

**EFFECTS OF FLOOD ON LIVELIHOOD DIVERSIFICATION STRATEGIES OF RICE FARMERS IN WUDIL LOCAL GOVERNMENT AREA OF KANO STATE, NIGERIA**

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**Abstract**

*This study examined the effects of flood on livelihood diversification strategies of rice farmers in Wudil Local Government Area of Kano State, Nigeria. Purposive and random sampling techniques were used to select 218 respondents. Data were collected through a structured questionnaire and analyzed using descriptive statistics, multiple regression, and Tobit regression models. The results revealed that 90.8% of respondents were male, with the majority aged between 41 and 50 years. Flooding was found to significantly affect rice yield, income, and food availability, compelling all respondents to engage in various livelihood diversification strategies such as irrigation farming, trading, and dry-season crop production. The Tobit regression analysis indicated that low income, livelihood diversification, and access to credit were statistically significant at 10%, 10%, and 5% levels of probability, respectively. High cost of petrol and inflation of farm inputs were identified as major constraints. The study concluded that flooding substantially affects rice production and farmers' livelihoods, necessitating policy interventions. It recommends government support in providing subsidized inputs, improved access to credit, and the promotion of early-maturing rice varieties to enhance resilience against flood impacts.*

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**Keywords:** Flood, Livelihood Diversification, Rice Farmers, Wudil, Kano State, Nigeria.

**1.0 Introduction**

Flood is a natural phenomenon, a condition of complete or partial inundation of normally dry areas due to overflow of tidal or inland waters or from abnormal and rapid accumulation of runoff (Akukwe and Ogbodo, 2015). Flood is one of the most common of all environmental Hazards and has been described as the natural disaster in the world today, with most consequences on Agriculture; creating devastating impacts on food security of the people and their livelihood especially in developing countries where people are predominantly dependent on agriculture (Pacetti, and Rulli, 2017). In various parts of Nigeria flooding has killed people and forced thousands away from their

homes; caused loss of life, animal and properties; destroy businesses, bridges, roads, and other infrastructure; caused poverty through the degradation of agriculture land and disruption of services; polluted water resources and increase the risk of diseases. And also destroyed farmland and agricultural products resulting to poverty, hunger and starvation. In 2012, the unprecedented flood that occurs in Nigeria affected the food security status of both male- and female-headed categories of households. Food insecurity among others had been identified as one of the effects of flooding in Nigeria (Ajaero, 2017).

Rice is among the three most important grain crops in the world and has a major contribution to fulfill the food needs across the globe (Chauban, Jarban and Mahajan, 2017). The main production ecologies for rice in Nigeria are rain fed lowland, rain fed upland, irrigated lowland, deep water/floating and mangrove swamp. Of this rain fed lowland has the highest share of the rice area (50%) and rice production, which much of the rice production in Nigeria more prone to flood (WARDA, 2016). Livelihood diversification is defined by several scholars in different ways. It is the scope and combination of activities and choices (Liu and Liu, 2016); a means of gaining a living (Loison and Loison, 2016). There are four distinct rural livelihood strategies, namely: on-farm agriculture production, unskilled on-farm or off-farm wage employment and non-farm earnings from trades, commerce and skilled employment and the fourth mixed strategy combines all the three strategies (Hilson, 2016; Sherren, Loik and Debner, 2016). It is also said that rural people establish their livelihood via three main strategies: agriculture intensification; livelihood diversification; and migration (Loison and Loison, 2016). Climate hazard such as flood impacts on agriculture can reinforce poverty traps, and heighten risk. In the absence of markets for insurance and credits, these impacts can lead (rice) farmers to choose low-return agricultural technologies to maintain stable livelihoods; Flood thus possess serious threats not only on the lives of individuals, but also to their livelihood sources (Barret *et al.*, 2015).

