ISSN:
Print - 2277 - 0593
Online - 2315 - 7461

Journal of Natural Science, Engineering and Technology

DETERMINANTS OF RISK MANAGEMENT STRATEGIES AND HOUSEHOLD INCOME SOURCES AMONG RICE FARMERS IN KEBBI AND EBONYI STATES, NIGERIA

[1]A. I. DAVID, [1]Y. U. OLADIMEJI, [1]O. YUSUF, [1]A. S. HUSSAINI, [1]S. ABDULRAHMAN, [2]C. U. UCHENDU, [1]M. A. OWOLABI, [1]M. UMAR

[1]Department of Agricultural Economics, Ahmadu Bello University, Zaria, Nigeria
[2]Samaru College of Agriculture, Division of Agriculture College, Ahmadu Bello University, Zaria, Nigeria
*__Corresponding Author__: yusuf.dimeji@yahoo.com **Tel**: +2348032220000

ABSTRACT

Smallholder farmers in rural Nigeria are usually confronted with agricultural risks which necessitate livelihood diversification. This study was conducted to determine risk management strategies and household income sources, and effects of farmers' attributes on the agricultural risks' sources and risk coping strategies. The study examined rice production in Nigeria, with reference to Kebbi and Ebonyi States where rice production is predominant. It utilized a multistage sampling procedure with sample size of 63 rice farmers from Ebonyi State and 315 from Kebbi State. Multinomial logit was used to analyze major factors determining the choice of risk management strategies adopted by the rice farmers. Rice production in the two states is predominantly embraced by middle-aged farmers, with mean ages of 43 and 42, respectively. Overall average household size was 9 people per household. About 54.0% of rice farmers lack formal education, in Ebonyi State and 39.0% in Kebbi State. Male genderism has marginal effect on market monitoring and evaluation risk mitigating strategies, with a household increase of 0.2%, indicating a higher likelihood of adopting economic factor strategies. Increasing rice farm size leads to a decrease in farmers' adoption of information and development factor, social factor and market and monitoring evaluation mitigating strategies. All households, on average, generate 75.4% of their total income from agriculture, with 25.0% receiving income from off-farm sources. Farmers either grow only rice, having no other income sources, or may diversify into some other categories. With age, rice farmers are more likely to engage in non-farm income activities due to the capital- and labor-intensive nature of rice cultivation. Higher education levels increase the probability of rice farmers adopting management strategy by 2.5%. The study found that socioeconomic and institutional factors influence rice farmers' risk management strategies and income sources. Most farmers rely on farming, suggestive the need for adult literacy programs and risk-mitigating strategies.

Keyword: Risks, Management strategies, Household, Income, Nigeria

INTRODUCTION

The 2030 agenda of the United Nations highlights the significance of food and agriculture in achieving the Sustainable Development Goals (SDGs). Consequently, investment in rural development and agriculture is critical for ending global poverty and hunger, as well as ensuring sustainable devel-

opment, especially in Africa (Kyire *et al.,* 2023). The consequence of unanticipated shocks and unpredicted natural problems in agriculture drives farming households toward alternative methods of income generation (Akintunde *et al*., 2022). According to Cooke *et al.* (2016), the smallholder farmers in rural Nigeria are confronted by imminent agricultural risks which necessitate livelihood diversification due to increasing climatic factors such as erratic rainfall, rising temperatures, overgrazing, and desertification in the far north, among others. Livelihood diversification is a way of mitigating against risk from agricultural disasters or shocks, compelling farming households to engage in other income-generating activities. This is very important in the socioeconomic life of the rural households (Oladimeji *et al*., 2019). Livelihood diversification of rural farming households includes other agricultural sectors and non-farm activities such as artisans and civil services (Oladimeji *et al*., 2015).

Nigeria exhibits notably accelerated growth in rice consumption compared to its West African counterparts, driven by rapid population growth, heightened urbanization, and prevailing preference for this staple product. The annual rice demand in Nigeria has been on the rise, increasing by 7.8%, while supply has grown at a contrasting rate of 5.5%, resulting in a deficit demand-supply gap of 2.3% (Obianefo *et al.,* 2022). Subsequently, the inability of farmers to achieve the potential yield has been partly blamed on the risks involved in rice production. Like any form of farming, rice cultivation is confronted with varying risks, ranging from production, technical, financial, market and price, political, and human or physical induced risks such as socio-economic characteristics (Pham *et al*., 2021).

