Qeios

Socio-economic Drivers of Food Security among Rural Households: Evidence from Smallholder Rice Farmers in Ebonyi State, Nigeria

Abstract

Nigeria has been facing a food crisis problem, with most of the poor population having limited access to adequate quantity and quality food. Food security reflects the stability of food supply, availability of, and access to food, and affects the amount of food consumed with implications on the population's health. Thus, this study examined the socio-economic drivers of food security among smallholder rice farmers in Ebonyi State, Nigeria. Primary data was collected under the Feed the Future Innovation Lab for Fish (Integrated rice-fish farming system) funded by USAID through a three-stage sampling technique. Foster–Greer–Thorbecke (FGT) and the Endogenous Switching Regression model were applied in the data analysis. The mean per capita household food expenditure is estimated at ₦ 1,026.43; the food security measure shows that 46.67% of the households experience the incidence of food insecurity, 24.6% point is the food insecurity depth, and 17.2 % point is the severity of food insecurity. The ESR model shows that the drivers of food security are access to credit, marital status, farming experience, primary occupation, education, and farm size. The study proposed implementing more programmes that focus on poverty alleviation, which should be gender inclusive with credit support.

Keywords: **Smallholder rice farmers, food security, food expenditure, poverty, Nigeria**

1.0 Introduction

Rice (*Oryza sativa*) is one of the most widely consumed staple crops with ever-increasing global aggregate demand. About 486.62 (MT) of rice is consumed globally annually (Statista, 2019). In Nigeria, cultivation is supported by all the agroecological zones, making the country the highest producer in Africa, with an average production of 8 million MT out of Africa and an average of 14.6 million MT of rice produced annually (FAO, 2019). Despite this, compared to the demand for rice in Nigeria, rice production has a non-ignorable gap. The country's estimated annual demand for milled rice is 5.2 million tons, while the national average output is 3.3 million tonnes. Nigeria's rice processing capacity is 2.8 million tons of paddy. The demand for rice was estimated to be 6.3 million tonnes in 2016, while the national supply was 2.3 million tonnes (FMARD 2016).

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The United States Department of Agriculture USDA reported that in 2016 the annual consumption of rice in Nigeria was about 5 million MT. The Rice quantity supplied was 2.7 million MT with a demand-supply gap of about 2.3 million MT (Ojo *et al*., 2020, Obih and Baiyegunhi, 2017); rice is filled today by rice importation.