## 2.0 Literature Review

Flooding has been and will continue to be a major problem for many rural and urban areas across the developing and developed

countries. In order to mitigate the effects of these flooding it is expedient to formulate a sound flood management policy (Nkunonwo *et al.*, 2016). Ability to forecast flood disaster and their impacts is an important approach to facilitate efficient monitoring and management of any devastating effects of flooding (Orimoogunje *et al.*, 2016). Some of the weaknesses of flood management has been attributed to weak infrastructure, inadequate drainage systems, absence of integrated food risk management systems, weak institutions and poverty (Oladokun and Proverbs, 2016). In addition, flood management can be classified into structural and non-structural measures. Structural measures are based on hard structures like dikes, detention basins, drainage channels, floodgates, pumping stations, dams, and reservoirs that help in controlling or containing water (Li, C.X., Cheng, N *et al.*, 2016). While non-structural measures involve flood forecasting, flood insurance, flood risk analysis, land use planning and zoning, flood awareness programs and post flood recovery (Zhou, Z. Wang *et al.*, 2017). Flood risks are seen within three components which are; probability of flood hazard, the level of exposure, and vulnerabilities of elements at risk. Reducing the severity of these components is the objective of flood risk management (Nkunonwo *et al.*, 2016).

## 3.0 Methodology

The study was conducted in Wudil local government area.

### Sampling Procedure and Sample Size

A multistage sampling technique was used to select respondents for this study. Reconnaissance survey was conducted in May 2023 to get the list of rice farmers in the study area. Firstly, Wudil Local Government Area

was purposively selected based on its prominence in rice production and it also experiences flood the most in Kano state almost annually for more than 7 years (due to the over bank flow of River Wudil during the rainy season). Secondly, Makera, Yan Doji and Yan Bukar villages were also purposively selected based on the fact that these 3 communities have experienced constant flooding over the years. The last stage involved random selection of respondents

from each of these communities from the list of 3117 sample frame obtained from the Anchor Borrower Program heads as well as head farmers in some villages. Finally, a total of 218 (7%) respondents was randomly selected for the research using table of random numbers.

**Analytical Techniques**

The tools of analysis include Descriptive statistics, Multiple Regression, and Tobit Regression Model.

The implicit function is given as:  $Y = f(X_1, X_2, X_3, \dots, X_6)$

Where;

Y = Flood on Rice Farm;

X<sub>1</sub>= Age of rice farmer (Years);

X<sub>2</sub> = poverty status (Poor=1, Non poor=0)

X<sub>3</sub> = Farm size (ha)

X<sub>4</sub> = low income (₦)

X<sub>5</sub> = Losses of Rice(kg)

X<sub>6</sub> = food scarcity

e = Error term.

The Cobb-Douglas regression function was adopted as the lead equation based on the highest coefficient of determination (adjusted R<sup>2</sup>), with the highest F-statistics,

**Tobit regression**

The Tobit model is expressed based on Tobin (1958):

$$y_{\#} = y_i^* = X_i\beta + \epsilon_{\#} \dots \dots \dots (5)$$

$$y_{\#} = 0 \text{ if } y_i^* \leq 0 \dots \dots \dots (6)$$

$$y_{\#} = y_i^* \text{ if } y_i^* > 0 \dots \dots \dots (7)$$

$$i = 1, 2, 3, n \dots \dots \dots (8)$$

Where,

y<sub>#</sub> = observable but censored variable measuring the livelihood diversification of the farmer

y<sub>#</sub><sup>\*</sup> = latent variable indicating that adoption may or may not be directly observable. Hence, diversification is observed if y<sub>#</sub><sup>\*</sup> > 0 and unobservable if y<sub>#</sub><sup>\*</sup> ≤ 0

X<sub>#</sub> = set of explanatory variables

The independent variables were specified as follows:

X<sub>1</sub>= age of the respondents (years)

X<sub>2</sub> = farming experience (years)

X<sub>3</sub> = educational status of the respondents (years of formal education)

X<sub>4</sub> = household size (number of individuals in a given household)

X<sub>5</sub> = livelihood diversification (number of livelihood activities engaged in by a given farm household head) which is the variable of interest in this study

X<sub>6</sub> = marital status (Married =1, Single =0)

X<sub>7</sub> = farm size (ha)

