Vulnerability Analysis of Rural Households to Food Insecurity in Ondo State, Nigeria

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Abstract:- **This study examines the vulnerability of rural households to food insecurity in Ondo State, Nigeria. Primary data were collected from two hundred and forty (240) rural household heads through a multi-stage random sampling procedure using a structured questionnaire. Descriptive statistics and binary logistic regression model were employed to analyse the field survey data. Results from the study showed that the mean age was 52 years, indicating that the respondents were still fairly young. Majority (77.5%) of the respondents were male households with 62.5% married. More than half (51.0%) of the household heads were uneducated and 62.5% of the respondents had less than 2 acres, while 58.8% were food insecure. The estimated logit regression results revealed that marital status, household size, dependency ratio and proneness to sickness increase the probability of rural households falling into food insecurity while education, cooperative membership, farm size decrease same at 1% and 5% level of significance, respectively. Result from the study also showed that majority of the respondents eats less preferred food as one of the coping strategies employed to cushion the effects of economic shock in the study area. Based on the findings, the study concludes and recommends that policies that are meant to increase educational level, cooperative membership and farm size in order to reduce food insecurity should be put in place.**

Keywords: **Vulnerability, food security, logit regression, Nigeria**

I. INTRODUCTION

Nigeria is an agrarian country with a land area of 910,770 square kilometres (World Bank, 2018). Agriculture is a critical sector that has the potentials to cushion the effects of vulnerability of rural households to food insecurity. Not less than 36.6% of Nigerianlabour-force engaged in agriculture. Nigeria is richly blessed with diversity of natural resources including vast areas of arable land (Millennium Development Goal [MDG], 2013). The contribution of agriculture to the nation's gross domestic product (GDP) was so significant in the past. Food production was highly sufficient between 1950 and 1960s with excess being exported to other countries until the advent of global economic crises of 1970s. The 2016 economic recession in Nigeria exacerbated Nigeria's food situation the more. Nigeria food import bill on foodstuffs increases on daily basis.

Recent facts showed that most of the food security indices were not in favour of Nigeria's socioeconomic characteristics. For instance, Nigeria's Human Development Index (HDI) of 0.53 ranking Nigeria as the 158th out of 189 countries in the world with low of HDI(United Nations Development Programme [UNDP], 2019) On the basis of income categorization, Nigeria is a lower-middle income group occupying 121st position in the world (World Bank, 2018). The low income will lead to food insecurity. Food security in Nigeria still demands for a serious concern given a global food security index of 43.0% which is far below the average world level of 88.0% (Economists Intelligent Unit, 2019). One of the major problems plaguing the society the world over today is food insecurity. Though, this has been a major discussion at both local and international conferences. As a result, several efforts have been made towards addressing this problem.

At the world level, several initiatives have been carried out to ameliorate the level of poverty. Notable among these programs are the World Food Summit (WFS) that came up in Rome in 1996. Not less than 182 governments committed themselves to eradicating hunger in all countries, with a target to reduce undernourished people to half their present level not later than 2015. Other initiatives are Millennium Development Goal (MDG) in the year 2000 and Feed the future initiative led by America to strengthen agriculture-led growth, nutrition and resilience.

Despite these laudable efforts, the annual state of food insecurity in the world by its assessment in 2015, revealed that hunger remains an everyday challenge for almost 795 million people worldwide, including 780 million people in the developing regions (Food and Agriculture Organization) [FAO], 2015). Recent review by FAO (2019) reported that 2 billion people are suffering from food insecurity between 2014 and 2018 across the world. This figure represents about 26.4% of the total world population. Out of the 2 billion, 676 million are from Africa representing about 47.9% of this figure, living in the West African countries, Nigeria inclusive (FAO, 2019).

