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Assessing Vulnerability to Food Insecurity and Coping Strategies Adopted by Rice Farming Households in Ekiti State, Nigeria

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Food insecurity remains a development challenge globally, particularly in the developing world. Several studies have been carried out to address the challenge. However, these studies hardly distinguished between food insecurity and vulnerability to food insecurity due to the overlap of the two concepts thus leading to targeting error. Therefore, this study was conducted to examine factors influencing vulnerability to food insecurity and coping strategies adopted by rice farming households in Ekiti state, Nigeria. The study used a well-structured questionnaire to collect data from a sample of 420 rice-farming households in the study area. Descriptive statistics, Feasible Generalized Least Square (FGLS), Tobit regression analyses, and a Likert-type rating scale were used to analyze the data collected for the study. Results showed that there are more male rice farmers than their female counterparts and that engagement in rice production declines as farmers age beyond 60 years. Some of the factors influencing vulnerability to food insecurity include adult equivalence, illness, and Fulani herdsmen challenge. Others include years of formal education, size

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of cultivated land, membership of an agricultural production group, agricultural commercialization, and contact with extension agents. Therefore, for farmers to be protected from vulnerability to food insecurity, the government should resolve the lingering farmer-herder conflict, intensify family planning campaigns, encourage farmers to produce for the market, join production and marketing groups such as cooperatives, and provide farmers with education in form of agricultural extension training.

Keywords: Coping strategy; food insecurity; feasible generalized least square; tobit; vulnerability; Nigeria.

1. INTRODUCTION

Rice is considered an important source of food for more than 3 billion people across the globe as it provides 20% of the global supply of nutritional energy [1] including Nigeria. Rice ranks high among the cash crops boosting a country's economy, serving as a source of employment and income generation as well as contributing to a country's foreign exchange earnings when it is exported [2]. Globally, rice ranks third after wheat and maize in terms of production and consumption and contributes over 20% of the total calorie intake of the human population [3]. Nigeria is the continent's leading rice producer and produces over 46% of West Africa's harvest [3] as well as one of the largest rice importers in the world [4]. Further to this, FAO [4] noted that rice is an important food security crop for human beings as well as an important cash crop for smallholder producers (who often sell about 80% of their total production and consume 20%) as it generates more income for Nigerian farmers than any other cash crops in the country [2].

Against the background of the foregoing, of paramount concern should be examining the food security condition of smallholder farmers who constitute the majority of the world's pool of farmers who operate on farms less than two hectares according to Adeniyi and Dinbabo, (2020) is important. Among smallholder farmers, the incidence of poverty and food insecurity is more markedly pronounced [5] with attendant consequences on their agricultural productivity [6].

As in most developing nations, the incidence of poverty and food insecurity in Nigeria is more of a rural phenomenon (Adeniyi and Dinbabo, 2020). Hence, the focus of most research and policies on food insecurity in rural areas because more than 80% of the global food consumed is produced by low-productive and vulnerable smallholder farmers, living in rural areas characterized by high poverty and food insecurity incidences [7].

Attesting to the claim that food insecurity is more challenging in rural areas, FAO (2023) indicated in its report that 33.3% of adults living in rural areas in 2022 compared with 28.8% in peri-urban areas and 26.0% in urban areas were affected by food insecurity globally. The foregoing report of FAO (2023) presents a paradoxical picture of food insecurity among food producers who are mostly rural dwellers. The paradox can be linked to the cultivation of an area of land smaller than 2 hectares, limited access to markets and services, constrained choices, use of family labour, and vulnerability among others.

On the challenge of food security faced by smallholder farmers in rural areas, literature posits that vulnerability to food insecurity is an important aspect of food security challenge that has not received much attention as ex-post food security challenge in research and policy circles [8]. An understanding of the current state of food insecurity is not enough without considering household's exposure to shocks [9] which in turn culminates in vulnerability. Vulnerability accounts for a household's or individual's exposure to future loss as a result of a shock causing the individual's welfare to fall below a predetermined level while vulnerable households are those having limited opportunities and facing difficulties after exposure to shocks [10,11].

An underlying factor responsible for the susceptibility of rural households to vulnerability is their dependence on agriculture which is characterized by risks and uncertainty and manifests as shock for livelihood. Households may experience unfavorable weather conditions, delayed onset of rain, pests and diseases incidence, price instability, conflict, terrorism, loss of a member of the household, and accident among others which affect income adversely and invariably welfare [12]. Most time, households who are vulnerable to food insecurity as a result of exposure to risks/shocks usually lack buffers [10], thereby adopting different types of coping mechanisms including borrowing, reduction of food intake, distress sale of assets, and

withdrawing children from school [13]. Therefore, making such households less prone to shocks is important in food insecurity alleviation programmes design and implementation [10].

