

EMPIRICAL ANALYSIS OF ADAPTATION STRATEGIES USED IN MITIGATING FLOOD RELATED LOSSES BY RICE FARMERS IN KWARA STATE, NIGERIA

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ABSTRACT

This study was designed to gain an insight into the adaptation strategies employed by smallholder rice farmers to mitigate flood losses as well as examine determinants of farmers' choice of adaptation strategy in Kwara State, Nigeria. Primary data were collected using semi-structured questionnaire administered to 240 smallholder rice farmers who were selected in a three-stage sampling procedure. Data were analyzed using descriptive statistics and multinomial logistic regression model. The study revealed majority (79.5%) of the rice farmers adopted the planting of early-maturing rice seedling variety so as to ensure early harvest before the peak of rainfall when floods are usually experienced. The least adopted strategy is the change of crop and upland cropping with only 2% of the rice farmers engaging in this. Educational status, past flood-related losses and savings positively influenced the adoption of early maturing rice varieties' relative to change of crop and upland cropping whereas household size and access to climate information had a negative influence on adoption of change in planting date relative to change of crop and upland cropping ($P < 0.05$). The study recommends an urgent need to address rice farmers' continuing dependence on flood plain farming in the study area through enlightening them on the locally adapted coping strategies such as upland cropping and planting of other crops.

Keywords: Climate change, Flooding, Multinomial logistic regression, Upland cropping

INTRODUCTION

Evidently, Nigeria has experienced devastating floods which affected millions of people and resulted in fiscal losses amounting to billions of US dollars (NEMA, 2013). In 2012, Nigeria experienced the worst flooding in over forty years as a result of heavy rainfall that lasted several days. The incidence affected 32 states with 24 considered severely affected (NEMA, 2013). The floods extended over a four-month period in the course of that year and affected 7.7 million people with more than 2 million other people considered as internally displaced. More than 5000 individuals suffered physical injuries along with over 5900 houses damaged; food crops were wiped away resulting in major threats to food security in the nation (Nkwunonwo *et al.*, 2015; Nemine, 2015). The National Emergency Management Agency (NEMA) estimated that a total of N2.29 trillion which represents 2.83 per cent of the rebased Gross Domestic Product of N81 million for 2013 was lost as a result of the floods (Okoruwa, 2014).

According to Anugwara and Emakpe (2013), the floods damaged over 1.9 million hectares of lands and reduced food production along flood plains. Rice production in the affected areas was reduced by 22.4%. The issue of flooding in Nigeria is one which requires urgent attention given its impact on agriculture especially on lowland rice production in the nation. With Nigeria being the highest rice producer in the West Africa sub-region (Kwari *et al.*, 2015), it is apparent that the country has high potentials yet unharnessed.

Flooding is unequivocally one of the major setbacks to rice production in Nigeria considering the common agricultural practice of farming along the flood plains of identified rivers. Flooding remains an issue of major concern given the threats it poses to food security and its negative impact on national wealth. According to Obalola & Tanko (2016), the huge reliance of agriculture in Nigeria on rainfall alone is becoming even more precarious in view of climate change. Nkwunonwo *et al.* (2015) debate that the impacts of flooding in Nigeria continue to trigger concerns for food security and as well vulnerability of the general public. In Nigeria, flooding and the means of addressing its challenges are issues of utmost concerns (Obeta, 2014). Serious damages from flooding incidences and the vulnerability of rural small holder farmers due to low capital has perpetually impacted negatively on their welfare and their ability to employ diverse adaptation techniques hence mitigating subsequent shock events is usually left to the government (Ajibade *et al.*, 2015).

Globally, many scholars have studied the behaviours of farmers in coping with agricultural risks, its effects and as well informal risk-sharing mechanisms among family and friends (Xu, 2000;

Chen *et al.*, 2005; Chen, 2007). Given the various constraints to rice production in Nigeria, of which flooding is cogent, farmers have been driven to seek ways of manoeuvring their challenges and this has made them gravitate towards developing some coping mechanism and adaptation strategy to enable them alleviate the issue which has supposedly perpetuated itself. Asian Disaster Preparedness Center (2003) and Maskrey (2014) both noted that over the last two decades there has been a growing recognition of disaster management being most effective at the community level where specific local needs, resources as well as capacities are met. Several studies have indicated positive outcomes of community-based approaches in management of disasters worldwide (Zhang *et al.*, 2013; Zahari and Ariffin, 2013; Chen *et al.*, 2006). It is against this background that this study was carried out to gain insight into the various adaptation strategies employed post-2012 floods by affected rural rice farming households in Kwara State and also to identify factors that determine the farmers' choice of adaptation strategies. This study is justified because the locally devised coping strategies and adaptation mechanisms by the farmers are more feasible and realistic hence providing the rural farmers with sustainable approaches to tackling the challenge of flooding in their localities.

