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Food Insecurity and its Correlates: Empirical Evidence from Fish Farming Households in Nigeria

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Abstract: *Over the years, the Nigerian government and partner agencies have implemented several interventions to unlock the untapped food security potential of aquaculture. However, there still exists a dearth of knowledge on the effect of these programmes on household food security, particularly among fish farming households in Nigeria. Therefore, this study engaged the Foster-Greer-Thorbecke model and the Probit model to examine the food insecurity incidence and the drivers of food security among the fish farming households in Nigeria. The study engaged secondary data of 1,587 fish farmers from the 2018/19 Nigeria Living Standard Survey panel data. The food insecurity estimates show that about 52.49% of fish farmers are food secure. The result further shows that most food insecure households are males, married, have fish farming as a primary occupation, reside in a rural area and are from the Northern part of the country with no formal education. Empirical evidence reveals that education, household size, access to phone, occupation, sector and location of the household head are the major determinants of food security. The study concludes that educating the fish farmers and upgrading the rural facilities will increase the probability of food security among the fish farming households in Nigeria.*

Keywords: Fish farmers, food insecurity, food security, Foster-Greer-Thorbecke model.

1. Introduction

Fish farming plays a vital role in ensuring the food and nutrition security of a nation. The key role of aquaculture in the economic development of a nation cannot be overemphasised. In Nigeria, fish does not only serve as a source of nutrients, but also serves as a source of income for both rural and urban households. As a direct source of nutrients, fish provides micronutrients such as zinc, vitamin A, iodine, calcium, vitamin B_{12}, and iron, as well as essential fatty acids and protein, which could contribute to food and nutrition security (Bradley et al., 2020). Congruently, fish are traded for money which is used to purchase other food materials to ensure the food security of the household. Global fish production has grown steadily, with its supply growing faster than the world population growth at an annual average rate of 3.2% (FAO 2020). Fish production peaked in 2016, with estimates of $362 billion, out of which aquaculture production was $232 billion (FAO, 2018). Nigeria is one of the principal fish-producing nations in sub-Saharan Africa, producing about 400,000 metric tonnes of cultured fish and about 390,000 metric tons of captured fish (Mohammed *et al*., 2014; FAO, 2020). Despite this significant production record, the country is still experiencing an increasing fish demand-supply gap. Correspondingly, Nigeria recorded about 98.8% fish self-sufficiency in 1983. However, as the country's population increased over the years, the country's self-sufficiency gradually declined to 40% in 2005 and about 19.2% in 2014 and is projected to decline further. The incessant slide in national fish sufficiency cost the country about US$400 million annually to bridge the country's fish demand and fish supply gap (Liverpool-Tasi et al., 2018; Oladimeji et al., 2017).

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FBN Quest Capital Research (2018) argues that the enormous potentials of aquaculture in contributing to the food security of millions of people who depend on aquaculture as the primary source of livelihood remain largely untapped. Consequently, in order to leverage the potential of aquaculture, the Nigerian government and partner agencies have implemented several development initiatives and interventions to accelerate aquaculture and fisheries production, improve the socio-economic livelihood, and improve the food security status of farming households. Such intervention includes the West Africa Agricultural Productivity Programme, Nigeria National Aquaculture Strategy and National Fadama Development Projects (Ahmed et al., 2021; Subasinghe et al., 2021). Despite these interventions, there still exists a dearth of knowledge on the outcomes of these programmes on household food security, particularly among fish farming households in Nigeria. As a sequel to the above, this study aims to examine the food insecurity incidence and the drivers of food security among the fish farming households in Nigeria