It is pertinent to mention that increasing rice production is needed to meet the supply-demand deficit in Nigeria as its production involves biological processes that are exposed to widely varying and unpredictable elements of nature, such as uncertainty in biological processes related to weather, diseases, and pests which cause yield variability. The complex nature of weather and climate as well as physical and environmental factors make rice farming enterprise more difficult to manage (Oladimeji *et al.,* 2019; Mohammed *et al.,* 2021; Yakubu & Oladele, 2021). In the case of Nigeria, and more specifically that of Ebonyi and Kebbi States, smallholder farmers are particularly vulnerable to certain risks such as environmental, technological, and financial risks. These include climate variability, pest infestations, price fluctuations, input cost volatility, institutional, yield, and market risks, and the consequences of these can be extreme, in some cases even pushing resource-limited smallholders into deeper poverty (Obianefo *et al.,* 2022; David *et al.,* 2024).

Rice production depends on optimum combination of factors of production in order to achieve remarkable yield. Researchers have found that risks cause farmers to be less willing to undertake activities and investments that have higher expected outcomes, but carry with them risks of failure (Magaji *et al.,* 2021). Farmers express their risk mitigation in diverse ways, some of which are forward pricing, diversification, insurance, cooperative participation, market engagement, unprecedented weather conditions, rigid behaviour of farmers for using improved agronomic practices, and liability management, or the combination (David *et al.,* 2024). Generally, these ways of risk mitigation have commanded substantial resources from farmers.
In Nigeria, however, there appears to be in-

adequate information on what determines and how farmers cope with agricultural risk in order to avert their vulnerability to poverty and food insecurity status. Knowing how households respond to risks is of critical importance since it reveals what the households can do to help themselves in these circumstances. Kebbi State is characterized by a semi-arid climate with irrigation -dependent rice farming (ACReSAL, 2024) while Ebonyi State has a humid climate with predominantly rain-fed rice cultivation (Ibeje & Ekeleme, 2020). These differences influence the risks faced by farmers and their corresponding mitigation strategies.

Understanding the factors that drive farmers' strategy selection is crucial for developing targeted policies and interventions to enhance resilience and sustainability in rice farming. Existing studies on agricultural risk management in Nigeria viz: Pham *et al.* (2021), **Obianefo** *et al.* (2022), and David *et al.* (2024), adopted a broad perspective, failing to account for regional variations in risk exposure and response mechanisms. This gap in knowledge hinders the formulation of state-specific policies that can effectively support farmers in mitigating risks. Also, there is limited empirical evidence on the specific risk management strategies adopted by rice farmers in these states and the key determinants influencing their choices. This raises the research questions: what are the determinants of risk management strategies and households' income sources among Rice Farmers in Kebbi and Ebonyi States of Nigeria?; What are the effects of farmers' attributes on the agricultural risks' sources and risk coping strategies in Ebonyi and Kebbi States?. By addressing these gaps, the study will provide insights for policymakers, extension services, and stakeholders to design more effective support systems that enhance farmers' adaptive capacity and productivity in Nigeria.

METHODOLOGY

Description of study area

This study targeted Kebbi and Ebonyi States in Nigeria. The duo is among the the primary rice-producing states in the nation, and these two states have similar characteristics in the management strategies, gender participation in rice production, land degradation, and both upland and lowland production.

Kebbi State is situated in the semi-arid Sudano- Sahelian ecological zone and suffers from a severe year-round lack of precipitation (Singh, 1995). Nonetheless, the state's southern region is located in the northern Guinea Savannah Ecological Zone. Rainfall in Kebbi State begins around April and ends in October, with highest rain in July and August. The annual rainfall ranges from 500 to 850 mm, increasing both in quantity and intensity within the State from the north to the south (Singh, 1995). Generally, the State is characterized by high temperatures especially in the months of March, April and May. The annual temperature varies from 21 – 38 ^{o}C. The soil type found in the state ranges from heavy clay in the *Fadama* areas to sandy loam and sandy soil in the upland areas [Kebbi Agricultural and Rural Development Authority (KARDA), 1992].

Ebonyi State is located in the southeast zone of Nigeria; it is characterized by mean annual rainfall range of 2250 in the south and 1500 mm in the northern part. Average annual temperature is about 27 °C with relative humidity of 85% (EBADP, 2012). The vegetation of the state is a mixture of savanna and semi-tropical forest with agriculture as

the mainstay of the economy. The underlying parent materials consist of shales interbedded with sand and limestone.

Sampling and sample size determination

A three stage sampling procedure was used to obtain the sample size. First phase, three Local Government Areas (LGAs) in Ebonyi State were chosen randomly due to their high rice farmers population in virtually all the rural and peri-urban LGAs, while the four main rice-producing LGAs in Kebbi State were purposefully chosen as a result of their dominance activities in rice enterprise. The LGAs selected from Kebbi State were: Augie, Birnin Kebbi, Dandi, and Zuru while in Ebonyi State: Abakaliki, Afikpo and Ikwo LGAs were randomly selected. In the second phase, a total of sixteen communities were randomly selected from the seven LGAs through the card system. In the third phase, power analysis software was used to arrive at the accurate sample size of 63 rice farmers from Ebonyi State and 315 rice farmers from Kebbi State, based on an allocation ratio of 1:5 due to the population density of rice farmers in the study areas with the actual power of 0.95 at two tails test.