Various efforts in the forms of programmes and projects have been launched to achieve item number two on the SDGs list. For instance, towards a zero hunger Nigeria, programmes such as Agricultural Transformation Agenda (ATA), Growth Enhancement Support Scheme (GESS), The Nigerian Incentive-based Risk-sharing System for Agricultural Lending (NIRSAL), National Strategic Plan of Action for Nutrition (NPAN), Agricultural Promotion Policy (APP), Zero Hunger Initiative (ZHI), National Policy on Food and Nutrition (NPFN) were launched by successive Nigerian government [14,15]. Even with these programmes in place, food insecurity remains an issue of serious concern in Nigeria as it is in most Sub-Saharan African countries (FAO,2019) as the world approaches the year 2030 deadline when hunger is expected to have been eradicated. This challenge may necessitate examining the dynamism of the food security challenge (Tibebu & Sisay, 2017) because people move out of and into food insecurity over the future (Thabane, 2015). By doing so, households who are currently food insecure but tend to be food secure shortly or households who are currently food secure but are susceptible to food insecurity shortly can be identified to design and implement food security policies [16,9] devoid of targeting error.

Although, studies [17,18,16,9,19], (Tibebu & Sisay 2017, Thabane, 2015) have been carried out on vulnerability to food insecurity, however, none of the studies examined the vulnerability of rice farming households. Therefore, this study examined rice farming households' vulnerability to food insecurity in Ekiti-state, Nigeria.

2. METHODOLOGY

2.1 Area of the Study

The research was conducted in Ekiti State, Nigeria, located in the South-West region of the country, situated between longitudes 7°45′ and 5°45′ East of Greenwich and latitudes 7°45′ and 8°05′ North of the equator. It shares borders with Kwara and Kogi States to the north, Osun State to the west, Edo State to the east, and Ondo State to the south. Ekiti State comprises sixteen Local Government Areas and experiences a tropical climate characterized by two distinct seasons: the rainy season (April – October) and the dry season (November – March). Temperatures typically range between 21°C and 28°C, with elevated humidity levels. The landscape varies, with tropical forests in the south and guinea savannah in the north. Notable rivers in the state include Ero, Osun, Ose, and Ogbese. The population primarily engages in agriculture, with major crops including yam, maize, cassava, cocoyam, and rice, alongside tree crops such as cocoa, kolanut, and oil palm. Livestock farming, focusing on sheep, goats, pigs, and poultry, is also significant. Ekiti State's inhabitants are predominantly rural, facing poverty due to limited income from agricultural and non-agricultural endeavors. Agriculture serves as the backbone of the economy, employing over 75% of the population. Women play crucial roles in food processing, trading, and farming activities. The favorable climate supports the cultivation of various crops, including maize, yam, cassava, millet, rice, plantains, cocoa, palm produce, and cashews.

2.2 Data Collection

Primary data collection involved field surveys employing structured questionnaires and oral interviews to gather information on various aspects such as household food consumption, socio-economic attributes, physical and financial resources, membership in social networks, exposure to shocks, and participation in agricultural commercialization. To assess household food insecurity dynamics, two main approaches were employed.

2.3 Sampling Techniques

The research utilized cross-sectional data collected from rice farmers, who constituted the focal group within the study region. The sampling methodology employed a multi-stage approach to identify respondents. Initially, rice-producing communities across Ekiti state were purposively selected. Subsequently, twenty-three communities were chosen randomly to ensure representation across the three Agricultural Development Projects (ADPs) zones, each situated within a senatorial district. In the third stage, a total of four hundred forty-six rice farmers were selected from the compiled list obtained from the ADPs office at the state headquarters. The selection was based on probability proportionate to size. However, among the 446 questionnaires distributed, 420

were adequately completed. The determination of the sample size followed the method outlined by Yamene [20].

n=N/(1+N(e^2)) (1)

The population size (N) was determined to be 1556, with a desired precision level set at 4%. The sample size was then calculated accordingly. The factor utilized to ensure proportional representation in sample selection is as follows:

x_i=n/N*No of registered rice farmers in the ith community (2)

Where, x_i = sample selected from the ith community, n = total sample estimate obtained from Yamene's [20] formula, and N population of registered rice farmers in the study area. The sampling procedure is shown in table one.

2.4 Analytical Techniques

Determination of Household Food Insecurity Status: Calorie consumption food security measure: The study critiques existing methodologies for measuring food security/insecurity, such as HFIAS, HFIAP, HDDS, MAHFP, and CSI, citing variations in results and the inability to capture food quantity consumed. Instead, the study opts for a calorie consumption measure, considering it a better reflection of actual food intake.