2. Literature Review

Literature that investigates food insecurity and its determinants among fish farming households include the study by Olaoye et al. (2021). They used primary data from 120 fish farmers in the Odogbolu Local Government Area of Ogun State to analyse the socio-economic determinants of household food security. The study engaged the household food security survey developed by the United States Department of Agriculture – USDA (2012) and multiple regression analysis. Findings from the study revealed that fish farming enormously contributes to household food security by guaranteeing dietary diversification, increased food consumption, employment generation, steady food supply, increased household per capita income, reduced household expenses on protein consumption and reduced malnutrition. The study concludes that household size and age significantly influence the household food security status of fish farmers. The study recommended that women and youths be urged to venture into the fish farming enterprise to improve their food security status. Similarly, Oladimeji et al. (2020) studied the impact of the Shiroro dam project on the poverty status and food security of rural fisher folks in the North-central geo-political zone of Nigeria. The study engaged the propensity score matching and local average treatment effect model and discovered that the Shiroro dam farmers were twice as food secured as the non-beneficiary farmers. The study further revealed that utilising the Shiroro dam produced about eleven units increase in income of the farmers and recommended the need to integrate fish production, both aquaculture and capture fisheries, into dam constructions and associated water management systems to improve the food security status.

Oparinde (2019) investigated the impact of risk management strategies adoption on fish output and food security among women aquaculture farmers in Ondo State, Nigeria. The study employed the recursive bivariate Probit model and endogenous switching regression model to analyse primary information from 90 respondents through a multi-stage sampling procedure. The result found that age, education, household size, non-farm income, credit constraint, pond system, risk attitude and quantity of feed significantly influenced the risk management strategies adopted. Furthermore, the adoption of risk management strategies increases fish production and food security among women fish farmers. In the same vein, Akuffo and Quagrainie (2019) studied the impacts of fish farming on household nutritional quality among fish farming communities in Ghana. Secondary data from 144 fish-farming households were elicited from the 2013 Ghana Living Standards Survey. The study hypothesises that engaging in fish farming will increase steady income flow and access to fish for the household's direct consumption. The study adopts the propensity score matching approach in a logit framework was adopted and the results revealed that fish farming households had a higher frequency of food consumed and nutritional quality than the counterpart non-fish farming households. However, literature has dwelt more on investigating the determinants of food security among rural households (Olaoye et al., 2021; Ogunniyi et al., 2021; Usman & Olagunju, 2019; Adepoju & Oyegoke, 2018; Ajayi & Olutumise, 2018). Therefore, there is limited empirical evidence on the

food security status of the fish farming households in Nigeria, particularly an empirical investigation that utilises the national representative data. Thus, this study seeks to fill this gap in literature.

3. Methodology

3.1 Data and descriptive statistics

This study engages the 2018/19 Nigeria Living Standard Survey (NLSS) panel data. The data was a collaborative effort implemented by both the Nigerian National Bureau of Statistics and the World Bank. The survey adopted a multi-stage stratified sampling technique to select primary sampling units and information on socio-economic characteristics and food security from 1,587 fish farming households is extracted and used for this study (NBS, 2020).

3.2 Analytical techniques

Several methods are used to measure food insecurity (Asige & Omuse, 2022; Ogunniyi et al., 2021; Usman & Olagunju, 2019). However, this study adapts the class of decomposable poverty measures of the Foster, Greer and Thorbecke (FGT) methods (Foster et al., 2010). The FGT is widely used because of its consistency and additively decomposability. The measures relate to different dimensions of P_0, P_1 *and* P_2. The food insecurity headcount (P_0) denotes the proportion or percentage of households living below the food security line. Food insecurity depth (P_1) denotes the required expenditure proportion to allow households below the food security line to attain the minimum food security status. Food insecurity severity index (P_2) denotes the severity of food insecurity among fish farming households.

The FGT is a common measure of poverty. It comprises the most desirable properties of the poverty index, such as sub-group consistency and decomposition. According to Foster et al. (2010) and following Adesina et al. (2019), the FGT index measure is expressed as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\frac{\left(z - y_i\right)^\alpha}{z}, 0 \le \alpha \le 2 \qquad 1$$

Where;

z = the food security line calculated as two-thirds mean per capita monthly food household expenditure

q = the total number of individuals below the food security line

N = the total number of persons in the reference population

y_i = the household i monthly per capita food expenditure

α = food security aversion parameter

when α = 0, measures the headcount of all food insecurity households

α = 1, measures the degree to which households fall below the food security line

α = 2, measures the severity of the food insecurity households

The food insecurity Index (*f*) is specified as:

$$F_i = \frac{Per\ capita\ food\ expenditure\ for\ the\ ith\ household}{2/3\ mean\ per\ capita\ food\ expenditure\ of\ all\ household} \qquad 2$$

Where F_i = food security index

$F_i \geq 1$ = Food secure i^{th} household

$Fi < 1$= Food insecure i^{th} household

The food consumption expenditure is calculated as the summation of all food items consumed in the household in the last seven days, including food purchased from own stock, gifts and food-for-work in-kind payments, scaled up to a month by multiplying the seven days' food expenditure recall by 4.28 (Dercon & Hoddinott, 2004).