Primary data for this study was obtained with the aid of a structured questionnaire administered and interview schedule by trained enumerators. The enumerators consisted of States' Agricultural Development Projects (ADPs) staff and Postgraduate students. They were trained by the researcher and assisted by some senior staff of the ADPs at the ADPs' headquarters in the two States. Data, evolving information on the 2021 farming season, were collected in December 2021.

Multinomial Logit model

The multinomial Logit was used to analyze major factors determining the choice of risk management strategies adopted by the rice farmers, and the effects of farmers' attitude risk management strategies. The multinomial Logit model (MNLM) is used for analyzing unordered qualitative variables. It deals with truly nominal and mutually exclusive categories as adopted by Umar *et al.* (2024). The choice of the reference category is arbitrary but should be theoretically motivated.

Multinomial logit Model used in the study is specified explicitly as:

$$Y_{i1} = V_1 + \lambda_{11}\eta_{i1} + \lambda_{12}\eta_{i2} + \lambda_{13}\eta_{i3} + \lambda_{14}\eta_{i4} + \lambda_{15}\eta_{i5} + \lambda_{16}\eta_{i6} + \lambda_{17}\eta_{i7} + \lambda_{18}\eta_{i8} + e_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where, Y_{i1} = Economic factor = 1, Institutional and development factor = 2 Social factor = 3 and Market, monitoring and evaluation factor = 4 for factors determining the choice of risk management strategies adopted by rice farmers.

$Y_{i1} = Rice\ only = 1, Rice\ and\ other\ agricultural\ income = 2\ Rice\ and\ non\ agricultural\ income = 3\ and\ Rice, other\ agricultural\ income\ non\ agricultural\ income = 4$ for

η_{i1} = Sex (Male = 1, female = 0), η_{i2} = Farm size (ha), η_{i3} = Education (years), η_{i4} = Age (years), η_{i5} = Households size (number), η_{i6} = Farming experience (Years), η_{i7} = Cooperative, Membership (years) and η_{i8} = Amount of credit obtained (₦).

RESULTS AND DISCUSSION

Socioeconomic and Institutional Characteristics of the Rice Farmers

Mean age of the farmers were about 43 years for Kebbi and 42 years for Ebonyi State (Table 1); implying that rice production in the two states was embraced predominantly by middle-aged farmers. The skewness is less than two in absolute value (0.09), implying being symmetrical about its mean. The kurtosis was -0.29, which exhibited a high level of consistency in the age of the farmers. Overall, about 94% of them were males. This result is skewed towards male folk, which is typical of male dominance on the issue of gender parity or disparity.

Overall average household size was 9 people per household, with *SD* = 6.80, Skewness = 1.35, and Kurtosis = 4.00. This is an indication of labour availability that can be used for different rice production operations. The kurtosis was 4, which exhibited a high level of inconsistency in the household size, implying that the household distribution is markedly not the same in both states as the normal distribution in its tendency to produce outliers. Over 54% of the total rice farmers in Ebonyi State and 39% in Kebbi State had no formal education. However, a larger segment (61%) of the rice farmers in Kebbi State had neither primary, secondary, nor tertiary education. This implies that the majority of the respondents in Kebbi State had no form of formal education or another, while their counterparts in Ebonyi State had mainly adult education which is a non-formal education.

The overall farming experience had an average of about 18 years, with *SD* = 9.96, Skewness = 0.95, and Kurtosis = 1.27. This implies an appreciable number of farming experience, with a low level of variation in the farming experience considering the value of skewness and kurtosis.

The majority of the respondents, 94.00% in Kebbi, and about 83.00% in Ebonyi States had cooperatives membership. Overall, about 89.00% of them belong to cooperatives. This implies that the majority of the farmers belonged to cooperative societies. In terms of years of cooperative membership, majority of the respondents (56.00% in Ebonyi; 36.40% in Kebbi State), had their membership within the range of 1-4 years.