METHODOLOGY

Kwara State in Nigeria is the study area. The State was created in May 1967 as one of the twelve states that replaced the nation's four regions. Initially the State was known as West Central State before the name changed to Kwara, a local name for the Niger River. Kwara State, lies on Latitude 8° 30 N and longitude 5° 00 E of the equator and is situated in the transition zone between the forest savannah region of Nigeria, having Ilorin as the capital. Kwara State has an estimated population of about 2.5 million people (NPC, 2010), covers about 32,500 km² and consists of sixteen Local Government Areas (LGAs).

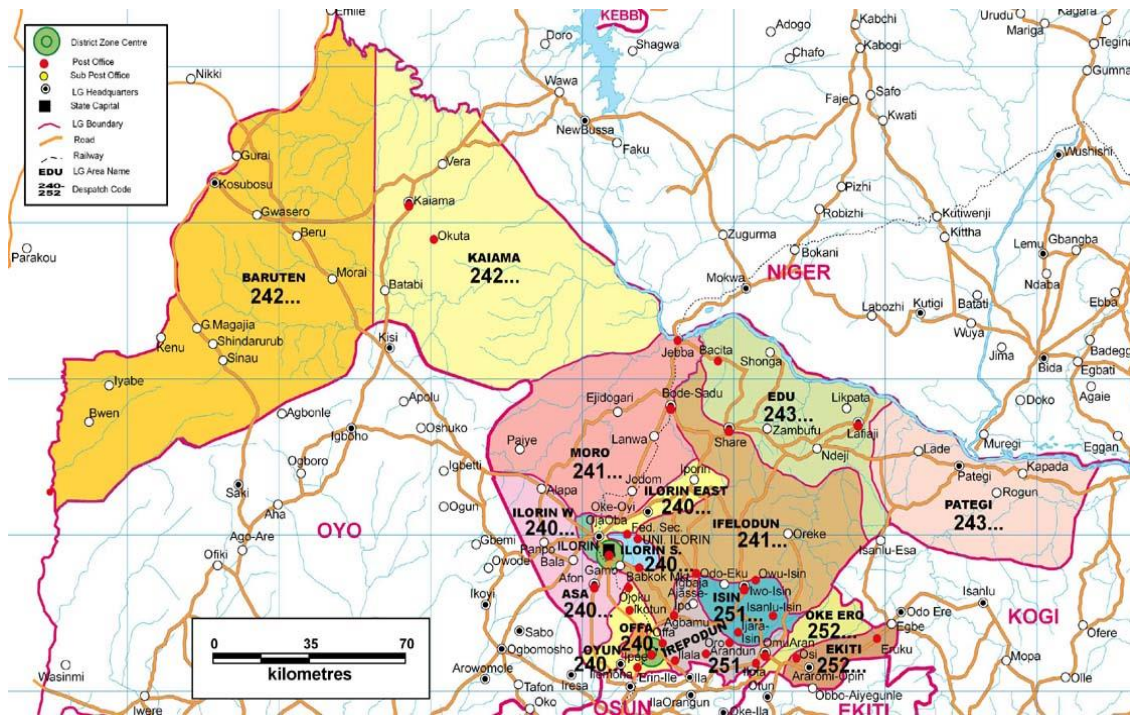


Figure 1. Map of Kwara State, Nigeria (Source: <https://www.google.com.ph>).

Kwara State has a total land mass of 32,500 square kilometres out of which 75.3% is cultivable (National Population Commission [NPC], 2010). Kwara State comprises rainforest in the southern parts with wooded savannah covering the larger part of the State. The soil is fertile and the state is well watered by the various tributaries of the Niger River which run through hills and valleys, none of which rise to any great height. The western section of the state is at a slightly higher altitude than the eastern. This is a summer rainfall area, with an annual rainfall range of 1000 mm to 1500 mm. The months of December and January coincide with the cold and dry harmattan period. Average maximum temperatures vary between 30°C and 35°C. Data used for this study were sourced primarily through the use of semi-structured questionnaire. Secondary information used in this study were sourced from journals, bulletins and reports of relevant agencies such as The Nigerian Meteorological Agency (NIMET), Kwara State Environmental Protection Agency (KWEPA), Nigerian Emergency Management Agency (NEMA) and Kwara State Agricultural Development Programme (KWADP).