3.3 The Probit model

The Probit model sometimes called the cumulative distribution function of the standard normal distribution, is employed to analyse the drivers of food insecurity among the fish farming households, given the dichotomous nature of the food security status variable. Probit models are mostly the same as Logit models, especially in binary form (0 and 1). Following Ogunniyi et al. (2021), it is expressed as follows:

$$y_i = \begin{pmatrix} y_i^* = \beta x_i + u_i \; if \quad y_i^* > 0 \\ 0 \quad if \quad otherwise \end{pmatrix} \qquad 3$$

where y∗ is the unobserved latent variable taking a value of 1 for food-secured households and 0 for food-insecure households. x_i represents vector of the independent variables, u_i represents the random error term. The independent variables x_i are the determinants of food security. Explicitly, it is given as;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_{11} X_{11} + \mu_i \qquad 4$$

Where;

Y_i = Food security status; (Dummy = 1 food secure, 0 if otherwise)

β_0 = Intercept

β_1 - β_{11} = Parameters to be estimated

X_1 - X_{11} = Explanatory variables

μ_i = Random error term

3.4 Measurement of Variables

Systematic empirical review of the literature and data availability guided the choice of the explanatory variables included in the model (Olaoye et al., 2021; Oladimeji et al., 2020; Oparinde, 2019; Oladimeji et al., 2017; Amao, 2009). Table 1 shows the measurement and the respective *apriori* sign of the variables. The first column shows the variable, measurement is presented in the second column and the expected sign is shown in the third column.

***Table 1**: Definition of variables and apriori expectation*

Variable	Measurement	Expected sign
Gender	Dummy; 1 = Male, 0 = Female	±
Age	Discrete; Number in years	+
Marital status	Dummy; 1 = Married, 0 = Otherwise	±
Religion	Categorical; 1 = Christianity; 2 = Islam, 3 = Traditional	±
Education	Discrete; Number in year	+
Phone access	Dummy; 1 = Yes, 0 = Otherwise	+
Household size	Discrete; Number of individuals	±
Credit access	Dummy; 1 = Yes, 0 = Otherwise	+
Primary occupation	Categorical; 0 = Fish farming; 1 = Public service; 2 = Manufacturing; 3 = Secondary; 4 = Entrepreneur,	+
Sector	Dummy; 1 = Rural, 0 = Urban	±
Zone	Categorical; 1 North central, 2 = North east, 3 = North west, 4 = South East, 5 = South south, 6 = South west	±

Source: Authors' compilation

4. Result and Discussion

4.1 Descriptive Statistics of Respondents

Table 2: *Socio-economic distribution of respondents*

Variable		Frequency	Percentage	Mean
Gender	Male	1,443	90.93	
	Female	144	9.07	
Age	18-35	415	26.15	46
	36-64	950	59.86	
	>64	222	13.99	
Marital status	Married	1,352	85.19	
	Otherwise	235	14.81	
Household size	1-5	737	46.44	6
	6-10	643	40.52	
	>10	207	13.04	
Educational status	No formal education	602	37.93	
	Vocation education	14	0.88	
	Primary education	352	22.18	
	Secondary education	504	31.76	
	Tertiary education	115	7.25	
Primary occupation	Fish farming	1,449	91.30	
	Public service	65	4.10	
	Manufacturing	32	2.02	
	Entrepreneur	41	2.58	
Access to credit	Yes	514	32.39	
	No	1,073	67.61	
Sector	Rural	1,421	89.54	
	Urban	166	10.46	
Zone	North Central	252	15.88	
	North East	312	19.66	
	North West	286	18.02	
	South East	81	5.10	
	South South	502	31.63	
	South West	154	9.70	