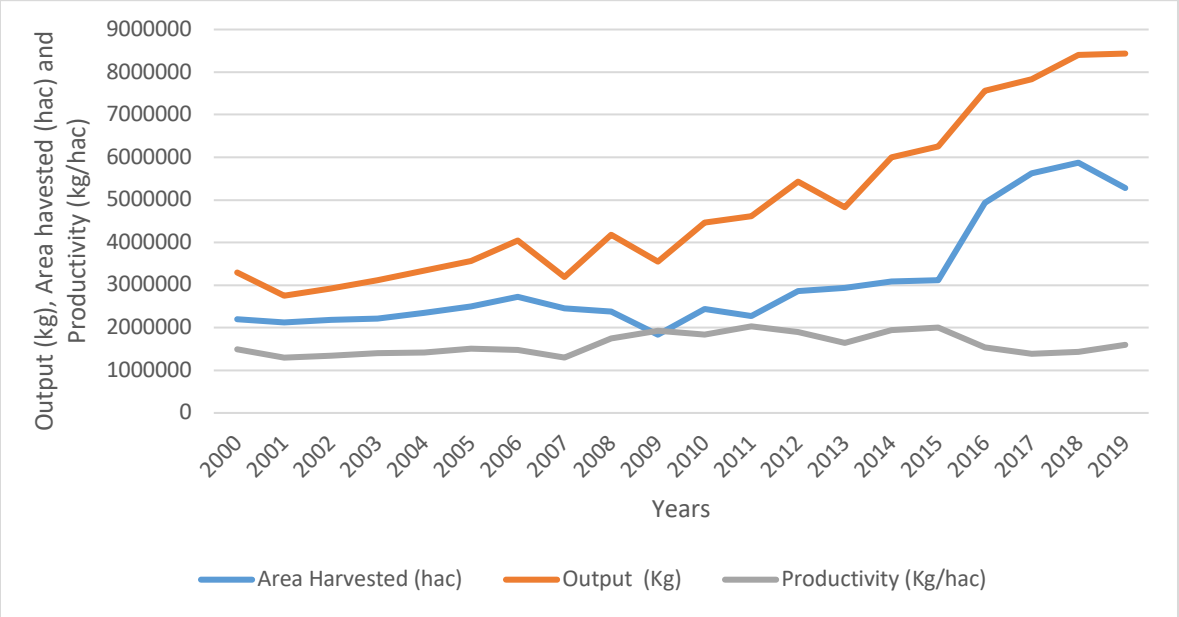

Figure 1: Nigeria Rice Production, Area Harvested and Productivity trends, 2000-2019

Source: Food and Agricultural Organization (2019). World Trade Report.

Food security, according to Food and Agriculture Organization, FAO (1996, 2008a), exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The definition of food security consists of four dimensions; food accessibility, availability, utilization, and stability. Food availability has to do with "sufficient food" and is associated with physical quantities, while food accessibility measures the ability to obtain/secure food. The utilization entails consuming food and how essential nutrients are acquired from consumed food by a person. At the same time, stability deals with the axiom "*at all times*" in the food security definition by FAO (1996, 2008a). To this end, achieving a state of food security by an individual (rice farmer/households), region or country requires arriving at an adequate level of good nutrition and food consumption and maintaining this level at low risk over time (FAO, 2008a, 2008b). The problem of food insecurity

is not only limited to developing countries, but it is a problem faced by developed countries as well. The World Poverty Clock reports that Nigeria has the highest number of poor people globally, with the poverty situation still growing in geometric progression. The proportion of the prevalence of malnutrition and people who suffer from food insecurity are found more in rural areas of developing countries.

Previous studies on determinants of food security among farming households in Nigeria classified households into food secure and food insecure and used the binary choice model (Amoo and Fasakin, 2019, Ibrahim *et al*., 2016, Edeh and Gyimah-Brempong, 2015, Agada and Igboke, 2014; Ahmed and Napthali, 2014; Adepoju and Kayode, 2013; Henry-Ukoha, 2013; Ayoade and Adetunbi, 2013 and Obayelu, 2012;), without focusing on the driving forces of food insecurity from the food secure and non-food secure households. This study will adopt the Endogenous Switching Regression model, which allows for interaction effects between treatment and the variables affecting outcomes, unlike the ordinary probit or Logit model, which did not have a selection equation. Also, the study area, Ebonyi state, despite being a primary rice-producing state in the country, the state is still one of the states with very high food and nutrition insecurity problems (USAID, 2018), with a poverty rate of 79.76% (National Bureau of Statistic, (NBS), 2020, Statista, 2019). The capital expenditure of the farmers was used in determining the poverty level of the rice farming households by using the Foster Greer and Thorbeck (FGT) class of poverty. This gives the advantage in ranking the rice farming households as either food secure or moderately food insecure; this measure considers the extent of severity (deviation from the minimum requirement). The introduction of a new class of food security (severity, gap, and incidence) measures that are understandable theoretically and robust in an application (Obike *et al.*, 2019). Thus, this present study investigates the food security status; and the determinants of food security across the food-secure and non-food-secure rice-farming households in Ebonyi state, Nigeria. Our findings from the study will provide essential recommendations for development planning on food insecurity situations among rice farmers in the form, especially for the Feed the Future innovation lab project.

2.0. Methodology

2.1. Survey, Study Area, and Sampling Techniques

The study area is Ebonyi state, a state in South-East Nigeria. The state lies in the humid tropical agro-ecological zone of Nigeria within Longitudes 70 30ˈE and 80 30ˈE and Latitudes 50 40ˈN and 60 45ˈN (Okereke, 2012). It has a land area of 5,935 km2, with a projected population of 2,253,140 persons in 2016, using a growth rate of 3.5% (National Population Commission, 2016). The State shares boundaries on the North by Benue State, to the West by Enugu State, to the East by Cross River State. and to the South by Imo and Abia State. The climate of Ebonyi State is that of a humid tropical climatic region, with a mean annual temperature standing at 280C and an average rainfall of 1200mm - 2500mm. It has luxuriant tropical rainforest vegetation, with basically clayey and loamy soil. The clayey swampy soil is suitable for rice farming (Chidiebere-Mark, 2020).

