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Determinants of Income Diversification Strategies among Rice Farming Households in Nigeria: Evidence from GHS Panel-Data

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Abstract- ***Income diversification strategies which have the potential of reducing food poverty among rice farming households in Nigeria by broadening their income sources is low and remain a major constraint to food security. This study addresses a critical methodological gap by analyzing actual choices instead of relying on a continous generalized diversification index. It draws on nationally representative data from the Nigeria General Household Survey (2010/2011 and 2015/2016) Panel. Information extracted included age of household heads, household size , formal education status, sex, marital status, access to credit, access to phone, access to remittances, extension contact, membership of cooperatives, farm-size, geo-political zones, income diversification strategies (on-farm, off-farm and non-farm activities), exposure to shocks, income and food expenditure. Data were analysed using descriptive statistics and panel multinomial logit regression model. Results showed that 75.54% and 61.61% of the sample households were male in both periods, with an average age of 45 years and 67.2% and 69.0% had formal education. Furthermore, majority of the households were married in both periods 68.11% and 60.68%, with a mean household size of 6 persons and farm-size of 0.2 ha. Majority had no access to credit, remittances, extension contact and cooperatives. Result of income diversification strategies showed that in 2010/2011, 28.2% , 23.2%, and 48.6% of the rice farming households diversified into on-farm, off-farm, and non-farm activities and 7.1%, 24.8%, and 68.1% in 2015/2016. Access to phone (β=0.152) and being married (β=0.147) increased the probability of diversifying into on-farm activities, while access to credit (β=0.025) and membership of cooperatives (β=0.173) increased that of off-farm activities. Furthermore, formal education (β=0.045), exposure to shocks (β=0.051), and membership of cooperatives (β=0.004) increased the probability of diversifying into non-farm activities. Non-farm income diversification enhanced reduction of food poverty among rice-farming households in Nigeria***

Keywords: Income diversification Strategies, Food poverty , Rice farming households, Non-farm activity

I. INTRODUCTION

The majority of Nigerian households rely on rice farming for their income, but it is nevertheless ironic that many of them experience food poverty. This study concentrates on the determinants of income diversification strategies—where farmers combine rice cultivation with non-farm wage labour, trading, or craft production. Food poverty is a major component of overall poverty, which is crucial for both human and economic development, which is why it is important to focus on it (UN Hunger Project, 2022). While Nigeria's output of food products is growing rapidly, the prevalence of food poverty remains to some extent, amongst large segments of the population, primarily households in rural areas (KPMG, 2019). Growing demand for staple foods such as rice is arising due to an increased rate of population, which has created scarcity in the supply of this item and also its accessibility. More than half of the world's population depend on rice, one of the most important cereal grains in the world (Agric.income, 2024). For poor nations in Sub-Saharan Africa, rice supplies about 20% of the protein and 27% of the daily energy (Kennedy et al., 2020). Rice is a vital cereal in Nigeria where it is the most consumed crop by about 55% in the diet and Nigeria stands as the leading rice producing and consuming countries in the West African sub region (Africa Rice, 2023). With a yield of 3.7 million tonnes, smallholder farmers in Nigeria's northern states account for up to 80% of the nation's entire rice supply (KPMG, 2019; FAO, 2020).

The production of rice started in Asia at over 5000 years back, the plant thereafter gradually migrated to India, the Southeast Asia, the Korean, the European and the African continent. The largest rice producing country in the world after Asia is Africa where Nigeria accounted for about 8, 435,000 tonnes per annum and trailed by other African Countries like Egypt, Madagascar, Tanzania and Mali in order of production (FAO, 2020). Nigeria is a popular destination for rice because it is a major crop that is consumed as a staple food throughout the country and is essential to attaining food security, an all-encompassing objective that requires government efforts to promote and develop the crop (Olakunle, et al., 2016). Nigeria plays a major role in West African rice production and consumption (Africa Rice, 2023). In Northern Nigeria, small-scale farmers are the main producers. Although Kebbi, Jigawa, Kano, Ebonyi, and Ekiti states are the nation's top producers of rice, rice may be grown in any geopolitical zone of Nigeria (KPMG, 2019).

In Nigeria, the government has put in place various policy measures and programmes to improve rice productivity towards attainability of rice sufficiency and this include: - The Rice Transformation Agenda under the Growth Enhancement Support (GES) scheme, Nigerian government has restricted the import of rice, Dry-season Rice Farming Program, and Anchor Borrowers Program (APP) under Agricultural Promotion Policy.