Table 1: Summary of Socio-Economic Characteristics of Rice Farmers from Ebonyi and

Variable	Dominant range	Kebbi State	Ebonyi State
Gender	Male (%)	93.02% Male	93.65% Male
Age	41-60 years	61.59%	76%
	Mean	43 years	42 years
Formal education	Non-formal	39.01%	54.01%
Household size	5 persons & above	98.33%	79.00%
	Mean	11	5
Farm experience	Mean	25 years	16 years
Membership of association	Yes	93.55	83.42
	No	6.45	16.58

Source: Data analysis, 2024

Factors Determining the Choice of Risk Management Strategies Adopted by Rice Farmers

The multinomial Logit model result was statistically significant at 1% level as measured by the probability of the Wald chi-squared estimate (Table 2). The marginal effects were discussed and not the coefficients since they tell not just the direction alone but also the actual probability and magnitude of change that occurred to the dependent variable as a result of changes in the independent variables.

Sex: The multinomial Logit marginal effect for males relative to females was -0.366 units lower for being in the market monitoring and evaluation (MME) risk mitigating strategies category relative to "economic factor only" given all other predictor variables in the model are held constant. This implies that female rice farmers were more likely to adopt the MME of risk-mitigating strategy compared to their male counterparts. This is because self-employment activities such as petty trading make up a significant proportion of non-farm activities in the study area and women usually dominate these activities. Male farmers are rather likely to be involved in agricultural-related activities as their diversification strategy and also have the advantage of social support as the production favours male folks over their counterparts. This assertion is confirmed by the fact that males were rather 19.7% and 4.1% more likely to take up economic and social factor strategies, respectively than their female counterparts. This finding corroborates the report of Akrasi *et al.* (2020) that females are more likely to be involved in non-farm activities than males.

Farm size of rice farm: As rice farm size increases, a respondent is less likely to add other risk management strategies information and social development (IDF), Social factor (SF), and MME strategies because rice cultivation in itself is both capital and labour -intensive. Increasing rice farm size means an upsurge in both labour and capital commitments for the rice farm which the farmer would have needed if he/she were to go into other management strategies. This implies that with a unit increase in farm size for rice production, farmers were 0.8, 2.1, and 11.5 units less likely to adopt IDF, SF, and MME mitigating strategies, respectively. This finding is in line with the report of Teshome and Edriss (2013), who opined that participation in risk-mitigating strategies decreased with an increase in farm size among smallholder farmers. The result, however, showed that an increase in rice farm size increased the probability that the rice farmer would adopt economic factor strategies by cultivating other crops and/or rearing animals (EF strategy) by 10.5%. It is relatively easier for the typical rice farmer to go into a crop diversification strategy (which constitutes EF) than to combine other strategies (IDF, SF, and MME strategies). Idowu *et al.* (2014), reported similar findings of a marginal increase in crop diversification with an increase in farm size.

Education: Education facilitates the adoption of modern technologies and improved farm practices. Notably, formal education is an essential tool for the adoption of modern production technologies and effective communication systems that encourage an increase in the productivity of any agricultural venture. This implies that an increase in the educational level of rice farmers in the study area increases by 2.5% the probability of rice farmers adopting the risk-mitigating strategy in contrast to the adoption choice of IDF, SF, and MME risk management strategies. Education of rice farmers was rather likely to reduce the chances that a farmer would

choose IDF, SF, and MME risk management strategies by 36.4, 20.9, and 0.2%, respectively. This also agrees with the findings of Yesuf and Bluffstone (2007), and Kuwornu *et al.* (2011), where it was observed that the level of education greatly increases the probability of adopting a particular technology and coping strategies (Table 2).

Household size: Household size determines the extent of rice farmers' risk management strategy. With a unit increase in the household, the likelihood that the rice farmer will adopt an EF mitigating strategy will increase by 0.2% (Table 2). This observation is so because large household sizes connote the availability of labour as well as additional responsibility by participating in more economic factors which will lead to an increase in his income. This confirms the argument by Asfaw *et al.* (2015), in rural Malawi that larger household is associated with income diversification. On the contrary, household size had an inverse effect on the choice of IDF and SF risk management strategies. A unit increase in rice farm households decreased the probability of the rice farmer choosing IDF and SF risk management strategies by 1.8 and 0.8%, respectively. This might be because compared to smaller households, large households are likely to be made up of many management strategies that would help to accomplish different mitigating strategies for the household. The fact that overall mitigating strategy needs of larger households would be a shared burden among the members of the households. This is in line with Ahmed (2012), who reported in Borno State of Nigeria where household size was inversely related to income diversification.