Source: Authors' compilation

Table 2 shows the socio-economic distribution of the fish farmers. The findings from the study reveal that about nine out of every ten fish farming households is male-headed. This result is in line with earlier findings of Olaoye et al. (2021); Adepoju and Oyegoke (2018), and Oladimeji et al. (2017), who also found in their studies that fish farming is an activity taken up by males. This could also be a result of the physical strength required for a successful managerial operation in fish farming. Also, the findings similarly indicate that the fish farmers' mean age is 46 years and are dominated by people within the age bracket 36-64 years. This suggests that the fish farmers are of active working age and economically active. The finding is in tandem with the report of previous studies (Olaoye et

al., 2021; Usman & Olagunju, 2019; Ajayi & Olutumise, 2018) who found that fish farming is largely composed of economically active persons. Similarly, the findings from the study indicate that about four out of every five fish farmers are married. This finding is consistent with the report of Olaoye et al. (2021) and Adepoju and Oyegoke (2018), who found that most fish farmers were married. The result further reveals that fish farming households predominantly comprise about one to five persons. This suggests a fairly small family size among the fish farmers. This result corroborates the findings of Olaoye et al. (2021), who found that small household size is sufficient to sustainably manage the fish farming business. The level of education results reveal that about one out of every five has primary education, while about two out of every five fish farmers had at least secondary education. This implies that the majority of the fish farmers in Nigeria had no formal education. This finding varies from the report by Olaoye et al. (2021) and Adepoju and Oyegoke (2018). Further results showed that about nine out of every ten fish farmers in Nigeria had fish farming as their major occupation and reside in the rural part of the country, while about two-thirds of the fish farmers have no access to credit facilities. Further result shows that nine out of ten fish farmers in Nigeria reside in the rural sector of the economy. This implies that the majority of the fish farmers in Nigeria are rural dwellers. The result from the location reveals a fairly equal distribution of the farmers along the northern and southern parts of the country.

4.2 Food insecurity estimates

Table 3: *Food security estimates*

Food insecurity indices	Estimates
Food insecurity incidence	47.51%
Food insecurity gap	21.94%
Food insecurity severity	12.12%
Mean per capita household food expenditure	₦1,374.41
Food insecurity line	₦1,162.05

Source: Authors' compilation

Table 3 reports the estimates of food insecurity among fish farming households in Nigeria. Based on food insecurity measures generated from the adopted FGT measure, the result reveals an estimated household mean per capita food expenditure (HMPCFE) of ₦1,374.41 and food security line estimates stood at ₦1,162.05 employing two-thirds of the HMPCFE of the total households. Food insecurity incidence of 47.51% indicated that about half of the fish farming households are food insecure. However, additional food expenditure of about ₦ 255.00 is needed to move a food insecure household out of the food insecurity domain as indicated by the 21.94% food insecurity gap. Similar result was reported in the study by Ettah et al. (2020) and Usman and Olagunju (2019).

4.3 Distribution of household food insecurity

Table 4*: Socio-economic distribution of food insecurity*

Variable		Food insecure	Food secure
Gender	Male	94.56	87.64
	Female	5.44	9.07

Age	18-35	23.34	28.69
	36-64	64.74	55.46
	>64	11.94	15.85
Marital status	Married	91.91	79.11
	Otherwise	8.09	20.89
Household size	1-5	30.90	60.50
	6-10	47.88	33.85
	>10	21.22	5.64
Educational status	No education	46.55	30.13
	Vocation education	0.53	1.20
	Primary education	22.81	21.61
	Secondary education	25.60	37.33
	Tertiary education	4.51	9.72
Primary occupation	Fish farming	94.56	88.36
	Public service	2.39	5.64
	Manufacturing	1.06	2.88
	Entrepreneur	1.99	3.12
Access to credit	Yes	33.16	31.69
	No	66.84	68.31
Sector	Rural	95.89	83.79
	Urban	4.11	16.21
Zone	North Central	20.95	11.28
	North East	27.32	12.73
	North West	24.67	12.00
	South East	5.04	5.16
	South South	18.57	43.46
	South West	3.45	15.37