This study used data from the Feed the Future (FTF)/USAID innovation lab on integrated rice-fish technology in Ebonyi State, Nigeria. The study adopted a three-stage sampling technique where Ebonyi state was purposively selected among the rice-producing states in Nigeria, which has a high rate of food and nutrition insecurity in Nigeria. This was followed by a random selection of three local governments, Ikwo, Izzi, and Onicha LGAs. In the final stage, a proportionate to-size selection of 143 rice farmers was selected in the three LGAs.

2.2. Analytical Framework

The study focused on two reliable and analytical frameworks; the Foster Greer and Thorbeck (FGT) class of food security to determine the food security status of the rice farmers and the Endogenous Switching Regression model to identify the determinants of food security among the rice in Ebonyi State, Nigeria. Therefore, this study adopted this analytical framework as used by (Zakari *et al*., 2021, Mansaray and Jin (2020), and Ibitola *et al*., 2019). Further details of each of the frameworks are discussed below.

2.2.1. Foster Greer Thorbercke (FGT) Class of Poverty Measure

The FGT index was used to determine the threshold, which forms the basis for categorizing the rice farmers' level of food security in the study area. Following Foster Greer and Thorbeck (1984) as used by Ibitola *et al.* (2019), this index is computed with the mathematical formula stated below:

$$p_{\propto} = \frac{1}{\mathrm{n}} \sum_{i=1}^{\alpha} \left[\left(z - \frac{y}{z} \right) \right]^{\propto} \qquad (1)$$

Where n = total number of households

Y = total Household monthly expenditure of the i^{th} household

Z = poverty line (the poverty line was arrived at by calculating the 2/3 of the mean per capita monthly household expenditure.)

α = is a measure of the sensitivity of the index to poverty or the degree of severity of poverty (food security index which takes values of 0, 1, and 2)

2.2.2. The Endogenous Switching Regression (ESR) model

This is a model regression-based method, which models two outcome equations (two regimes), one for treatment and one for comparison, allowing for the endogeneity of selection into treatment (Maddala & Nelson, 1975). It is a natural extension of classical experimental design, which allows tests of assumptions about the exogeneity of treatment effects from survey data. It is a particular case of the Heckman model, where the second stage (outcome) equation is a switching regression. For this study, the endogenous switching regression model estimates a simultaneous equation with endogenous switching by the complete information Maximum Likelihood (FIML) with the various covariates variables that influence rice farmers that are food secure and those that are not food secure. The method simultaneously estimates the binary selection (determinants) and the binary outcome (impact) parts of the model to yield consistent standard errors:

$$\Omega = \begin{bmatrix} \sigma_{\mu}^2 & \sigma_{1\mu} & \sigma_{2\mu} \\ \sigma_{1\mu} & \sigma_1^2 & . \\ \sigma_{2\mu} & . & \sigma_2^2 \end{bmatrix} \qquad (5)$$

Where $\sigma_{\mu}^2 = var(\mu_i),\ \sigma_1^2 = var(\varepsilon_1),\ \sigma_2^2 = var\ (\varepsilon_1),\ \sigma_{1\mu} = cov(\mu_i,\ \varepsilon_1),\ \sigma_{2\mu} = cov(\mu_i,\ \varepsilon_2).$