Table 2: Factors Determining the Choice of Risk Management Strategies Adopted by Pooled Rice Farmers from Ebonyi and Kebbi States, Nigeria

Variable	EF		IDF		SF		MME	
	ME	SE	ME	SE	ME	SE	ME	SE
Sex	0.197***	0.028	0.0021	0.307	0.041***	0.255	-0.366***	0.635
Farm size	0.105***	0.013	-0.008***	0.130	-0.021**	0.828	-0.115***	2.926
Education	0.025**	0.010	-0.364	3.655	0.209	-1.593	0.002	0.083
Age	0.012*	0.001	0.082**	1.795	0.113**	1.538	0.010***	0.092
Household size	0.002*	0.002	-0.018***	2.446	-0.008**	-2.375	0.116	-0.672
Farming experience	-0.003	0.001	-0.002	1.944	0.070	-1.829	-0.082	0.902
Membership	-0.002	0.002	0.000	0.595	0.000	0.983	0.003	-1.656
Credit	0.156***	0.149	-0.094***	2.111	-0.006***	1.911	-0.103***	-1.914
Constant	0.219	0.009	0.239	2.111	0.192	2.129	0.000	0.819
No. of observations	377							
P- likelihood	-181.241							
Wald chi^2 (348)	156.912							
Log Prob > chi^2	0.0000							
Pseudo R^2	0.48							

Credit: Credit accessibility would compel a rice farmer into an economic factor portfolio (EF)

Consequently, access to rice farm credit was likely to lead to a 15.6% increase in the probability that a farmer will choose the EF risk mitigating strategy in contrast to IDF, SF, and MME risk management strategies. Access to rice farm credit was rather likely to reduce the chances that a farmer would choose IDF, SF, and MME risk management strategies by 9.4, 0.6, and 10.3%, respectively. This ties in with the findings of Asfaw *et al.* (2015), and Ahmed (2012), who both reported credit access to have a negative influence on the decision to diversify income. This is because the credit the farmers received was specifically meant for their rice farm hence it led to intensification of the rice farming rather than diversification.

Effect of Farmers Attributes on Households' Income Sources:

Average annual income: All households derived income from Agriculture, with an average of 75.40% of the total household income (Table 3). Crop production, which is mainly subsistent in nature is the most single source of income, providing about 43.80% of total income. Almost 28.00% of the household derived their income from livestock enterprises. About 25.00% of the household receive income from off-farm sources. This corroborates the studies of Abdulrahman *et al. (*2016), Oladimeji *et al.* (2019), and Babatunde *et al.* (2010), that income obtained from agricultural sector is greater than off-farm sector.

Table 3: Average Annual Income Obtained from Different Sources of Rice Farmers Pooled across Ebonyi and Kebbi States Nigeria

Income Sources	Income	Percent
Crops	1,715,701.0	43.8
Rice	868,250.9	22.2
Other crops	847,450.4	21.6
Livestock	1,093,333.0	27.9
Fishery	142,857.1	3.6
Total Agriculture	2,951,892.0	75.4
Off-farm labour	221,233.3	5.7
Self-employment	222,396.9	5.7
Public services	299,381.0	7.6
Migration & others (Okada, Pension and Remittance)	220,000.0	5.6
Sub-total	963,011.2	24.6
Ground Total	3,914,903.0	100.0

Source: Data analysis, 2024

Multinomial Logit Results of the Effect of Farmers' Attributes on Households' Income Sources among Pooled Rice Farmers from Ebonyi and Kebbi States, Nigeria

The outcome variable of interest, whether or not one diversifies, is categorical in nature (Table 4). This is due to the fact that a farmer may either be growing only rice and therefore has no other source of income aside from the rice farm (no diversification) and thus be classified into "Rice only category" (R strategy) or may diversify and hence be classified into any of the other three categories of diversification; "rice plus other agricultural incomes" (RA), "rice plus non-agricultural income sources" (RN) and "rice plus other agricultural plus non-agricultural incomes" (RAN). "The Rice income only" (no diversification) group was selected as the base category for the multinomial logit to determine the effect of farmers attributes on households' income sources of rice farmers so that all other choices of diversification strategies were compared to this group.

The entire model was statistically significant at a 1% significance level as measured by the probability of the Wald chi-squared estimate. The marginal effects (ME) were discussed and not the coefficients since ME shows both the direction alone and the actual probability/magnitude of change that will occur to the dependent variable as a result of changes in the independent variables.

Sex: The multinomial logit for males relative to females was 0.383 units lower for being in the RN diversification category relative to "rice only" given all other predictor variables in the model are held constant. This implies that female rice farmers were more likely to adopt the RN diversification strategy compared to their male counterparts. This is because self-employment activities such as petty trading make up a significant proportion of non-farm activities in the study area and women usually dominate this. Male farmers are rather likely to be involved in agricultural-related activities as their diversification strategy. This assertion is confirmed by the fact that males were rather 45.7% more likely to take up RA and R strategy only for their rice farming (that is adopt RA/R diversification strategy) than their female counterparts. The fact that males have more farmland than females in the study area makes it easier for them to go into the cultivation of other crops (usually on different pieces of land), classified in this study as 'RA income strategy'. This finding corroborates that of Hjelm and Dasori (2012), who also reported that females are more likely to be involved in non-farm activities than males.