Data collection involved recording food quantities consumed by households over seven days and converting these quantities to grams. Calorie estimates were then obtained per household using nutrient composition tables for commonly consumed foods in Nigeria [21,22]. The total calorie values for all food items consumed during the seven days were summed up and expressed in terms of kilocalories per day.

The aggregate calorie consumption was adjusted to adult equivalence using conversion factors. Household food security status was determined by comparing the adult equivalent calorie consumption per day with the minimum recommended daily intake of 2850 kilocalories per adult equivalent, as specified by FAO-WHO-UNU [23] for a moderately active adult. Households meeting or exceeding this threshold were considered food secure, while those consuming less were deemed food insecure. Despite previous studies using different benchmarks, the study chose 2850 kcalories per adult equivalent per day due to the labour-intensive nature of rice-growing activities.

Determination of Vulnerability to Food Insecurity Using Value at Risk (VaR) Analysis: VaR analysis was utilized to assess the probability of households facing food insecurity. This methodology evaluates the likelihood of a risky event leading to outcomes falling below a critical threshold, based on the statistical distribution of potential outcomes. Following Adegoroye et al. (2021) and Ogunyemi et al. [24], the study employed the Feasible Generalized Least Squares (FGLS) analytical technique to determine VaR.

In this framework, the food security indicator (C) summarizes a household's food security status. Household vulnerability to food insecurity is defined by the expected welfare loss associated with inadequate food security indicator values, considering various household characteristics, strategies, public risk management policies, and external factors like community-wide shocks.

The econometric formulation of vulnerability considers household kilocalorie intake (C_h) and a vector of variables (X_h) such as household size and location. Each family's calorie consumption is expressed as:

$$C_h = X_h'\beta - \beta_1 x_{h1} + \cdots + \beta_2 x_{h2} + \cdots + \beta_3 x_{h3} \quad (3)$$

In each case, β represents a vector of constant parameters. To estimate the multivariate equation and provide estimates of the parameters that account for both the residual component and calorie consumption, one must first do the 3 FGLS process.

U = $[U_1, U_2, \ldots, U_n]$:
C = Xβ + u (4)

The study examines the heteroskedastic and correlated residuals from (4) using a set of parameters γ. It computes the following equation.

U = X γ + ε (5)

Where ε is the residual vector from the second estimation, revealing all the necessary residual features that u lacks. Use the deterministic section of equation (5) to get a consistent estimate of the household variation in food consumption, and then repeat the adjustment for heteroskedasticity. The variance is used to

determine the risk of food insecurity for each family. The study evaluates the risk that a household would face food insecurity in the next period given X, or vulnerability estimations, and assumes log normality of the calorie consumption distribution. The estimations are as follows:

$$V_h = pr(lnch < \ln(Z\backslash X) = \theta\left[\frac{lnZ}{\sqrt{varln(Ci\backslash x)}} - \frac{E(ln\ Ci\backslash x)}{\sqrt{varln(Ci\backslash x)}}\right] = \theta\left[\frac{lnZ - \alpha X}{\sqrt{\dot{\eta}Xi}}\right] \quad (6)$$

In this equation, ln represents the natural logarithm of household kilocalorie consumption, θ represents the standard normal cumulative distribution, ά and ή are parameter estimates, and X is a vector of variables. The computations produce a series of estimates (one for each home h) of the chance that each household will go below the minimal energy need in the future. The resultant estimate, V_h, was compared to a vulnerability threshold of 0.5. A household is susceptible if its V_h value exceeds 0.5; otherwise, it is not vulnerable. The vulnerability threshold of 0.5 is arbitrary (Chaudhuri et al, 2002), although this analysis used the 0.5 set by Azam and Imai (2012). A household requires at least 2850kcal per day per AE to be food secure. According to Chaudhuri et al. (2003), a household's vulnerability to food insecurity is defined as the likelihood that the house hold would fail to meet the minimal level of calorie consumption in the future.

Tobit Regression Model: Following Awotide et al [25] and Mshuha and Kissoly [26], the study used the Tobit model to examine factors influencing the vulnerability of rice farming households to food insecurity. The Tobit model, a mix of the discrete and continuous dependent variables developed by Tobin [27], depicts the relationship between a non-negative exogenous variable y^i and an independent variable (or vector of X^i. The Tobit model uses a latent unobservable y_i^* that has a linear dependence on x^i via a parameter vector β. A normally distributed error term U^ireflect random effect of this connection. If the latent variable is greater than zero, the observed variable y^i is equal to it; otherwise, it is equal to

$$\text{zero}.y_i \begin{cases} y_i^* if\ y_i^* > 0 \\ 0 if y_i^* \le 0 \end{cases} \quad (7)$$

where: y_i^* is a latent variable which is equal to $y_i^* = \beta x_i + u_i$ u_iN(0, σ^2)