Furthermore, σ_{μ}^2 is estimated up to a scalar factor and can be estimated to be equal to 1(Maddala, 1983) and (ε_i, ε_2) is not defined as Y_1 and Y_2 cannot be observed simultaneously, hence the dots in the covariance matrix. Moreover, the correlation between the error term of the selection equation and the outcome equation is not zero *i. e.*, $((\mu_i, \varepsilon_1) \neq 0)$ & $(\mu_i, \varepsilon_2) \neq 0$ which creates selection bias. ESR addresses this selection bias by estimating the inverse mills ratios ($\lambda_{1i}\ and\ \lambda_{2i}$) and the

covariance terms ($\sigma_{1\mu}\ and\ \sigma_{2\mu}$) and including them as auxiliary regressors in equations (4) and (5). If $\sigma_{1\mu}$ and $\sigma_{2\mu}$ are significant, the absence of selection bias will be rejected. In addition, $\sigma_{1\mu} < 0$ represents positive selection bias (i.e., households with above-average welfare are more likely to choose to be in the treatment). The logarithmic likelihood function given the previous assumptions regarding the distribution of the error terms is

$$\ln L_i = \sum_{i=1}^{N} \left\{ T_i \left[\ln \phi \left(\frac{\varepsilon_{1i}}{\sigma_1} \right) \ln \sigma_1 + \ln \Phi(\theta_{1i}) \right] + (1 - T_i) \left[\ln \phi \left(\frac{\varepsilon_{2i}}{\sigma_2} \right) - \ln \sigma_2 + \ln\left(1 - \Phi(\theta_{2i})\right) \right] \right\} \tag{2}$$

Where ϕ and Φ are the standard normal probability density function and normal cumulative density function respectively and

$$\theta_{ji} = \frac{\gamma Z_i + \rho_j \varepsilon_{ji} / \sigma_j}{\sqrt{1 - \rho_j^2}} \tag{3}$$

With j = 1,2 and ρ_j denoting the correlation coefficient between the error term μ_i in the selection equation (18) and the error term ε_{ji} of the outcome equations

$$\rho_1 = \frac{\sigma_{21}^2}{\sigma_u \sigma_1} \tag{4}$$

$$\rho_2 = \frac{\sigma_{21}^2}{\sigma_u \sigma_2} \tag{5}$$

To make sure that ρ_1 and ρ_2 are bounded between -1 and 1, and estimated σ_1 and σ_2 are always positive, the maximum likelihood directly estimates ln σ_1, ln σ_2, atanh ρ:

$$\operatorname{atanh} \rho_j = \frac{1}{2} \ln \frac{1 + \rho_j}{1 - \rho_j} \tag{6}$$

A negative and significant rho (ρ) i.e. correlation coefficient indicates that rice farmers that have that are food secure have an effect or impact on the treated group than any randomly sampled individual would have from the sample (Lokshin and Sajaia, 2004).

3.0. Results and Discussions

3.1. Socio-economic Characteristics of the Rice Farmers

The socioeconomic characteristics of the rice farmers are shown in table 1. The table shows that most of the farmers were male, 54.20% and 90.08% were married; this agrees with Omotesho *et al.* (2015). The mean age of the farmers was 44 years. In contrast, a significant proportion, 66.41%, of the farmers were between 31-60 years old, indicating that they are mostly youth, very agile with more energy for farming activities. The farmers' education level shows that most had education (ranging from primary and secondary to adult literacy). Total years spent in school by the farmer's highest percentage was with the group that had 0-10years of education, with 21-30years having the lowest. The mean household size of the farmers was 51.15% of the farmers had about 16-20years of household members. The prominent household members might be due to the uses of the household members for family labour on their farms. The mean years of farming experience by the farmers were 21 years, while 30.47% of the farmers had experience from 1-10 years.

About 87.60% of the farmers needed access to formal agricultural training, implying that getting new information passed to the farmers might be difficult; only 12.40% had access to agricultural activity. The primary sources of the training were not the government extension agents, mainly from private organizations 63.64%. The Majority, 78.29% of the respondents, engaged primarily in farming as their primary occupation, while 12.40% of the farmers majored as rice farmers. The farm size distribution shows that the farmers were smallholder farmers, with 96.88% cultivated between 0-25acres. The rice production or operation modality shows that the farmers are smallholder farmers, with 83.46% operating smallholding farming while 14.17% working on a commercial scale. Access to credit was very poor, as only 41.86% of the farmers had access to credit for their production; the source of the credit was majorly the cooperative association, an indication that cooperative association is a substantial factor in credit accessibility among the farmers. The origin of land used for rice farming by the farmers was majorly inherited (38.93%) and private land (24.42%), respectively, while others acquired their land through rented/lease and bought the land 18.32%. Access to land has been a significant issue among rural farmers in southeast Nigeria. About 51.91% of the farmers did not belong to any cooperative association, while 48.09% were members of one cooperative association or others. Access to extension was also poor, a justification for poor access to agricultural training, with only 23.66% of the farmers having access to extension services.