Size of rice farm: As rice farm size increases, a respondent was less likely to add on other non-farm income activities (RN and RAN strategies) because rice cultivation in itself is both capital and labour intensive. Specifically, for every 1-hectare increase in rice farm size, respondents were 2.1 and 11.5% less likely to engage in RN and RAN diversification respectively. This finding supports the argument of Man (2009), that larger farm size is an indicator of good asset holding and social status, hence persons with larger farm sizes are less likely to engage in non-farm income diversification. Teshome and Edriss (2013) also reported similar results in Ethiopia where participation in income diversification decreased with an increase in farm size among smallholder farmers.

The result showed that an increase in rice farm size increased the probability that the rice farmer would add on the cultivation of other crops and/or rearing animals (RA diversification strategy) by 0.8% points. It is relatively easier for the typical rice farmer to go into crop diversification (which constitutes RA diversification) than to combine the rice production with an entirely new non-farm activity (which would imply RN or RAN strategy in this study) hence the observation. In a related study in Ogun State of Nigeria, Idowu *et al.* (2014), reported similar findings of a marginal increase in crop diversification with an increase in farm size.

Table 4: Effect of farmers' attributes on households' income sources pooled data from Ebonyi and Kebbi States, Nigeria

Variable	Rice income only		Rice and other agricultural incomes		Rice and non- agricultural incomes		Rice, other agricultural & non-agricultural incomes	
	ME	SE	ME	SE	ME	SE	ME	SE
Sex	0.197***	0.028	-0.457***	0.307	-0.383***	0.255	-0.366	0.635
Farm size	0.105***	0.013	0.008***	0.130	-0.021**	0.828	-0.115***	2.926
Education	0.025**	0.010	-0.364	3.655	0.209	1.593	0.002	0.083
Age	0.0102*	0.001	0.082**	1.795	0.113	1.538	0.010***	0.092
Household size	-0.002*	0.002	-0.018***	2.446	-0.008**	2.375	0.116***	0.672
Farming experience	-0.003	0.001	-0.002	1.944	0.070	1.829	-0.082	0.902
Cooperative membership	-0.002	0.002	0.000	0.595	0.000	0.983	0.003	1.656
Credit	0.156	0.149	0.094***	2.111	0.002***	1.911	-0.103***	1.914
Constant	0.219	0.009	0.239	2.111	0.192	2.129	0.000	0.819
No. of observations	378							
Pseudo likelihood	-181.241							
Wald chi^2 (348)	156.912							
Log Prob > chi^2	0.0000							
Pseudo R^2	0.48							

Education

An increase in the educational level of rice farmers in the study area increases (2.5%) the probability of rice farmers adopting R strategy in contrast diversification into RA and RAN was not significant. This also agrees with the findings of Yusuf *et al.* (2017), and Kuwornu *et al.* (2011), where it was observed that the level of education greatly increases the probability of adopting a particular technology and coping strategies

Age: As the age of rice farmers increases, a respondent was more likely to add on other non-farm income activities (RA and RAN strategies) because rice cultivation in itself is both capital and labour intensive. Specifically,

for every increase in age, respondents were 8.1 and 1% more likely to engage in RN and RAN diversification, respectively.

Household size

Adoption of RAN diversification strategy conformed to our apriori expectation of an increase in the probability of income diversification as one's household size increases. For each person added to the household, the likelihood that the rice farmer will adopt the RAN diversification strategy increases by 11.7%. This observation is so because bigger household sizes imply more mouths to feed and also more needs to be met. On the contrary, household size had an inverse effect on the choice of R, RA and RN income diversification strategies. Every person added to a respondent's household decreased the probability of the rice farmer choosing R, RA, and RN income diversification strategies by 0.2, 1.8 and 0.8%, respectively. This might be due to the fact that compared to smaller households, large households are likely to be made up of many income earners who would help raise the needed income for the household. The fact that overall income needs of larger households would be a shared burden among the many income earners might compel respondents therein not to take up multiple jobs but rather concentrate on their rice production, hence specialization. This was what Ahmed (2012), reported in the Borno State of Nigeria where household size was inversely related to income diversification.

Access to credit: Diversification into RAN followed the findings of Akaakohol & Aye (2014), who argued that credit access would compel a farmer into income diversification. Consequently, this present study found that access to rice farm credit was likely to lead to a 9.4 and 2% increase in the probability that a farmer will choose the RA and RN diversification strategy. The opposite was however true for the choice of RAN diversification strategies. Access to rice farm credit was rather likely to reduce the chances that a farmer would choose RAN income diversification strategies by 10.3%.