From national perspective, poor-resource farmers in Nigeria are often worse hit by food insecurity due to several factors ranging from climate change to insecurity of lives and property. Major food insecurity drivers in Nigeria include the sudden appearance of Boko Haram insurgency, flood, drought, and indiscriminate use of cattle to graze farmers' crops, destruction of oil pipelines by Niger Delta militants, oil spillage and a lot of other challenges have contributed to the nation's food insecurity. Consequently, food prices are soaring high beyond means of the rural farmers. Many farmers have abandoned the choice of farming to do non-

farming activities because of the fear of losing their crops to Fulani herdsmen.

Nigeria government has come up with so many intervening programs to ameliorate the level of poverty vis-à-vis hunger. Some of the notable programs introduced were Operation Feed the Nation (OFN); Directorate of Food Road and Rural Infrastructure (DFRRI), Economic Empowerment Strategy at all levels of governments, Family Support Program and Better Life Programme. Recently, National Social Investment Programs like Amnesty, N-Power, Tradermoni and School feedings introduced by the past and present governments have gone a long way to ease the burdens placed on household heads. These programs were conceived in the right direction, nevertheless, they are still bedeviled with myriads of problems and thus preventing them from achieving their purposes.

Studies on vulnerability to food insecurity have been on the increase for decades, but investigations into rural households' vulnerability to food insecurity have not been adequately researched in the study area. More information is therefore needed on this important issue in order to update the existing knowledge. The justification for the study area is premised on the fact that the percentage distribution of rural – urban population in Nigeria is 48.8% and 51.2%, respectively (World Bank, 2019). It is, therefore, necessary to focus attention on the rural households' welfare in order to ascertain the level of their vulnerability to food insecurity. Information generated from this study will assist government and private body to formulate relevant policies on food security. The study will stimulate further studies.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Vulnerability and food insecurity

According to Food and Agriculture Organization [FAO] (1996), food security exists when all people at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. The concept of food security is built on four pillars which include (i) food availability (ii) food access (iii) food utilization and (iv) food stability. Therefore, food insecurity exists when people have just little access to physical and economic sufficiency, safe and nutritious food to meet their dietary and healthy needs. Food insecurity is often rooted in poverty and has long-term impacts on the ability of families, communities and countries to develop and prosper (USAID, 2019). Prolonged undernourishment stunts growth, slows cognitive development and increases susceptibility to illness (USAID, 2019)

2.2 Food security measures

Food security measurements can be viewed basically from different angles as follows. First, food security can be measured through dietary diversity. This method requires taking the sum of the number of different foods consumed by an individual over a specified period of time. This may be a simple arithmetic sum, sum of the number of different food groups or within a food group or a weighted sum where additional different weights are given to the frequency by which different foods are consumed.

In case of using calorie acquisition to measure food security of rural household, quantity of food prepared are converted into common unit such as a kilogram while adjustment for processing is made before converting it to calories using a standard calorie conversation. Other method employed in the literature include individual food intake which is a measure of the amount of calorie or nutrients consumed by an individual in a given time period usually 24 hours. Last, but by no means the least, food security measure can be explored using coping strategies. It is an index based method employ by theoretical framework. So, based on the available literature, vulnerability to food insecurity is measured in proxy through several indicators. Prominent among the indicators include food intake as earlier mentioned, dietary diversity, calorie consumption, coping strategies employed by households and calculating the two-third mean monthly household expenditures. Several studies like Radimer 1990; Maxwell and Frankenberger 1992.; Babatunde, *et al.* 2008; Muhammed-Lawal, *et al.* 2012; Sanusi, *et al.* 2006; Abimbola and Kayode 2013; Ahmed, *et al.* 2015 Widad, et al., 2017; Ngena,et al 2018; Haddinott, 1999) have used similar method in their various studies.

To model an economic vulnerability of the rural households, we obtained the two-third of the mean monthly per capital expenditure of all sample observations and compare individual observation's monthly per capita consumption expenditure. The outcome is regarded as Food security index (FSI) which serves a threshold with which to compare those whose household expenditure that falls below or greater than the threshold. The criterion is that if a household monthly per capita expenditure is greater than two-third monthly per capita consumption expenditure, the household is termed food secured, otherwise not food secure.