In contrast, a more significant percentage of farmers did not have access to extension services. The distance covered by the farmers to the farm distribution shows that 72.52% covered between 0-

5km, while 14.50% covered around 6-10km in reaching their farm. Distance covered by the farmers to the farm has been identified as a significant factor affecting farmer productivity. About 88.55% of the farmers usually pay between N100-2000 to access the input market, while 3.45% pay beyond or higher amounts]in access input markets—lastly, questions on the farmer's awareness of integrated rice-fish technology. Only 25.95% of the farmer's sample were aware of the technology, with a more significant percentage of 74.05% unaware. Of the 25.95% aware, only 3.05 said they had previously engaged or practiced the technology.

Table 1: Socio-economic Characteristics of the Rice Farmers.

Variable	Frequency	Percentage	Mean
Age (years)			
18-30	27	20.61	Mean =44
31-60	87	66.41	Min = 18
61-89	17	12.98	Max =89
Sex			
Female	60	45.80	
Male	71	54.20	
Marital status			
Married	118	90.08	
Not married	13	9.92	
Education Level			
Formal Education	116		
No formal Education	15	11.45	
Household Size			
0-5	22	16.79	Mean= 8
6-10	08	6.11	Min =0
11-15	34	25.95	Max= 20
16-20	67	51.15	
Farming Experience			
1-10	39	30.47	Mean=21
11-20	35	2.34	Min= 0
21-30	26	20.31	Max= 70
31-40	10	07.81	
> 40	18	14.06	
Membership of Association			
Yes	63	48.09	
No	68	5.91	
Formal Agricultural training			
Yes	113	87.60	
No	016	12.40	
Primary Occupation			
Farming	117	89.31	
Non-farming	014	10.69	
Access to Extension			
Yes	031	23.66	

No	100	76.34	
Access to Credit			
Yes	54	41.22	
No	74	56.49	
Farm Size			
0-25	124	94.66	
Above 25	007	5.34	
Farming experience (year)			
1-10	39	30.47	Mean=21
11-20	35	27.34	Max=70
21-30g	26	20.31	Min=0
31-40	10	7.81	
Greater than 40	18	14.06	
Distance to Input Market (Km)			
0-20	96	91.43	
21-40	8	7.62	
Greater than 40	1	0.95	

Source: Authors' Computation, 2021

3.3. Distribution of the rice farmers by Incidence, Depth, and Severity of Food Poverty

The food insecurity index or headcount (P_0), the food insecurity gap or depth (P_1), and the food insecurity severity index (P_2) are the first three indicators of the FGT class of food insecurity measures. The headcount index (P_0), measures the proportion of the population that is poor. The food insecurity gap or depth (P_1) measures the extent to which individuals fall below the food security line (the food-insecurity gaps) as a proportion of the food security line. While the food insecurity severity index (P_2) averages the squares of the poverty gaps relative to the food insecurity line. It allows different weights to be put on the income (or expenditure) level of the poorest.

The insecurity depth represents the percentage of expenditure required to bring food-insecure households below the food insecurity line up to the food insecurity line. As shown in table 4, the P0 among rice farmers in Ebonyi state was 0.4667, indicating that 46.67% of the respondents live below the food insecurity line. The food insecurity depth (P_1) was 0.2462, implying that the food expenditures of the poor households in the study area must be raised by 24.62% to move out of insecurity. The severity of the food insecurity index was 0.1721; this explains that 17.21% of the rice farmers are extremely poor, indicating that food insecurity is less severe among rice farmers in Ebonyi state.