CONCLUSIONS AND RECOMMENDATIONS

Multinomial Logit results established that socioeconomic and institutional variables were the factors determining the choice of risk management strategies adopted by rice farmers and the effect of farmers attributes on households' income sources among rice farmers. It can also be concluded that majority of rice farmers derived large portion of their income from farming activities. Adult literacy programmes should also be established by extension agencies. Seminars/ workshops and meetings on risk-mitigating strategies and related issues should also be organized by the agencies.

REFERENCES

Abdulrahman, S., David, A. I., Yusuf, O., Abdulazeez, R. O., and Binuyo, G. 2016. Analysis of Livelihood Diversification by Farming Households in Kaduna State, Nigeria. 2nd International Conference on Dry land Agriculture, Centre for Dry land Agriculture, Bayero University, Kano. 12th -16th December, 2016. *Proceeding,* 2: 45-49.

ACReSAL, 2024. Kebbi Agro-Climatic Resilience in Semi-Arid Landscape https://acresal.gov.ng/states/kebbi/

Ahmed, F. F. 2012. Income diversification determinants among farming households in Konduga, Borno State, Nigeria. *Academic Research International* 2(2): 556-561. ISSN- L : 2223-9553, ISSN: 2223-9944.

Akaakohol, M., Aye, G. 2014. Diversification and farm household welfare in Makurdi, Benue State, Nigeria. *Development Studies Research,* 1(1): 168-175. http://dx.doi.org/10.1080/21665095.2014.919232

Akintunde, O., Ajayi, F., Bamiwuye, O. P., and Olanrewaju, K. 2022. Factors influencing livelihood diversification among farming households in Ejigbo local government area of Osun State, Nigeria. *Economic Engineering in Agriculture and Rural Development,* 22(3): 15-22. PRINT ISSN 2284-7995, E-ISSN 2285-3952

Akrasi, R. O., Eddico, P. N., Adarkwah, R. 2020. Income diversification strategies and household food security among rice farmers: pointers to note in the north tongu district of Ghana. *Journal of Food Security* 8 (3): 77-88. Http://dx.doi.org/10.12691/jfs-8-3-1

Asfaw, S., McCarthy, N., Paolantonio, A., Cavatassi, R., Amare, M., Lipper, L. 2015. Livelihood diversification and vulnerability to poverty in rural Malawi (ESA Working Paper No. 15-02). Rome: FAO. http://dx.doi.org/10.2139/ssrn.3305894

Babatunde, R. O., Adejobi, A. O., and Fakayode, S. B. 2010. Income and calorie intake among farming households in rural Nigeria: results of parametric and non parametric analysis. *Journal of Agricultural Science,* 2(2): 135–146. DOI:10.5539/jas.v2n2p135

Cooke, J. G., Jonathan, E. 2016. Tracing the Roots of Nigeria's Agricultural Decline. Center for Strategic and International Studies, Washington, D.C., Online]. Available https://www.csis.org/analysis/tracing-roots-nigeriasagricultural-decline, Accessed on 25/12/2024.

David, A. I., Oladimeji, Y. U., Yusuf, O. 1., Abdulrahman S., Hussaini, A. S., Kehinde, E. A. 2024. Effects of risk management strategies on the efficiency of rice farmers in Nigeria. *Journal of Agricultural Research and Entrepreneurship,* 1(1), 45-53.

Ebonyi State Agricultural Development Programme EBADP, 2012. *Bulletin, No 2, 6pp.*

Hjelm, L., and W. Dasori. 2012. Ghana Comprehensive Food Security & Vulnerability Analysis 2010: Focus on Northern Ghana, Ministry of Food and Agriculture Ghana StatisticalService,1–61. http://documents.wfp.org/stellent/groups/public/documents/ena/wfp257009.pdf .

Ibeje, A., Anthony, E. 2020. Statistical analysis of climate data of Southeast Nigeria. *Umudike Journal of Engineering and Technology,* 6(2): 82-87. Http://dx.doi.org/10.33922/j.ujet_v6i2_10

Idowu, A. O., Ambali, O. I., Onasanya, A. S. 2014. Living condition, livelihood and crop diversification among rural farm households in Remo division of Ogun State Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology,* 3(6): 619- 629. Http://dx.doi.org/10.9734/AJAEES/2014/8608

Kebbi Agricultural and Rural Dev Authority (KARDA), 1992. Basic Information, 17 pp.

Kuwornu, J. K. M., Iziden, M. P. M., Osei-Asare, Y. B. 2011. Supply response of rice in Ghana: A co-integration analysis. *Journal of Economics and Sustainable Devel-*

opment, 2(6): 1-14. ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online).