X<sub>8</sub> = access to credit (amount of credit obtained)

X<sub>9</sub> = membership of cooperative (years of membership in cooperative)

$X_{10}$  = extension (number of extension contacts)  
 $\beta$  = vector of Tobit maximum likelihood estimates  
 $e_{\#}$  = independently distributed error term

**Results and Discussion**

Table 1: Quantitative of Socioeconomic Characteristics of the Respondents

Variable	Frequency (N=218)	Percentage
<b>Age</b>		
< 30	23	10.6
31-40	55	25.1
41-50	81	37.2
> 50	59	27.1
<b>Household size</b>		
1-10	71	32.6
11-20	83	38.1
21-30	64	29.3
<b>Farming experience (in years)</b>		
< 6	54	24.8
6-10	63	28.9
11-15	62	28.4
16-20	18	8.3
> 20	21	9.6
<b>Quantity sold/Bag</b>		
30,000 -32,000	113	51.8
> 32,000	105	48.2

Source: Field Data, 2023

The result presented in Table 1 revealed that most of the farmers age lies between 41-50 years which represent 37.2%, those from 31-40 represents 25.1%, 20-30 represents 10.6% and 51year old and above represent 27.1%. this implies that the majority of the farmers in Wudil local government area of Kano state are the elderly who are above 40 years and this may be because the physically strong and young people in society have migrated to look for jobs in the urban areas. The result further revealed that, 4.1% of the respondents were single and 95.9% of the respondents were married with 38.1% household representing 11-20 household size,

others have 1-10 household size representing 32.6% and 21 above household size representing 29.3% respectively. According to Magego (2022), a large household size needs more assets to meet the basic necessities for its members and that in ordinary circumstance larger households are likely to engage in more activities to get a means of living. On the other hand, a large household size with more dependents are likely to use a lot of resources generated from the livelihood activities and depleting them leading to unsustainable livelihood outcomes hence poverty. The findings also established that majority of the respondents obtained their farm by inheritance

which represents 49.1%, others by purchase represented by 9.6%, rented for cash represents 28.9% and some have to borrow which represents 12.4% from the table. 24.8% of the respondents have obtained 1-5years experience in farming, 28.9 have 6-10 years farming experience, 28.4% have 11-15 years farming experience while 9.6% have more than 21 years farming experience.

Majority of the respondents grow rice because it is profitable which represents 61.1% in the table, while others grow rice

because it is easy to cultivate, there is high yield and high demand for it which represents 1.8%, 33.9% and 3.2% respectively. More than half of the respondents sold a bag of rice at the rate of 30,000 to 33,000 Naira per 60kg which represents 51,8% while others (48.2%) . Significant number of the respondent’s primary occupation is full time farming with 92.2%, 1.4% are civil servants while others have several other occupations like trading, planting of other crops, studying etc. which represent 6.4% from the table of the findings of the study.

Table 2: Qualitative Socioeconomic Characteristics of the Respondents

<b>Variable</b>	<b>Frequency (N=218)</b>	<b>Percentage</b>
<b>Sex</b>		
Male	198	90.8
Female	20	9.2
<b>Marital status</b>		
Single	9	4.1
Married	209	95.9
Divorc	0	0.0
Widow	0	0.0
<b>Primary occupation</b>		
Farming	201	92.2
Civil services	3	1.4
Others	14	6.4
<b>Level of education</b>		
Primary	42	19.3
Tertiary Education	11	5.0
Secondary	29	13.3
Adult literacy	0	0
Quranic education	136	62.4
<b>Mode of Obtaining Farm</b>		
Inheritance	107	49.1
Purchase	21	9.6
Rented for cash	63	28.9
Borrow	27	12.4
<b>Why Choose to Grow Rice</b>		
It is profitable	133	61.1
Easy to cultivate	4	1.8
High yield	74	33.9
High demand for food	7	3.2