Table 2: Food Security Indices of Rice Farmers in Ebonyi State, Nigeria

Food Poverty Indices	Percentage
Food insecurity incidence (P_0)	0.4667
Food insecurity depth (P_1)	0.2462
Food insecurity Severity (P_2)	0.1721
Mean per capita expenditure	₦2456.42
Food security line	₦ 1,026.43

Source: Field Data computation, 2021

Decomposition of the households by socio-economic and food security indices

Table 4 shows households with their socio-economic characteristics based on the food insecurity measures or indices generated by the adopted Foster *et al*. (1984) method. P_0 measures the incidence of food insecurity, P_1 implies a depth of food insecurity, and P_2 values imply the severity of food insecurity situations. Higher values of P_0, P_1, and P_2 imply that incidence, depth, and severity of food insecurity are high in the study area and vice The incidence of food insecurity of 49% was higher among the female household heads than the 46% found among their male counterparts. Among the male-headed households, a 21% increase in per capita food expenditure is needed to draw the food insecure households to the food insecurity line as against the 24% increase required for the female-headed households' rice farmers. This is in line with the expectation of this study, as female-headed households are always prone to food insecurity and most food insecurity. Food insecurity incidence increases with the increase in the age of the farmers; the values of 43%, 45%, and 66% correspond to 0-30years 31-60years and 61-90 years old rice farmers, respectively. Likewise, the progression of 17%, 22%, and 40% increase in per

capita food expenditure is needed to draw the food insecure households to the food insecurity line among the age categories. This agrees with Oguniyi *et al*., 2021 and Ogundipe *et al*. (2019). Food incidence was higher among non-married households, with an 88% incidence value compared to a 43% value for married households, likewise the depth and severity too with 44% and 29%, respectively. Non-educated rice farming households have a higher incidence, depth, and severity of poverty, with values of 63%, 31%, and 25%, compared to educated households, with values of 45%, 22% and 15%, respectively. In comparing the values with the demographic variable, households that belong to members of the cooperative association have a low incidence, depth and severity values of 47%, 22% and 16% in contrast to households that did not belong to the cooperative association with the values of 49%, 27% and 17% respectively. Access to credit is also an important variable determining the food security of rural farmers. In this study, rice farmers with access to credit have a high poverty incidence of 61% with a poverty depth of 29% and poverty severity of 19%, while farmers without access to credit have 32% 17percent and 12percent poverty incidence, depth and severity, respectively. Also, households with access to extension services have poverty values of 38%, 26percent, and 17percent incidence depth and severity values. In contrast, households without extension access have values of 51%, 18 per cent and 12 per cent, respectively.

Table 4: Decomposition of the households by socio-economic and food security indices

Variables	**Food security indices**		
	P_0	**P_1**	**P_2**
Sex			
Male	0.46	0.21	0.14
Female	0.49	0.24	0.17
Age			
0-30	0.43	0.17	0.08
31-60	0.45	0.22	0.15
61-90	0.66	0.40	0.29
Marital Status			
Married	0.43	0.21	0.15
Non-Married	0.88	0.44	0.29
Education Status			
Educated	045	0.22	0.15
No Education	0.63	0.31	0.25
Household Size			
1-5	0.52	0.32	0.23
6-10	0.40	0.17	0.11
11-15	0.55	0.31	0.24
16-20	0.86	0.51	0.35

Farm Size			
0-10	0.49	0.24	0.17
11-20	0.57	0.19	0.06
21-30	0.00	0.00	0.00
31-40	0.00	0.00	0.00
40-50	0.00	0.00	0.00
51-60	0.00	0.00	0.00
Years of Farming experience			
1-10	0.55	0.29	0.21
11-20	0.38	0.17	0.10
21-30	0.00	0.00	0.00
Above 60 years	1.00	0.24	0.06
Cooperative Membership			
No	0.49	0.27	0.18
Yes	0.47	0.22	0.16
Formal Agricultural training			
No	0.47	0.26	0.17
Yes	0.54	0.23	0.16
Primary occupation			
Farming	0.47	0.23	0.16
No-farming	0.56	0.27	0.17
Access to credit			
No	0.32	0.17	0.12
Yes	0.61	0.29	0.19
Access to extension			
No	0.51	0.18	0.12
Yes	0.38	0.26	0.17