A three-stage sampling technique was used in selecting the sample size for this study. The first stage involved the random selection of one of the five identified LGAs heavily affected by the

2012 flooding in Kwara State. The sampling frame includes: Edu, Ilorin South, Kaiama, Moro and Patigi. The selected Local Government Area was Patigi. The second stage involved random selection of 20 affected villages using the Kwara ADP village listing which comprised 663 villages. The randomly selected villages included Pkada, Bobagi, Emiworogi, Guluka, Gokpan, Ebu, Babogi, Jida, Duro, Kpevun, Wako, Gila, Kajika, Rokovi, Vabi, Chikangi, Dgakagi, Edogi, Gbaradogi, and Guluka. The third stage involved the random sampling of twelve (12) households from each of the twenty (20) selected villages to give a total number of 240 farmers.

In order to ascertain the various adaptation strategies utilized by affected rural rice farming households in Kwara State, descriptive statistics was used while the multinomial logistic regression model was used to identify factors that determine the farmers' choice of adaptation strategies. The empirical specification for examining the influence of explanatory variables on the rice farmers' choice of adaptation strategy against flooding (Y_i) is implicitly specified as follows:

$$Y_i = f(X_1, X_2, X_3, \dots, X_n)$$

$$Y_i = \alpha + \sum \beta_i X_i + \mu_i \quad (\beta_i: i=1,2,3,\dots,n; X_i: i=1,2,3,\dots,n)$$

Where $Y = 0$ Change of Crop and Adoption of Upland Cropping, $Y=1$ Change of Variety and Planting Date, $Y=2$ Change of Planting date, $Y=3$ Change of rice variety; while the regressors X_1 = Farm Experience (in years), X_2 = Gender (1 for male and 0, otherwise), X_3 = Education (years), X_4 = Household size (persons), X_5 = Access to Yearly Climate Prediction (SRP: 1=have access, 0=otherwise), X_6 = Access to credit (1 = have access, 0 = otherwise), X_7 = Loss due to flooding (expressed in naira value of Output lost during the last flooding event in the farming season), X_8 = Age (in years), X_9 = Savings (Amount in Naira), X_{10} = Farm Size (Hectare), α = intercept, β = regression coefficient, μ_i = error term .

RESULTS AND DISCUSSION

Adaptation strategies devised by small-holder rice farmers in flood prone areas of Kwara State

Figure 2 gives a pictorial representation of the various flood adaptation strategies that were adopted by rice farmers in the study area. As revealed by the study, the smallholder rice farmers were more attuned to changing the variety of rice that they planted as a strategy to mitigate flood related losses.

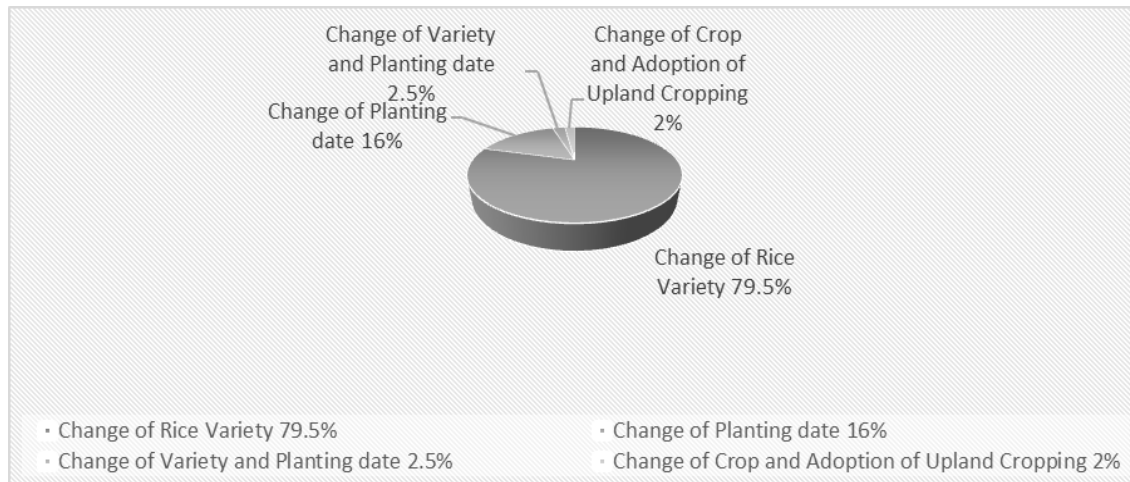


Figure 2: Flooding adaptation strategies adopted by rice farmers in the study area