III. METHODS

3.1 Study area/ sampling design

The study was carried out in Ondo State, Nigeria. The State is located in the Southwest geo-political zone of the country. It is divided into three agro-ecological zones with eighteen (18) Local Government Areas (LGAs). The climatic condition of the State is positioned between latitude $5^0\,45^1$ and $7^0 52^1$ of the equator and longitude $4^0\,30^1$ and $6^0\,05^1$E (UNAAB IFSERAR, 2010). The state is also located in the tropical rain forest zone with two distinct seasons which include the wet and dry seasons and these are likely to occur between April and October for Wet season. The dry season usually starts from November and sometimes ends in March. There is always low rainfall around August which is often referred to as August break.

A multi-stage sampling procedure was employed for the collection of data from the rural household heads in the study area. First, two LGAs namely Akure-South and Owo were purposively selected from the 18 LGAs of the State, because they are highly prominent in farming activities. The second stage involved a random selection of four villages from each of the two LGAs, making 8 villages selected. The villages selected from Akure South LGA were Oda, Ibulesoro, Igbatoro, and Eleyewo while Emure, Otapete, Uso and Isuada were chosen from Owo LGA.

The third stage involved a random selection of thirty (30) rural household farmers from each of the villages, thus making a total sum of two hundred and forty (240) farmers randomly selected for this study.

3.2 Data estimation

This study used ratio analysis to calculate the two-thirds mean monthly per capita consumption household expenditure (MPCHE) of ith individual. Having computed this, MPCHE was used to divide the sampled households into food secure and food insecure groups. This method has been used by several studies to categorise group of individuals into say vulnerable and non-vulnerable, poor and non-poor (see Omonona and Agoi (2007; Iorlamen *et al.,* 2014). The method therefore facilitates the dichotomization of the outcome/dependent variable into food secure and food insecure groups which is the focus of the present study. Food security index is calculated by taking the two-thirds of the monthly mean expenditure food and non-food to divide the per capita expenditure on food and non-food for individual i^{th} household. This therefore makes it relatively easy to classify households into food secure and non-food secure groups. Mathematically, food security index is expressed as:

$$F_i = \frac{\text{MPCE on food and nonfood for ith household}}{\frac{2}{3}\text{x MPCE on food and nonfood of all households}} \qquad (1)$$

The criteria for classifying the households into food secure and food insecure was based on if $F_i > 1$ or not. A food secure household = 1, if $F_i => 1$, and 0 otherwise. The binary generated here was used as dependent variable to model factors influencing rural households' vulnerability to food insecurity in the study area.

3.3 Binary Logistic Regression

Binary logit and probit models are popular econometric tools used in adoption related studies. The choice between the two models is often based on computational convenience and easy interpretation of the parameter estimate through its odds ratio. We therefore prefer the choice of binary logit regression since the dependent variable of our model is dichotomous. Several studies have used binary Logit regression to analyse variables in adoption of technologies (see Johnson, *et al*., 2018; Ahmed, *et al*. 2015; Fawole and Ozkan, 2017;).

Following Guajarati (2003), binary logit model can be expressed as

$$Y^*_i = In(\frac{P}{1-P}) = \frac{1}{(1 + \exp{-(\beta_0 + \beta_1 Xi))}} \qquad (2)$$

Where, Y^*_i = log of the odds ratio

In = natural logarithm

P_i = Probability that a household ith is being food secure

1-P = probability that a household ith is being food insecure

β_i = vector of unknown parameters to be estimated,

β_0 = constant,

X_i = a set of explanatory variables affecting rural households' vulnerability

Equation 2 can be rewritten as

$$Y^* = \beta_0 + \beta_i X_i + \varepsilon_i \qquad (3)$$

Where, β_0 and β_i remains as earlier defined,

X_i remains as earlier defined

ε_i = error term.