Income diversification is the process through which households develop diverse bundles of activities and networks to make ends meet and enhance livelihoods (Iraoya et al., 2020, Kamwi et al., 2018). These can be on-farm activities, off-farm activities and non-farm activities, depending on the capacities of the households and the available resources and opportunities in the area (Gebru, 2018). Since the phrase "food poverty" refers to a lack of access to food based on the resources, assets, activities, and tactics employed by the households, there is a strong correlation between income diversification and food poverty (Rahman, 2019). In this regard, one way to reduce food poverty is for households to diversify their sources of income. Numerous empirical research, including those by Gani et al., (2019) in North-East Nigeria, Jedidah et al., (2018) in rural Kenya, Khatiwada et al., (2017) in Nepal, and Iraoya et al., (2020) in Nigeria, have shown that income diversification reduces food poverty.

II. METHODOLOGY

Nigeria is a country in western Africa that is part of sub-Saharan Africa (SSA). Nigeria is made up of the Federal Capital Territory (FCT) and thirty-six (36) states. The Republic of Benin borders it on the west; the Niger Republic borders it on the north; the Republic of Cameroon and the Republic of Chad border it on the east; and the Atlantic Ocean borders it on the south. Its entire land area is 92,377,000 hectares, of which 91,077,000 hectares are land. There are over 200 million people living there, and the population is expected to expand by 2.6 percent annually (World Bank, 2016).

Nigeria has an abundance of natural resources and endowments that boost agricultural output. The country, which is in the tropics, has high temperatures all year round, with an average mean temperature of 27°C. On the coast and in the extreme north, the average maximum temperature ranges from 32°C to 41°C, while the mean minimum temperature ranges from 21°C to less than 13°C. The country's climate varies from the Sahel in the north west and north east with less than 600 mm of annual rainfall to the extremely humid coast with over 3,500 mm. Nigerians make their living from a variety of sources, including mining, manufacturing, trade, crafts, and agriculture. Of all the aforementioned professions, agriculture is the one that directly employs the majority of people roughly 68 percent of the labour force and contributes significantly to the GDP (FAO, 2021).

Data utilised in this study are from secondary source from the General Household Survey (GHS) Panel data set. The GHS Panel was an initiative between National Bureau of Statistics (NBS) and the Living Standards Measurement Study (LSMS) team of the World Bank, under the aegis of Integrated Survey on Agriculture (ISA) programs and was revised to include panel design (GHS Panel) in 2010 with the intention to promote innovative models for

agricultural data collection and inter institutional co-operation and to perform extensive analyses on welfare outcomes and socio-economic characteristics. The GHS-Panel since 2010 have been a representative nationwide household survey of 5000 Households. For this investigation, Waves 1 and 3 of the GHS-Panel data set were utilised. They were gathered in Wave 1 (2010–2011) and Wave 3 (2015–2016). Since the study needed to track the same households from Wave 1 to Wave 3 in order to perform a transition analysis, Waves 1 and 3 were chosen. Data used in this study encompassed socio-economic characteristics such as age, gender, education level, household size, and household's income diversification strategies, farm size, marital status, income per month, food consumption expenditure per month and access to credit. In addition to the socio-economic information, institutional variables such as membership of cooperatives, extension contacts and geopolitical locations were captured through the survey. The data collected were structured as a balanced panel of 323 chosen rice-farming households that diversified income in the 2010/2011 farming season (Wave 1), whereas the same households were followed-up again in the 2015/2016 season (Wave 3) producing a balanced panel of 646 rice-farming households based on pooled panel data. Descriptive statistics such as frequency distributions, means, standard deviations, percentages, and cross tabulations were used to evaluate the households' descriptive features.

The determinants of income diversification strategy among rice farming households was obtained by estimation of panel multinomial logit regression model (Random Effect Model). This allows modeling a panel data because it accounts for both individual-specific and time-specific effects that are likely to vary over time. This model can address the heterogeneity in the rice farming households and provide a consistent estimate on the factors that influence income diversification. This model offers more accurate estimates of the factors influencing income diversification and takes into account unobserved variation among rice farming families more reliable estimates of the determinants of income diversification.

$$Y_{it} = \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \ldots + \mu_{it} + \epsilon_{it}$$

Where;

Y_{it}= Income diversification strategies for household i in the period t (On-farm = 0, Off-farm = 1, Non-farm = 2)

X_{it} = is the time-variant k^{th} explanatory variable for household i at time t

β *is the* kx1 matrix of parameters

μ_{it} is the unobserved household-specific effect.