Source: field data, 2023

The finding of the study also reveals that majority of the rice farmer level of education in the study area are is Qur’anic education with percentage of 62.4%, followed by primary education representing 19.3% tertiary education represents 5.0% and secondary education represents 13.3%. This implies that almost all the rice farmers have no formal education. The socially constructed roles assigned to males and females vary from one society to another and hence this determines the livelihood diversification strategies chosen by people (Francis, 1998). Gender therefore becomes a very important variable when analyzing rural livelihoods. Madanda (2023) notes that women in rural areas are more likely to undertake various

livelihood activities than men but, in many contexts, men have access to resources hence can engage in many diversification opportunities that are not open to women due to cultural constraints. Livelihood diversification strategies therefore may be related to the gender of the household members in which the farmer determines roles within the household (Bryceson, 2020). This therefore means that gender is a determinant in the livelihood options undertaken and consequently affecting the livelihood outcome. From the findings of the study, significant number of the respondents were male which represents 90.8%, while 9.2% of the respondents were female.

**Table 3: Tobit Regression Results on the effects of flood on yield**

Variables	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t-value	Sig.
Constant	1.756	0.959	-	1.640	0.093*
Poverty	0.448	0.045	0.723	4.665	0.000***
Total destruction	1.003	0.056	0.000	1.260	0.210
Rice got spoiled	-0.022	0.023	-0.040	-0.436	0.665
Farm size	0.184	0.096	0.182	2.230	0.039**
Low income	-0.689	0.235	-0.523	-2.678	0.010*
Scarcity of food	-0.112	0.162	-0.194	-0.995	0.021**

The regression model result as presented in Table 3 explains 90% ( $R^2 = 0.900$ ) of the variation in annual productivity, indicating a very strong explanatory power. The constant term (1.756) is positive and weakly significant, representing the baseline productivity when all predictors are held constant. Poverty shows a strong positive and statistically significant influence on productivity at the 1% level, suggesting that increases in poverty-related conditions or

interventions are associated with higher productivity levels, possibly due to increased labor effort or targeted support programs. Farm size also positively affects productivity and is significant at the 5% level, indicating that farmers with larger land holdings tend to produce more. Conversely, low income negatively and significantly affects productivity, showing that farmers with limited financial resources have reduced output due to constraints in accessing inputs

and technology. Food scarcity also exerts a negative and significant effect, implying that food-insecure households may divert resources away from farming activities, thereby reducing overall productivity. Meanwhile, total destruction and rice spoilage exhibit no significant influence on

productivity, suggesting that their impacts are either minimal or inconsistent within the farming context studied. Overall, the findings highlight the central role of economic and food security factors in determining annual agricultural productivity.

**Table 4: Tobit model estimates of the determinants of Effects of Flood on Livelihood Diversification Strategies of Rice Farmers**

Variable	Coefficient	Standard Error	T-value	Marginal Effect
Constant	-0.6360	0.1331	-4.778	-0.6360
Age	0.8381	0.5982	1.401	0.8381
Education	-0.2157	0.3969	-0.543	-0.2157
Low income	0.5200*	0.8740	5.951	0.5200*
Farming experience	0.6848	0.5276	1.298	0.6848
Livelihood diversification	-0.0014*	0.0050	-2.845	-0.0014*
Association membership	0.5577	0.6159	0.906	0.5577
Extension contact	-0.4703	0.1101	-0.427	-0.4703
Farm size	0.7992	0.6120	1.306	0.7992
Credit access	-0.7583**	0.3439	-2.205	-0.7583**
Sigma	1.252***	1.1170	10.700	1.252***

The result presented in Table 4 revealed the factors influencing livelihood outcomes among farmers. The constant term is negative and highly significant, indicating a low baseline livelihood outcome when all predictors are held constant. Age has a positive but statistically insignificant coefficient, suggesting that older farmers may have slightly better livelihood outcomes, though this effect is not strong enough to be conclusive. Education also shows a negative but insignificant effect, implying that formal schooling does not directly translate into improved livelihood outcomes in this context. Low income has a positive and weakly significant influence, indicating that farmers