As could be observed from the result in Figure 2, majority (79.5%) of the respondents adopted a change of rice seedling to a variety which matured earlier than the local rice and it may be said that this was to ensure early harvest of rice crops before the peak of rainfall when floods are usually experienced. Based on the focal group discussion held during survey in this study, one could observe a linkage between this adaptation strategy and the awareness programmes reportedly conducted for community members by various public and private entities such as Olam Nig. Ltd., Veetee Ltd. and also the agricultural extension work force which was operational in the study area. However, it is worthy of note that the information on such early maturing rice varieties was not fully explored by the rice farmers at the time of dissemination as there were still severe cases of rice losses due to flooding in 2012 despite the fact that the awareness had continually been created before then. Apparently, the major flooding of 2012 tipped numerous rice farmers towards adopting this strategy in the area. This finding is somewhat in tandem with Umoh (2013) which revealed that in the wetland regions of Ondo State, farmers plant flood resistant or flood tolerant varieties of crops they usually cultivate. As shown in the chart, up to 16% of the respondents adapted to flooding through a change in their planting date. This is in line with the findings of Mandal (2010) where it was stated that farmers try to minimize risk from various sources in their own way, often by adjusting the cropping pattern and/or cropping season. Findings that the least adopted strategy (2%) in the study area was the adoption of change of crop and upland cropping may be attributed to the fact that farmers may be restrained by water availability and as well may not be open to such options considering the traditional method they

have used over the years which is basically planting along the flood plains of the Niger River. This is unanticipated as one would have expected that the upland cropping would be better explored given the innovation and technology which would readily facilitate irrigation of the farms. In Blade and Slinkard's (2002) research, diversification of crops was suggested as a risk reduction tool as well as inclusion of several species in a crop production plan such as to have the advantage of buffering low price in a specific crop. However, findings from this research indicate that such strategy has not been duly explored by rice farmers in Kwara State considering the low rate of adoption observed.

In order to examine the determinants of the rice farmers' choice of adaptation strategies in the study area, the multinomial logistic regression model was used and the result is as shown in Table 1. Change of crop and adoption of upland cropping was chosen as the reference category given that this strategy had the lowest frequency of occurrence.

Table 1: Determinants of the adoption of change of crop and upland cropping relative to adoption of other flood adaptation strategy by rice farmers in Kwara State.

Variables	Change of Rice Variety		Change of Planting Date		Change of Variety and Planting Date		Change of Crop/Upland Cropping
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	
Intercept	-5.775 (11.86)	0.7549	-2.178 (2.36)	0.0953	-1.732 (1.06)	0.6510	9.685
Age of farmer	-0.743 (2.55)	0.0697	-0.851 (1.92)	0.1806	-0.482 (0.097)	0.7804	2.076
Gender	2.931 (2.59)	0.1425	40.83 (1.61)	0.6024	12.492 (1.94)	0.0826	-56.253
Education	2.497** (17.19)	0.0387	3.826 (0.51)	0.3081	1.977** (0.81)	0.0329	-47.3
Household size	-5.581 (6.12)	0.4593	-5.278** (2.57)	0.0488	-5.456 (7.86)	0.0725	16.315
Access to climate information.	-34.766 (0.09)	0.6508	-6.32** (0.02)	0.0038	-12.18** (0.48)	0.0000	53.266
Access to credit	-0.743 (0.09)	0.3244	-0.002 (0.08)	0.0950	-0.001 (0.072)	0.9900	0.746
Flood related Losses	0.115 (0.04)	0.0962	0.783 (0.04)	0.9741	0.185** (0.014)	0.0492	-1.083
Farming experience	1.009 (3.43)	0.2154	1.707 (18.61)	0.0859	0.041 (3.59)	0.9840	-2.757
Savings	1.568** (0.027)	0.0471	0.002 (0.026)	0.3121	0.002** (1.02)	0.0000	-1.572
Farm size	-3.906 (16.45)	0.7824	-4.353 (2.83)	0.2901	-9.323 (0.71)	0.9026	17.582
Log Likelihood Ratio (λ)	169.02**						
n	191		38		6		5

Source: Data Analysis **5% level of significance; Standard error in parenthesis

The multinomial logistic regression model fitting gave a test statistics value (λ) of 169.02 with the critical value significant at $p < 0.05$ which is an indication that the regression coefficients are significantly different from zero. This implies that the adaptation strategy groups are heterogeneous. As revealed in Table 1, level of education of the rice farmers and the savings were significant and positively influenced the adoption of change of rice varieties planted relative to change of crop and upland cropping. In other words, the level of education of rice farmers increased the probability of changing the variety of rice that the farmers planted by 2.497 relative to their opting for change of crop and upland cropping while the amount the rice farmers have in savings also increased the probability of adapting to flooding through changing of the rice variety planted relative to the change of crop and upland cropping.