ϵ_{it} is the idiosyncratic error term

The choice of included variables was based on relevance and empirical evidence from the literature.

X_1 = Sex (Male =1, Female = 0)
X_2 = Age of household head (years),
X_3 = Marital status (Married = 1, 0 otherwise),
X_4 = Educational status (years)
X_5 = Household size (number)
X_6= Access to Credit (1=Yes, 0 otherwise)
X_7 =Access to phone (Yes =1, No = 0)
X_8 = Access to remittance (1=Yes; 0 otherwise)
X_9 = Access to extension contact (1=Yes; 0 otherwise)
X_{10} = Membership of cooperatives (Yes =1, 0 otherwise)
X_{11} = Exposure to Shocks (Yes =1, No = 0)
X_{12} = Farm-size (Hectares)
X_{13} = Geo-political Zones (NC =0, NE =1, NW=2, SE=3, SS =4, SW=5)

III. RESULTS OR FINDINGS

Table 1.0 presents the determinants of the adoption of income diversification strategies among rice farming households. The Income Diversification Strategies (IDS) are classified into three (3) categories; on-farm (0) as base, off-farm (1) and non-farm (2) income-generating activities. Table 2.0 also shows the Marginal effects. Using panel multinomial logistic regression model, the factors identified as influencing households to shift from exclusively on-farm to off-farm and non-farm income sources were identified. The explanatory variables strongly influence the decision to diversify by households; this reflects the importance of socio-economic, institutional and shock related factors that shape

livelihood choices of households. The statistical significance of the Wald test (148.26, $p<0.001$) shows that the models has a good fit. Given that the households are followed over time in panel data analysis, the study applies the random effects model, which has the capability of analysing the within and between variation among households. The significance of both variance components, var(u1) and var (u2) indicates that there exist substantial variation, unobserved heterogeneity (risk preferences, asset holding and social network etc) within households, the omission of which could lead to bias and distort the inferences on factors influencing income diversification. Results indicate that household decision-makers, when compared to those who remain solely on farm activity, tend to switch from purely on-farm activities to off-farm and non-farm income-earning.

The study indicates that sex is significantly positive for both the off-farm and non-farm income generating opportunities (Table 1.0), meaning that when the respondent has non-agricultural income opportunities the more the household chooses the option of expanding their business portfolio. Transition from sole dependence on farm related income livelihood to non-agricultural income options is an important aspect of income diversification as it may enable households to insulate against seasonality and vulnerability associated with farming livelihoods and thus reduce their food poverty status. Marginal effect in Table 2.0 reports that there is increase in diversification by 2.0 percent from on-farm to off-farm and 8.2 percent from on-farm to non-farm when the rice farming household is a male.

The results of this study further show that access to credit is statistically significant for both off-farm and non-farm activities (Table 1.0). Access to credit enables people to invest in other lucrative non-farming endeavors, and improves livelihood diversification. According to the study, households that have access to finance are more likely to diversify into non-farm and off-farm industries by 2.5 percent and 2.6 percent respectively (Table 2.0). Therefore, a major barrier to income diversification may be a lack of access to reasonably priced financial services. The degree of income diversity was shown to be positively and significantly impacted by loan availability. Credit facilities enhance the production function in agriculture; it could be argued that access to finance increase farmers capacity to invest in purchasing of additional inputs required for diversification. In order to sustain new productive enterprises which contribute to income diversification, farmers require access to reliable source of financing to facilitate the procurement of needed inputs, thus improving the likelihood of adoption of income diversified agricultural practices. A farmer's inclination to engage in a variety of lucrative crop-producing endeavors will increase as they have access to loan facilities with more favorable terms. This result is in line with Arega et al., (2018), who found a positive correlation between the likelihood of diversifying income and loan availability.