The selection of independent variables into the model was fully guided by previous related literature.

Table1: Description, measurement of variables and hypotheses

Variable	Definition of variable	Measurement of variable	Expected signs
X_1	Age in years	Years	-
X_2	Gender	Male = 1, 0 otherwise	-
X_3	Marital status	Married 1, 0 otherwise	-
X_4	Experience	Years (continuous)	-
X_5	Primary education	Yes =1,0 otherwise	-
X_6	Secondary education	Yes =1, 0 otherwise	-
X_7	Household size	Number of household members	+
X_8	Coop. Membership	Belong to cooperative 1, 0 otherwise	-
X_9	Farm size	Acre of land covered	-
X_{10}	Dependency ratio	Dependent/working pop.in the family.	+
X_{11}	Off-farm income	Yes = 1, 0 otherwise	-
X_{12}	Proneness to sickness	Always falling sick 1, 0 otherwise	+

IV. RESULTS AND DISCUSSION

4.1 The socioeconomic characteristics of rural households are discussed insection

Table 2 presents the distribution of socioeconomic characteristics of the respondents. The mean age of the respondents was 52 years, indicating that rural household sampled are not getting younger though can still fairly cope with the rigour associated with farming in the study area. Majority (77.5.0%) of the respondents were female households, indicating that females dominated the households

sampled. Result on marital status as depicted in the table showed that 37.5% of the sampled households were single while over half (62.5%) of them were married. This result reveals that rural households are likely to have access to cheap labour (i. e family labour) in the study area.

The result further revealed that less than 50% of rural households sampled were educated which implies that rural household farmers are likely to be ignorant of many agricultural technologies and other income generating activities in the study area. The mean experience of the rural households was 20 years which suggests that respondents will be able to take rational decision on resource allocation to cope with the food insecurity in the study area. The distribution of rural households by farm size showed that majority (62.5%) of the rural households had less or 2 acres of land. About 22.5% had between 3 and 5 acres while 15.0% owned 5 acres or more in the surveyed area. The mean farm size was approximately 3 acres which implies that food insecurity will be aggravated by small-sized farms.

Table 2: Socioeconomic characteristics of rural households

Variable	Frequency	Percentage	Mean
Age			
≤ 30	21	8.8	
31-60	159	66.3	52.0
≥60	60	25	
Total	240	100	
Gender			
Female	186	77.5	
male	54	22.5	
Total	240	100	
Marital status			
Single	90	37.5	
Married	150	62.5	
Total	240	100	
Education			
No formal education	122	50.8	
Primary education	60	23	
Secondary education	40	16.7	
Tertiary education	18	7.5	
Total	240	100	
Household Size			
≤5	72	30	
6-10	156	65	6.0
≥11	12	5	
Total	240	33.3	
Farming Experience			
≤10	30	12.5	

11-20	20	8.3	20.0
21-30	13	5.4	
≥30	17	7.1	
Total	240	100	
Farm size			
≤2	150	62.5	2.9
3-4	54	22.5	
≥5	36	15	
Total	240	100	

Source: Field Survey, 2019

4.2 Food Security

Table 3 presents the distribution of respondents by food security. Result showed that 58.8% of the rural households were food insecure while about 41.3% was food secured. This implies that majority of the households are not food secured and there is a high prevalence of food insecurity in the study area.