Source: Authors Computation, 2021

3.2. Determinants of Food Security among Rice Farmers in Ebonyi State

An Endogenous Switching Regression (ESR) was used to examine the determinants of Food Security among rice farmers in Ebonyi State, Nigeria. The results of the correlation coefficient (ρ) indicate selection bias and the existence of observed and unobserved factors influencing the food security status of the rice farmers. The non-significance of covariance estimates for both food-secure and non-food-secure households shows that in the absence of association membership, there will be a difference in evidence in the food security status between the food-secure and non-food-secure households. The significant value of the Wald test for independence of the equations suggests interdependence between the selection equation and the outcome equations for food-secure and non-food-secure rice farming households. This offers more proof of endogeneity, and the test results established the validity of our instrument because it has a significant effect on the food security status of rice farmers.

The selection equation (column 1) results indicate the first stage of providing the driving force behind rice farmers' food security status. That had been interpreted as standard probit coefficients. The results show the statistical significance of the coefficients of a relative number of variables. Gender was significantly different from zero and negative in the selection equation. This indicated that the availability of more female farmers increased the inclination to be food secure, suggesting that female rice farmers are more likely to be food secure than their male counterparts. This agrees with Oyebanjo *et al*. (2013) that female household heads' will increase household food insecurity. Access to agricultural extension by the rice farmers was positive and significantly different from zero. That suggests that all things being equal, as the access to extension agents increased, their propensity or likelihood to be food secure improved. This might be because contact with extension services provided more access to improved production techniques, inputs, and other production incentives. These would positively affect farmers' output and income-generating ability, reducing their poverty level (Asogwa *et al.,* 2012). Association membership by the farmers was also positive and significantly different from zero. This implies that as the membership of cooperative associations increases, the possibility of the households being secure food increases. Fasakin and Popoola, 2019) emphasized the importance of cooperative association membership positively in improving the livelihood of rural farming households. This may be due to some advantages the households are likely exposed to that can enhance their food insecurity problems.

The results of the endogenous switching regression show that access to credit has a familiar and adverse effect on both food-secure and non-food-secure households. This means that credit access can significantly decrease rice farmers' food security. This corroborates the study of Adeyeye (2001) and Adekoya (2014). Access to credit is a veritable tool for a household's food security. It assists the farm households in purchasing farm inputs such as fertilizer, herbicides, improved seeds, and investment demand, ultimately increasing their productivity. The gender of the households was positive in influencing the food security of the non-food secure rice farming households. This implies that the availability of more male farmers increases the likelihood of being non-food secure. This might be because male-headed households are already exposed to food insecurity or not being food secure since they do not engage in domestic activities like food making. This contradicts the findings of Obayelu and Orosile (2015) and Awotide *et al*. (2011). Still, it agrees with Ogunniyi *et al.* (2021) and Milazzo and Van de Walle (2015). They found that the declining aggregate food insecurity incidence has been observed among African female-headed

households. The marital status of the households was negative in influencing the food security of the food secure rice farming households. This implies that unmarried rice farmers are more food secure than married rice farming households. This might be because unmarried farmers have less family responsibility to care for compared to married households, hence the reason for their food security status. The years of education coefficient was negative under the food-secure households. This implies that as the education of the food secure group increases, the likelihood of the households attaining better food security status decreases, i.e. the more educated the respondents, the higher their food security status. This is in line with the findings of Oluyole and Taiwo (2016). They opined that education is a form of human capital and could positively impact the household's ability to take excellent and well-informed production and nutritional decisions.