When compared to the only on-farm category, the study demonstrates a significant impact of cooperative membership for both non-farm and off-farm categories. Membership of cooperative societies is instrumental for diversifying from solely on-farm activity, especially with the non-farm option. Membership of cooperatives supports households to overcome barriers to diversification by providing access to information, technology, inputs, markets and financial resources that may not otherwise be available. Cooperative access can help reduce food poverty through a broadened range of livelihood opportunities. According to Table 2.0, marginal effect, cooperative membership increases the likelihood of diversifying into off-farm and non-farm industries by 17.2 percent and 4.0 percent, respectively. Put differently, rice farmers who are members of of cooperative group are more likely to diversify their sources of income than those who are not. The most important reason behind the positive coefficient is that cooperatives provide their members access to crucial information, technologies and other advantages that are crucial for improving their chances of income diversification. This outcome supports the findings of Ahmed et al., (2018), who found that diversification into the nonfarm sector is more likely when cooperative membership is higher.
Additionally, Table 1.0 shows that the likelihood of having access to non-farm and off-farm options is

higher for people with higher education levels than for those who have access to on-farm chances. This implies that when household members' educational attainment rises, they will find better employment in urban areas or set up their own businesses, and may gain more entrepreneurial knowledge for better business management and profitability. Table 2.0 demonstrates that the probability of diversifying into the non-farm activities is increased by 4.5 percent and into the off-farm by 5.6 percent when a farmer has education as compared to on-farm activity. Education helps household members to find better paying and more secured employment, possibly in non-agricultural occupations and develop skills to engage in other profitable entrepreneurial activities. These findings concur with those of Tizazu et al., (2018) and Gebru et al., (2018). which confirmed the positive effects of education on diversifying activities. Moreover, positive coefficient for education imply that increase in educational attainment by farmers encourages diversification into off-farm and non-farm employment or entrepreneurial activities. This finding corroborates the findings of Akinyemi et al., (2021) that educational level is a significant factor determining income diversification. The result is in harmony with the work of Gecho (2017) that people with a higher level of education possesses diverse set of skills, knowledge and experience needed to search for better income sources and opportunities. The positive sign also aligned with the previous findings of Ahmed et al., (2018). This implies that rice farmers will further diversify their sources of income as they complete more years of education. To put it another way, better decision-making regarding the adoption of innovation, efficient use of resources, and income diversification has been influenced by the farmer's education (Bitrus et al., 2020).

On the other hand, compared to the reference group, phone access had a negative and statistically significant effect: families with phone access are less likely to engage in non-farm and off-farm income diversifications than the reference group of remaining in on-farm production. Although counter intuitive, it may reflect context specific mechanisms. One could interpret that telephone is used mainly to coordinate activities related to farm production rather than facilitate diversification, or maybe the variables in the dataset did not fully capture the intensity of digital access and its use. Mobile phones have generated income diversification opportunities for the farmers, and especially for the rice farmers, to be supplied with the information they needed on diversification in adequate, timely manner (Masanori et al., 2022). The marginal effect in comparison to the reference case of continuing with on-farm operations, the marginal effect shows that the likelihood of diversifying in off-farm and non-farm industries falls by 5.4 percent and 9.0 percent, respectively.

The impact of shocks is probably most noticeable in the non-farm and off-farm categories, where the household's decision to switch from on-farm to off-farm output is positively influenced by shock exposure by 1.9 percent and 5.0 percent, respectively. The result is consistent with the argument that income diversification is often an ex-post adjustment strategy employed in response to negative events. When facing shocks such as crop failure, price volatility, or climatic stress, household would reallocate labour to other sectors of activities that are potentially more resilient. Such reactive diversifications may help in stabilising consumption level in the short term, yet may signify household vulnerability. Shocks are associated with income diversifications. This finding is consistent with Masanori et al., (2022) study for Rural Bangladesh that show weather shock is a trigger of income diversification. Several studies have revealed that weather shocks may push rural households to diversifications of incomes to reduce their vulnerabilities to future climate shocks. For example, several studies on sub-Saharan and Eastern African countries have concluded that weather shocks encourage income diversifications (Salazar-Espinoza et al., 2015; Asfaw et al., 2018, 2019; Arslan et al., 2017).

It has been demonstrated that income diversification tactics are significantly impacted by marital status as individuals in the group “never married” have higher probabilities of choosing the off-farm and non-farm option than married individuals relative to the group in reference. The study on rice-growing households

in Nigeria revealed that, although marital status influences young, single households are more likely to choose non-farm sources of income because they perceive them as a way out of subsistence farming, regardless of farmers' abilities to manage their farms. The probability of diversifying into non-farm and off-farm industries rises by 6.5 and 8.3 percent, respectively, according to the marginal effects result for single or never-married rice farming households, but decreases for married rice farming households relative to remaining in on-farm activities.