In the case of the rice farmers adapting to flooding through changing of planting date, Table 1 revealed that the household size as well as access to climate information were significant and they both negatively influenced the adoption of change in planting date relative to change of crop and upland cropping. The size of the farming household decreased the probability of adapting to flood merely through change in the planting date by 5.278 relative to the use of change in crop and upland cropping strategy. This is in tandem with *a priori* expectation as a larger household size is expected to translate into more labour which may be very important when the farmer is taking decision to go for upland cropping rather than stay within the flood plains in a bid to reduce the labour required most especially when it comes to irrigation, crop management to mention a few. The rice farmers' access to climate information also reduced the probability of adapting to flood through change in planting date by a factor of 6.32 relative to adapting through change of crop and upland cropping which may be attributed to the fact that access to climate information would have equipped the rice farmers with adequate information on impending flooding and this may be a sort of red-alert or discouragement to the farmers making them risk averse and their likelihood to adopt the strategy of change of crop and upland cropping. From Table 1, it can be seen that in the case of the adaptation strategy involving change of variety and planting date, there were four variables that were significant and these include the educational level of the rice farmer, access to climate information, loss due to flooding and savings. The rice farmers' access to climate information negatively influenced their adaptation to flooding by changing the rice variety planted and the planting date relative to change of crop and upland cropping. The rice farmers' access to climate information reduced the probability of the farmer embracing the change in variety and planting date by 12.18 relative to the adaptation strategy of change of crop and upland cropping. The educational level of the rice farmer, past losses due to flooding and the

farmers' savings were all shown to have positive influence on the farmers' adaptation strategy of changing the plant variety and planting date relative to the change of crop and upland cropping. Educational level, past losses due to flooding and the farmers' savings increased the probability of the rice farmers adapting to flooding by changing the rice variety and planting date by 1.977, 0.185 and 0.002 respectively over the adaptation through change of crop and upland cropping.

This result corroborates that of Olayemi (2012) which reported that for every unit increase in age, years of formal education, farming experience and farm size of farmers there is probability of increase in coping strategies employed. It is also aligned with Adeloye and Sotomi (2013) which revealed that age, years of schooling and farming experience were significant in the adoption of coping strategies by young farmers in Osun State. The determinants of the adaptation strategy employed by farmers in the study area are also well in line with a study carried out in Faridpur by Biswas *et al.* (2015) where the variations in risk perception were influenced by various factors including age, gender, educational level, livelihood and socio-economic attributes whereas, to ensure their food cum nutritional security, farmers adopted diverse mitigation strategies like integrated farming system, changing cropping pattern, use of resistant, tolerant or hybrid varieties, good management practices, integrated pest management practices, appropriate diseases prevention and hygienic measures.

CONCLUSION AND RECOMMENDATIONS

There is the urgent need to address the respondent rice farmers' dependence on farming in the flood plains of the Niger River. It is paramount for the farmers to diversify their risks and take advantage of upland cropping of rice and even intensify efforts in the planting of other staple crops that are well suited to the area such as to be able to provide some form of buffer in the case of crop failures and flood related losses especially in this era of changing climate. Given that rice is of utmost importance in the diet of Nigerians its losses should be mitigated. Embracing the upland cropping and planting other crops such as grains, legumes, root and tuber crops will go a long way in securing or even improving the welfare of the respondent households in the study area, providing adjunct incomes to them. The government has been clamouring for a reduction in the import bills on rice annually, which is an indication of the need to gear up our level of rice production in Nigeria. In the bid to boost production, there is the need to guide against some avoidable losses which have somewhat remained unaddressed. An integrated irrigation scheme should be created to cater for communal farming needs as this is expected to encourage upland cultivation of rice away from river bodies thus reducing risk of flooding impacts on the rice growers. Likewise, there should be increased access to banking facilities in the vicinity of rice

farming communities as this will in turn encourage savings culture which impacts on the farmer's decision on strategies to employ against flooding challenges. There is the need to improve the farmer's level of knowledge and also to increase their access to timely and comprehensible information as related to climatic conditions as this will influence the farmers' agricultural planning and decision making in their efforts at imbibing strategies that will help them mitigate flood related losses. Farmers should have ready access to the seasonal rainfall prediction annual report (SRP) as this has proven to be fairly accurate and will be beneficial to farmers in decision making.

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