Source: Authors' compilation

The food insecurity incidence of the households is further decomposed with some selected socio-economic characteristics of the households. The resulting profile is presented in Table 4 and is discussed as follows. The decomposition by gender shows that female-headed households are more food secure than their male counterpart. The result agrees with (Ogunniyi et al., 2021, Adepoju & Oyegoke, 2018; Ogwumike & Akinnibosun, 2013). With respect to the age of the household head, the results reveal that food insecurity increases as age increases but declines as the age approaches 65 years. Similarly, food insecurity is more pronounced among households between the age of 36 and 64. This result agrees with Ogunniyi et al. (2021) and Adepoju and Oyegoke (2018), who found a similar relationship between the age of the household heads and food security. The marital status food security distribution shows that the incidence of food insecurity for married household heads is higher when compared with their single, widowed or separated counterparts. The result shows that about nine out of the ten food-insecure households are married. This result is at variance with the findings of Ettah et al. (2020) and Adepoju and Oyegoke (2018) but in agreement with the findings of Ogunniyi et al. (2021). The decomposition of the household size shows that households with less than five members have the least incidence of food insecurity; about two-thirds of this group is food secure. On the other hand, about two-thirds of food-insecure households are characterised by household members above six. This suggests that food insecurity increased with an increase in household size. This result is in line with Usman and Olagunju (2019), who also found a positive relationship between food security and household size.

Further result shows that a larger proportion of households with farming as their primary occupation was more food insecure, while a larger percentage of households with other occupations had a lesser incidence of food insecurity. This implies that having an additional source of income reduces the food poverty incidence among fish farming households in Nigeria. The profile of the educational status revealed that household heads with no formal education had the highest food insecurity incidence, as about half of the food-insecure households had no formal education. Similarly, the result revealed that food insecurity incidence reduces as the level of education increases. The finding is in tandem with Ogunniyi et al. (2021) and Amao (2009), who found that human capital development in the form of education and training can boost income-generating capacity, alleviate poverty and decrease food insecurity among farming households. Further result reveals that about one-third of the food-insecure fish farmers has no access to credit facilities. Ogunniyi et al. (2021) report similar findings among smallholder maize farmers in Nigeria. The sector analysis revealed that most food-insecure households reside in the rural sector of the economy, while urban households are more food secure than their rural counterpart. Similarly, the zonal food security incidence decomposition reveals that the northern part of the country contributed about two-thirds to the food-insecure households in Nigeria. The result also shows that the southern part of the country has lower food insecurity incidence compared to its northern counterpart. This finding is consistent with Ogwumike and Akinnibosun (2013) reports.

4.4 Determinants of food security among fish farming households in Nigeria

***Table 5**: Determinants of food insecurity among the fish farming households*

Variable	Coefficient	Marginal effect	Z - statistics
Gender	0.1753 (0.1604)	0.0600	1.09
Age	0.0027 (0.0027)	0.0008	1.00
Marital Status	-0.0822 (0.1314)	-0.0264	-0.63
Religion	0.0448 (0.0779)	0.0140	0.58
Education	0.0980*** (0.0294)	0.0305***	3.33
Phone Access	0.3463*** (0.0895)	0.1029***	3.87
Household size	-0.1412*** (0.0124)	-0.0430***	-11.38
Credit Access	0.1131 (0.0780)	0.0337	1.45
Primary Occupation			
Public Servant	0.7592*** (0.2160)	0.2192***	3.51
Manufacturing	0.5694** (0.2660)	0.1751**	2.14
Entrepreneur	0.3532 (0.2427)	0.1183	1.46
Sector			
Rural	-0.5467*** (0.1337)	-0.1569***	-4.09
Zone			
North East	0.1321 (0.1200)	0.0434	1.10
North West	0.2460** (0.1254)	0.0650**	1.96
South East	0.2481 (0.1747)	0.0721	1.42
South South	0.7154*** (0.1142)	0.2195***	6.26
South West	1.1650*** (0.1652)	0.3359***	7.05

_cons	0.2089 (0.3552)	0.59
Log-likelihood	-853.06685	
LR $chi^2(17)$	489.98	
Prob > chi^2	0.0000	
Pseudo R^2	0.2231	