Rural households' decisions toward diversification are significantly influenced by the size of their land and the use of agricultural extension services. Compared to the reference situation of participation in on-farm income generation, a reduction in the overall farm size increases the likelihood of engaging in non-farm activities. The likelihood of diversifying into non-farm activities will rise by 2.9 percent for each unit (ha) that the land size decreases. There is an 11.8 percent chance of diversifying into non-farm activities when there are more interactions with extension agents.

Geographical zones are also crucial. When compared to on-farm activities, households in Nigeria's northern regions were found to have the least tendency toward off-farm and non-farm activities. The likelihood of diversifying to off-farm and non-farm income will rise by 6.4 percent from the north to the south when compared to the other regions. and 10.7 percent, respectively, in comparison to continuing to work on the farm. The results show that participation in non-farm income diversification is linked to greater livelihood resilience.

IV. CONCLUSION

The empirical evidence from this research firmly establishes the determinants of income diversification strategies among Nigerian rice farming households. Rice cultivation is the principal occupation, but a family's livelihood will hardly be food secured if it only relies on its farming revenue due to the risks associated with agricultural production, fluctuating income over the season, variability of the climate, and the deficiencies of the market. The results showed that complementary engagement in off-farm and non-farm livelihood activities significantly boosted the capacity of households to stabilise their consumption; diversify their incomes and be more resilient to negative economic shocks. The role of productive assets and institutional factors such as education, access to credit, extension contact, and ownership of mobile phones and cooperatives as a means to influence the decision to diversify, as well as affect livelihood diversification and outcomes, has also been identified. Iincome diversification as part of Nigeria's agricultural and rural policies as a way of complimenting efforts to attain national food security and reduce rural food poverty.

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Table 1.0: Factors affecting Income Diversification Strategies among Rice farming households in Nigeria

	ONF		OFF		NFF	
Variables	Coef.	Std.error	Coef.	Std. error	Coef.	Std. error
Sex	0.047	0.398	2.302***	0.355	2.415***	0.326
Age	-0.183	0.118	-0.218	0.131	-0.183	0.116
Marital status	2.515***	0.507	-2.735***	0.401	-2.534***	0.356
Education	0.682	0.884	1.504***	0.495	1.720***	0.481
Household size	0.358*	0.211	0.364	0.231	0.356	0.209
Access to credit	0.677	0.519	0.960**	0.400	0.876***	0.366
Remittance	-0.664	0.499	-0.204	0.540	-0.661	0.479
Access to phone	2.115***	0.381	-2.282***	0.397	-2.108***	0.367
Extension contact	1.927	1.551	1.721	1.239	1.92*	1.201
Membership of cooperatives	0.418	0.484	14.691***	0.829	15.080***	1.925
Farm-size	-0.528**	0.236	0.525	0.245	-0.528**	0.236
Exposure to shocks	-0.489**	0.221	0.496***	0.146	0.489**	0.221
Geo-political zones	-0.675***	0.202	0.517***	0.177	0.675***	0.202
Constant	19.733	1213.06	-16.984***	0.986	-18.661***	0.910
Model Summary						
Obs = 646						
Wald Chi2 (26) = 148.26., Prob>Chi2=0.0000., Log likelihood= -462.291						

Source: Computed from GHS 2010-2016

Table 2.0: Marginal Effects obtained from the Panel MNL Model

Variable	ONF	OFF	NFF

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	114	155	377
Sex			
	0.102	0.020	0.082
Age			
	-0.013	-0.005	-0.017
Marital status			
	0.148	-0.065	-0.083
Formal Education			
	0.011	0.056	0.045
Household size			
	0.025	-0.008	-0.017
Access to Credit			
	0.052	0.025	0.026
Phone			
	0.152	-0.054	-0.091
Remittance			
	0.038	-0.052	-0.091
Extension contacts			
	0.117	0.001	0.118
Membership of Cooperative			
	0.176	0.173	0.039
Exposure to shocks			
	-0.032	0.019	0.050
Farm-size			
	0.041	-0.011	-0.029
Geo-political zone			
	-0.043	0.064	0.107

Source: Computed from GHS 2010-2016 Data Set