The farming experience coefficient was negative under the non-food secure households. This implies that the level of food security among rice farmers decreases as the years of farming experience increase. This may be due to reduced income over time, as continuous rice production could result in lower yield without improvement in production techniques since most farmers needed access to extension services for training. This contradicts the findings of Mohammed *et al.* (2014), where the higher the years of farming experience by the head of the household, the higher the likelihood of the household being food secured. The primary occupation coefficient was positive under the food-secure households. This implies that household members that have rice farming as their primary occupation will be more food secure than the other households. This agrees with the findings of Amao and Ayantoye (2015), who opined that engaging in farming as the primary occupation has the likelihood of reducing food insecurity. The positive coefficient of farm size suggests that as the non-food secure rice farming households cultivate more farm size, the possibility of the households being food rapidly increases. This implies that if the non-food-specific farming households grow more rice farmland, they will be more food secure. This disagrees with (Mansaray & Jin, 2020), who opined that farmers who cultivate small farms are more food-secure than farmers who cultivate large farms. It may further imply that farmers with small farm sizes are more effective (or productive) than farmers with larger farms in terms of providing more food. The relationship between food security and farming on given farmland is mainly appropriate for farm households.

Table 5: Endogenous Switching Regression estimates for the determinants of food security among Rice Farmers in Ebonyi State

Variables	Selection	Food security	
		FS=0	NFS=1
Access to credit	0.110	-0.190*	-0.344***
	(0.272)	(0.109)	(0.124)
Age	0.003	0.003	-0.005
	(0.040)	(0.015)	(0.026)
Age squared	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Sex	-0.587**	0.184	0.558***
	(0.280)	(0.123)	(0.171)
Marital status	0.005	-0.334*	-0.230
	(0.486)	(0.177)	(0.245)
Years of education	-0.018	0.006	-0.028**
	(0.016)	(0.006)	(0/014)
Household size	-0.038	-0.026	-0.031
	(0.044)	(0.018)	(0.015)
Farming experience	-0.001	-0.008**	0.007
	(0.010)	(0.004)	(0.004)
Pry occupation	-0.157	0.341*	-0.182
	(0.545)	(0.195)	(0.191)
Farm size	-0.002	-0.003	0.008**
	(0.013)	(0.008)	(0.003)
Access to extension	0.705**	0.128	-0.068
	(0.288)	(0.144)	(0.167)
Distance_ market	0.022	-0.001	-0.011
	(0.021)	(0.007)	(0.008)
Association Member	1.270***	-	
	(0.318)		
Constant	-0.758	0.704	1.065
	(1.030)	(0.424)	(0.521)
Wald chi^2	20.28		
Log-likelihood	-127.345		
LR test of ind. Variable	1.92		
/lns		-0.820***	-1.094***
		(0.107)	(0.154)
Rho		-0.477	-0.231

	(0.296)	(0.992)

, **, * denote significance at the 0.1, 0.05, and 0.01 levels, respectively.*
Source: Author's computation.

5.0. Conclusion and Policy Recommendations

Using a cross-sectional dataset, this study examined food security analysis and its determinants among rice farming households in Ebonyi State, Nigeria. The mean per capita household food expenditure was estimated at ₦ 8456.427, and the poverty line, which is two-thirds (67%) of the mean per capita household expenditure, was estimated at ₦ 5386.07. The food insecurity measure shows that 46.67% of the households express the incidence of food insecurity, while 24.62% and 17.21% were found to have depth and severity. The food insecurity decomposition shows that food insecurity is higher among female households than the male-headed counterparts, and it was obvious that larger households had a higher incidence of food insecurity. The incidence of food insecurity was higher among non-married households compared to married households, higher among non-educated households to educated households, and higher in households with lower farming experience. We further modeled the determinants of food insecurity among rice farming households, controlling for endogeneity in most variables that could determine food insecurity. The endogenous Switching Regression model showed the significance of determining food insecurity among the food-secure and non-food-secure rice farmer's area is access to credit, marital status, farming experience, primary occupation, gender, years of education, and farm size.

The findings of this study reveal some policy issues in the Nigerian context. The reported incidence of food insecurity across the households (male and female-headed) calls for more actions on the food insecurity situation in the country. Programs that will help alleviate poverty among households should be prioritized, and existing programs on food security should be sustained. The focus should be on programs that will make credit facilities available to farmers across gender and age, and consideration should be given to experienced farmers with larger farm sizes. Finally, due to the importance of education in reducing rural households' food insecurity, policy on revamping the education sector in the study area should focus on households with low education levels while strengthening existing educational institutions.

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