***, ** and * implies significant at 1%, 5% and 10% level of probability, respectively

Table 5 presents the coefficients of food security determinants among fish farming households in Nigeria, along with the standard error, marginal effects and z-values. The chi-square (λ^2) statistics test the null hypothesis that all estimated coefficients are equal to zero. The estimate of the λ^2 statistics for the model is 489.98 and it is significant at a 1% confidence level. This implies that all the variables embedded in the model are jointly significant in influencing the fish farmers' food security status. The pseudo-R-squared of 0.2231 implies that 22.31% of the variation in the food security status of the fish farming households is jointly explained by the significant explanatory variables.

The explanatory variables introduced show that zone, sector, education, household size, access to phone and occupation have a significant effect on food security. The coefficient of education is positive and significant at a one per cent level. This implies a direct relationship between the level of education and food security. Thus, the higher the household head's education level, the higher the probability of being food secure. The marginal effect revealed that, on average, a unit increase in education level would lead to about a three per cent increase in the probability of the households being food security. This result is in line with Amao's (2009) findings but is at variance with Ettah et al. (2020), who found a direct relationship between education and poverty of fish farmers in southern Nigeria. Also, it was observed that access to a phone is positively related to the probability of being food secure at one per cent. Other things remaining constant, the likelihood that a household is considered food secure increases with the household heads' increased access to a phone. The result from the marginal effect revealed that a unit increase in access to a phone would, on average, increase the probability of food security by ten per cent. This is probably due to access and utilisation of the market information services associated with owning a mobile phone. The result shows a negative relationship between household size and the probability of being food secure which was significant at a one per cent level. A decrease in household size will increase the probability of food security. The marginal effect results show that a unit decrease in household size will increase the probability of food security by three per cent on average. This result agrees with the findings by Olaoye et al. (2021) and Adepoju and Oyegoke (2018) and Usman and Olagunju (2019).

The result from the occupation shows that the coefficients of the public servant and manufacturers are positive and significant at one per cent and five per cent levels, respectively. The result implies that the public servant and manufacturers are more food secure compared to their counterparts who have fish farming as their primary occupation. The results show that rural households are more food insecure than their urban counterparts at a one per cent level of significance. The marginal effect revealed that a unit decrease in the probability of being rural increases the probability of food security, all things being equal. Nigeria is a country with marked differences in the cultural, geographical and social settings, which produce differences in the probability of being poor among the people in these regions. The result shows that the coefficients of southwest and south-south are positive and significant at a one percent level of significance, while the northwest is also positive but significant at a five per cent level. This implies that fish farmers in the northeast, south-south, and southwest have less probability of being food insecure than the northcentral fish farmers. This result is in tandem with Ogwumike and Akinnibosun (2013), who found that northern geo-political zones are more food insecure compared to their southern counterpart

5. Conclusion and Recommendations

Sequel to the limited empirical evidence on the food security status among the fish farming households in Nigeria, this study contributes to the existing body of literature by examining the drivers of food security among fish farming households in Nigeria. The study employs secondary information from 1,587 fish farming households extracted from the 2018/19 Nigeria Living Standard Survey (NLSS). The food security indices obtained from the Foster, Greer and Thorbecke methods reveal that the mean per capita household food expenditure for fish farming households and the food security line was ₦1,374.41 and ₦1,162.05, respectively. Also, the result shows that about 47.51% of the fish farmers are food insecure and on average, an additional ₦255 in food expenditure is needed to move the food insecure households out of food insecurity. On the other hand, the result from the Probit models showed on average, a unit increase in education, a unit decrease in household size and a unit increase in access to a phone will lead to about 0.03 unit, 0.04 unit and 0.1 unit increase in food security of the households, respectively. The result also shows that the rural fish farming households are probably less food secure compared to their urban counterpart, similarly, the northern fish farming households are less food secured compared to their southern counterparts. From the above, it implies that investing in formal education and mass enlightenment on family planning to reduce household size will increase the probability of being food secure among the fish farming households in Nigeria.

Conflict of Interest

There is no conflict of interest.

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