit can constrain farmers' ability to invest in improved agricultural practices, purchase quality inputs, and navigate financial shocks. Consequently, these farmers may face increased vulnerabilities to income fluctuations and economic uncertainties.

In addition, marital status, it was negative coefficient suggests that being married is associated with lower income security for arable crop farmers. This negates the expected *a priori*, as one might expect that the economic contributions and support from a spouse could enhance household income security. However, the economic activities and contributions of the spouse can influence overall household income. If the spouse is not actively engaged in income-generating activities or faces economic challenges, it could affect the household's overall financial well-being. Also, the quality of the marital relationship, communication and decision-making processes can play a crucial role. Marital stress, disagreements or financial mismanagement within the household could contribute to decreased income security.

4. CONCLUSION

The study concluded that arable crop production before the flooding was more profitable than after flooding. In addition, there was inequality in the distribution of income among the arable crop farmers after the flooding in the study area. In terms of income security, the arable crop farmers became income insecure after flooding. Deforestation, bush burning, inadequate maintenance of water ways, inadequate soil conservation measures, uncontrolled grazing and change in agricultural practices were the major factors promoting flooding in the study area. The study also concluded that total crop loss to flood, access to credit and marital status had inverse relationship with income security by arable crop farmers in the study area. It therefore recommended that the government and other relevant stakeholders should place concerted efforts to increase smallholder farmers' access to credit and loanable funds to reduce inequality among them. More so, efforts should be made to provide practical skills training programmes that are relevant to the needs of the farmers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/143465