Table 3: Distribution of Respondents by Food Security

Food security	Frequency	Percent (%)
Food insecure	141	58.8
Food secure	99	41.3
Total	240	100.0

Source: Field survey, 2019

4.3 Annual Income

The distribution of respondents by annual income is presented in Figure 1. 29% of the respondents earned about ₦200,000 or less, 46.0% of the respondents earned an annual income that ranges between ₦250,000-₦300,000, 15.0% of the rural households earned as much as ₦350,000-₦400,000 income per year while 4.0% made as much as ₦450,000-₦500,000 in the same year. According to the table, only 6.0% of the households could earn ₦500,000 and above annually in the study area.
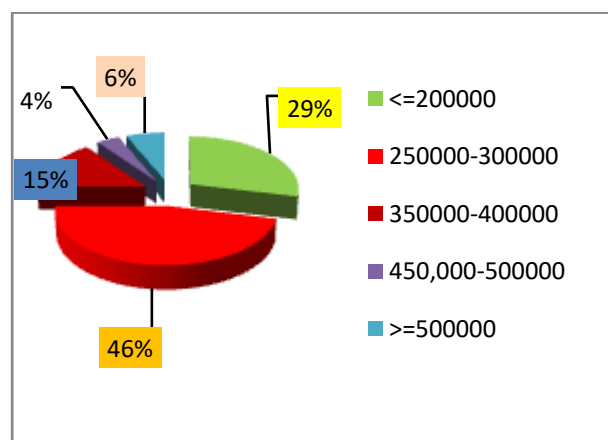

Figure 1: Distribution of respondents by annual income

Source: Field survey, 2019

4.4 Binary Logit Regression Result

Data estimation in this study was carried out by the maximum likelihood estimation method. The results of the binary logistic regression are presented in Table 4. The chi-squared statistics was 45.78 with P<0.01, thus implies the overall adequacy of the model was reasonably good. The goodness-of-fit of the model as revealed by the R^2 value of 42.0%, shows that 42.0% of the variations in the food insecurity of the rural household could be explained by all the explanatory variables in the model. The percentage correct classification of the model was as high as 81.3%, indicating a good fit of the data. The discussion of the result in Table 4 is based on the odds ratio since logit parameters cannot be interpreted directly (Gujarati, 2003).

The results also revealed that eight (8) out of 12 variables included in the model were found to be statistically significant at the 1%, 5% and 10% levels, respectively. The key determinants of vulnerability to food insecurity in this study were marital status, household size, educational status of the rural household heads, and membership of cooperative societies, farm size in acre, dependency ratio and proneness to sickness of the household heads.

The estimated logit coefficient of the marital status was 1.39 and positively related to food insecurity. The corresponding odds ratio was 4.01, indicating that the odds of being a married household will increase the odds of being vulnerable to food insecurity by 4.0 times compared to the unmarried household head.

The estimated logit coefficient of household size was 0.99 and found to be positive, while the corresponding odds ratio was 2.69, which signifies that an additional increase in household member, *ceteris paribus*, the probability of a household falling into food insecurity will increase by 69% in the study area. This result agrees with a study conducted by Babatunde, *et al*. (2008) that an increase in household size has a direct relationship with food insecurity.

The estimated logit coefficients of years of schooling at primary and secondary schools level were -3.50 and -2.17, respectively, and both were negatively related to food insecurity. The implication of the results on food insecurity was that a one year increase in education from primary school level up to secondary school level will help to reduce the chances of falling into the state of food insecure. The corresponding odds ratios were 0.03 and 0.11, respectively, indicating that the odds that an educated household falling into food insecurity will be 0.03 and 0.11 timesless, respectively compared to the uneducated household. This result indicates that educationis important in facilitating the adoption of innovation which in turn helps to improve farm productivity.

Membership of cooperative society is a vital socio-economic instrument in dealing with poverty in the rural area. Most farmers join cooperative societies in order to ease their access to credit facilities and besides to enable them to bridge

seasonality that is associated with production or consumption during off season. In this study, the coefficient of cooperative membership was -2.54 with corresponding odds ratio of 0.08. This variable was found to be negatively related to the food insecurity and statistically different from zero at the 1% level. The result indicates that the odds of household being vulnerable to food insecurity will be 0.08 times less the odds of non-cooperative member, given that other variables are controlled in the model. Cooperative membership of household can help him/her to mitigate all kinds of shocks.