with lower income categories may benefit more from livelihood-enhancing interventions or intensify efforts to improve their welfare. Farming experience positively influences livelihood outcomes, but the effect remains statistically insignificant. Livelihood diversification shows a small but statistically significant negative effect, suggesting that spreading income sources might reduce specialization and productivity, thereby lowering livelihood outcomes. Membership in associations, as well as extension contact, show mixed results—both positive and negative effects respectively, but neither is statistically significant. Farm size displays a positive but insignificant influence, implying

that additional land contributes to better livelihoods, although not strongly enough to be statistically reliable. Access to credit significantly and negatively affects livelihood outcomes at the 5% level, suggesting that credit-provided farmers may struggle with repayment or invest funds in non-productive ventures. Finally, the sigma parameter is statistically significant at the 1% level, indicating strong model precision and reliability of estimates. Overall, the results emphasize the importance of income level, livelihood diversification, and credit access as key determinants influencing livelihood outcomes among the sampled farmers. This is not surprising, as credit can reduce liquidity constraints and the effect in the aftermaths of flood and can also increase the capacity of households to start irrigation against flooding. This is in line with the findings of Babatunde and Qaim (2019) who reported that access to credit has a positive influence on income diversification. Surprisingly, land area (farm size) owned by household heads was not significant.

### Summary

The study was designed to assess the effects of flood on the ways rice farmers in Wudil LGA of Kano State adapt and manage risks to ensure a steady income and improve their well being. The study formulated five specific objectives; to describe the socioeconomic characteristics of rice farmers in the study area, to determine the effect of flood on yield of rice farmers in the study area, to examine the nature and extent of livelihood diversification strategies, to determine the effect of flood on livelihood diversification strategies and to describe the constraints faced by rice farmers on livelihood diversification strategies, related literatures

were reviewed, Two Hundred and Eighteen (218) respondents were sampled for the study.

### Conclusion

The study findings reveal that, despite the annual flooding experienced in the study area, most of the respondents still depend on farming as their main source of livelihood. This dependence on farming and the continued destruction of farms and food stores by flood pushed farmers to adapt the strategies that will enable them get a steady flow of income despite the annual flooding.

The study findings therefore, conclude that all the rice farmers in the study area have experienced flooding and it has affected them in different ways which includes total destruction of their farm produces. The flood has continued to disrupt the rice farming activities of the farmers in the study area and as a result, the farmers have developed alternative to raises their livelihoods. The findings also conclude that farmers involved in irrigation farming, dry season farming, planting of other crops, casual work on the farms, small scale businesses, construction of houses and employment in nearby institutions such as schools and hospital as watchmen and cooks as their livelihood diversification strategies. Although, as much as rice farmers were involved in other activities, the finding revealed that they still went back to rice farming because it is their main source of livelihood and were not ready to abandon it despite the persistent flooding. The rice farmers faced several constraints on their livelihood diversification strategies which include high cost of petrol, unexpected flood, inflation of fertilizer and chemical prices, insecurity and difficulty in getting irrigation machines and experts that can operate the machines.

### Recommendations

The study findings established that despite the occurrence of floods and the consequent destruction of farms and farm produce, the rice farmers in Wudil Local government area of Kano state still consider farming as their major source of livelihood. It also emerged that the respondents were involved in some other livelihood strategies just for survival purpose but did not invest much in them. It is therefore imperative to come up with recommendations that can boost livelihood diversification strategies so that the rice farmers can endure floods without facing food insecurity and destitution. The study therefore makes the following recommendations:

- i. Effort should be made by the government to provide production inputs (such as herbicides, insecticides, etc.) at a subsidized rate to the farmers.
- ii. Farmers should be educated on the use of early maturing rice varieties (and if possible be provided with the seeds) so as to control the effect of unexpected flooding which comes earlier than usual and destroy even the irrigation farming.
- iii. There is also need for stakeholders to offer grants and soft loans to the rice farmers so that they can invest in their irrigation farming and different kinds of businesses thus have sustainable livelihood diversification strategies.
- iv. Irrigation machines should be provided (even if it is for rent) and farmers should be educated on how to use them.
- v. The rice farmers need to be educated on meaningful investment on livelihoods diversification strategies of their choice

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