Kyire, S. K. C., Kuwornu, J, Bannor. R., Apiors, E., Martey E. 2023. Perceived risk and risk management strategies under irrigated rice farming: Evidence from Tono and Vea irrigation schemes-Northern Ghana. *Journal of Agriculture and Food Research*, 12(2023) 100593. https://doi.org/10.1016/j.jafr.2023.100593. www.sciencedirect.com/journal/journal-of-agriculture-and-food-research.

Magaji, B. D., Oladimeji, Y. U., Hassan, A. A., Siewe, F., Njiforti, P. P. 2021. Risk management strategies of micro, small and medium agribusiness enterprises in northwest, Nigeria. *Journal of Agripreneurship and Sustainable Development,* 4(2): 214-227.http://dx.doi.org/10.59331/jasd.v4i2.223

Man. N. 2009. Factors affecting the decision making in off farm employment among paddy farmers in Kemasin Semerak. *Pertanika Journal of Social Science and Humanity*, 17(1), 7-15. ISSN: 0128-7702

Obianefo, C. A., Okoroji, N. O., Obiekwe, N. J., Osuafor, O. O., Shah, Z. A. 2022. Economics of good agronomic practices adoption by rice farmers in value chain development programme, Anambra State, Nigeria. *Journal Food, Agriculture and Nutrition Development,* 22(8): 21308-21330. https://doi.org/10.18697/ajfand.113.2142522.

Oladimeji, Y. U., Abdulsalam, Z., & Abdullahi, A. N. 2015. Determinants of participation of rural farm households in non-farm activities in Kwara State, Nigeria: A paradigm of poverty alleviation. *Ethiopian Journal of Environmental Studies and Management,* 8(6): 635 – 649. http://dx.doi.org/10.4314/ejesm.v8i6.3

Oladimeji, Y. U., Galadima, S. A., Hassan, A. A., Sanni, A. A., Abdulrahman, S., Egwuma, H., Ojeleye, A. O. and Yakubu, A. 2019. Risk analysis in fish farming in Oyo State, Nigeria: A prospect towards improving fish production. *Animal Research International,* 16(1): 3226 – 3237. ISSN 1597-3115. https://www.scholar.google.com

Pham, T. T., LeDang, H., . Pham, N. T. A.and Dang, H. D. 2021. Adoption of contract farming for managing agricultural risks: a case study in rice production in the Mekong Delta. *Vietnam Journal of Agribusiness Development and Emergency Economy,* 1-13. https://www.emerald.com/insight/2044-0839.htm

Shahid, M., Munda, S., Khanam, R., Chatterjee, D., Kumar, U., Satapathy, B. S., Mohanty, S., Bhaduri, D ., Tripathi, R., Nayak, P. K., and Nayak, A. K. (2021). Climate resilient rice production system: Natural resources management approach. *ORYZA-International Journal on Rice,* 58(1), 143-167. http://www.dx.doi.org/10.35709/ory.2021.58.spl.6

Singh, B. R. 1995. Soil management strategies for the semi-arid ecosystem in Nigeria: the case of Sokoto and Kebbi States. *African Soils*, 28: 317-320. https://doi.org/10.5897/JAERD2013.0547.

Teshome, B., Edriss, A. K. 2013. Determinants and patterns of income diversification among smallholder farmers in Akaki District. *Ethiopia Journal of Research in Economics and International Finance,* 2(4): 68-78.

http://dx.doi.org/10.22004/ag.econ.157598.

Umar, M., Oladimeji, Y. U., Egwuma, H., Owolabi, J. O. 2024. A comprehensive analysis of market structure- performance of sugarcane (*Saccharum officinarum* L.) in north-central Nigeria. 2nd Faculty of Agric. Int Con. (Hybrid). Theme: *Digitalization of Agriculture and Bio-Conservation for Food Security* held at Nnamdi Azikiwe University, Awka, Nigeria, from 12-14th March, 2024. *Proceeding,* 2: 276- 285. https://journals.unizik.edu.ng/faic/article/view/3500

Yakubu, D. H., Oladele, O. I. 2021. Determinants of Use of Climate Change Adaptation Practices by Rice Farmers in Kebbi State, North-West Nigeria. *Science Journal of Warsaw University of Life Sciences,* 21(1): 52–69. DOI: http://dx.doi.org/10.22630/PRS.2021.21.1.4

Yesuf, M., Bluffstone, R. 2007. Risk aversion in low-income countries: Experimental evidence from Ethiopia, IFPRI discussion papers 715, International Food Policy Research Institute (IFPRI). Environment and Production Technology Division, Washington, D.C. https://hdl.handle.net/10568/21522

(Manuscript received: 3rd March, 2025; accepted: 16th May, 2025).