The parameter estimate of farm size was negative (-0.41) and statistically significant at the 1% level with food insecurity while the corresponding odds ratio was 1.51 This implies that an increase in the number of acres farmed, all things being equal, the odds of being vulnerable to food insecurity will be reduced by 51.0%. This finding was similar to the findings of Babatunde, *et al*. (2008) that increase in farm size reduces food insecurity.

As displayed in the table, the coefficient of dependency ratio of the rural household farmer was 22.33. It had a positive and significant influence on food insecurity as expected. This indicates that an addition of one dependant, the odds of being vulnerable to food insecurity will increase by 0.4E-9 times than a household without dependant.

Further scrutiny of the result showed that proneness to sickness was positively related to food insecurity as expected. The logit coefficient was 2.22at 5% level of significance. The odds of a household head that always falls sick will increase the chance of falling into food insecurity by 9.2 times compared to the odds of household that is not falling sick always. As often said, health is wealth. Sickness can expose farmers to risk and thus give birth to low productivity which eventually leads to low income.

Table 4: Parameter Estimates of Binary Logit Regression Model

Variable	Coeff. (Std. Err)	Odds ratio	p-Value
Constant	6.28(3.01)*	632.70	0.04
Age	-0.05(0.04)	0.95	0.29
Gender	-1.49(1.01)	0.23	0.14
Marital Status	1.39(0.77)*	4.01	0.07
Experience	0.03(0.92)	1.02	0.56
Household Size	0.99 (0.40)**	2.69	0.01
Primary Education	-3.50 (1.07)***	0.03	0.00
Secondary Education	-2.17 (1.00)**	0.11	0.03
Coop. Membership	-2.54 (0.88) ***	0.08	0.00
Farm Size	-0.41 (0.14) ***	1.51	0.00
Dependency Ratio	22.33 (8.19) ***	4.00E-09	0.00
Prone to sickness	2.23 (0.83) **	9.21	0.00
Off-Farm income	-0.32(0.72)	1.38	0.67
Sample size (N) 240,	LRCHI2 = 42.31 p<0.000), $R^2 = 0.39$		

Note; % Classification 81.3%, ***, ** and * Significant at 1%, 5%, and 10%, respectively.
Source: Field survey, 2019

4.5 Coping Strategies

Table 5 presents the distribution of respondents based on coping strategies employed by the household heads to combat economic shocks in the study area. Majority (35.0%) of the respondents mitigated economic hardship by eating less preferred food while only 15% of them skipped meal occasionally. About 31.2% of the respondents resulted to borrowing from cooperatives while 18.8% reduced meal served to members of their families.

Table 5:Distribution of Respondents by Coping Strategies Adopted

Coping strategies	Responses	Percentage (%)
Reduction of food served family members	15	18.8
Borrowing from cooperatives	25	31.2
Skipped meal some times	12	15.0
Eating less preferred meal	28	35.0
Total	80	100.0

Source: Field Survey data, 2019

V.   CONCLUSION AND RECOMMENDATIONS

The study concludes that aging farmers are likely to be vulnerable to food insecurity during economic shock with a mean age 52 years. Majority (77.5%) of the respondents were male households with 62.5% married. It is established that more than half (51.0%) of the household heads were uneducated. Farm size was small typifying the farmers as subsistent farmers and majority (62.5%) of the respondents had less than 2 acres, while 58.8% were food insecure. It was concluded that marital status of the respondent, household size, dependency ratio and proneness to sickness increase the probability of vulnerability of rural households to food insecurity if increases by one unit. On the other hand, the study also concludes that the years of schooling (primary and secondary school levels), cooperative membership and farm size decrease the probability of being vulnerable to food insecurity if increases by one unit. The result also revealed that majority of the respondents eats less preferred food in order to withstand economic shocks. Based on the findings, the study concludes and recommends that policies that are meant to increase educational level, cooperative membership and farm size should be put in place to reduce food insecurity.

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