Following Chebil et al. [28], the likelihood function of the model (2) is given by L and it is presented as follows:

$$L = \prod_0 F(y_{0i}) \prod_1 f_i(y_i)$$
$$L = \prod_0 [1 - F\left(\frac{x_i\beta}{\sigma}\right)] \prod_1 \sigma^{-1} f[\frac{y_i - x_i\beta}{\sigma}] \quad (8)$$

where f, and F are the standard normal density and cumulative distribution functions, respectively. A log-likelihood function can be written as follows:

$$logL = \sum_0 \log(1 - F(x_i\beta/\sigma) + \sum_i \log\left(\frac{1}{(2\prod\sigma^2)^{\frac{1}{2}}}\right) - \sum_1 \frac{1}{2a^2}(y_i - \beta x_i)^2 \quad (9)$$

The β and σ parameters are estimated by maximization of log-likelihood function

$$\begin{cases} \frac{\partial LogL}{\partial \beta} = -\sum_0 \frac{x_i f(x_i\beta/\sigma)}{1 - F(x_i\beta/\sigma)} + \frac{1}{\sigma^2}\sum_1 (y_i - \beta x_i)x_i = 0 \\ \frac{\partial LogL}{\partial \beta} = \frac{1}{2\sigma^2}\sum_0 \frac{\beta x_i f(x_i\beta/\sigma)}{1 - F(x_i\beta/\sigma)} - \frac{n_i}{2\sigma^2} + \frac{1}{2\sigma^4}\sum_1 (y_i - \beta x_i)^2 = 0 \end{cases}$$

The Tobit model is presented below:

$$Y_i = \beta_0 + \beta_1 GENDER + \beta_2 AGE + \beta_3 HSIZE + \beta_4 FARMSYS + \beta_5 MSTAT + \beta_6 CUTLAND + \beta_7 EDU + \beta_8 MEMAGP + \beta_9 AGRICOM + \beta_{10} EXCONT + \beta_{11} ILL + \beta_{12} CRPLOSS + \beta_{13} FULANI + \beta_{14} CTRANSF + \beta_{15} SAVIN + v_i \quad (10)$$

Definition of variables and measurement
Dependent variable

Y = Household vulnerability index
Independent variables
$X1$ = Gender $of\ the\ Household\ head$ (1=male; 0=otherwise)
$X2$ = $Age\ of\ the\ Household\ head$ (Years)
$X3$ = Household size (Number)
$X4$ = Farming system (Upland = 1, 0 otherwise)
$X5$ = $Marital\ status$ (Unmarried =1, 0 otherwise)
$X6$ = Size of cultivated $land$ (Hectares)
$X7$ = Years of formal education (Years)
$X8$ = $membership\ of\ agricultural\ production\ group$ (No = 1; 0=otherwise)
$X9$ = $Agricultural\ commercialization\ status$ (Non-participant =1, 0 otherwise)
$X10$ = $Contact\ with\ extension\ agent$ (No = 1; 0 $otherwise$)
$X11$ = $Incidence\ of\ illness$ (Yes =1; 0 otherwise)
$X12$ = $Incidence\ of\ crop\ loss$ (Yes =1; 0 otherwise)
$X13$ = $Fulani\ herdsmen\ challenge$ (Yes=1; 0 otherwise)

$X14$ = Cash transfer (Naira)
$X15$ = $Savings$ (Naira)

Likert-type Rating Scale: The coping strategies adopted by rice farming households were determined by employing a 5-point Likert-type rating scale. Responses of the household heads to the coping strategy questions [29] were awarded points based on the frequency of adoption of a particular coping strategy. The points awarded to the frequency of adoption of each coping strategy range from 1-5 for "Never", "1 day/week", "1-2 days/week", "3-6 days/week" and "daily" respectively [29]. The mean response was calculated and used to rank the coping strategies adopted by households.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Rice Farmers

Table 1 shows the distribution of rice farmers by socio-economic characteristics. The results show that the majority (86.7%) of the rice farmers are within 60 years and the average age of the farmers is 47.2 years. This implies that the farmers are in their active and economically productive age. The reason for this could be that rice cultivation is labour-intensive. The results shared a similar view with the studies of Kehinde et al. [30] and Wudil et al. [31] in their respective study areas. Similarly, the results show that men are about two-thirds (68.1%) of the rice farmers. This implies that there are more male rice farmers than female rice farmers. This may be due to the physical strength required by rice cultivation as well as better access of men to productive resources. The results further show that more than half (58.1%) of the rice farmers are married. This implies that the couple would complement each other in providing inputs for the rice farming activities. Further findings from the study show that only 2.9% of the rice farmers have no formal education while the rest possess varying levels of formal education. This suggests that they would leverage being educated to access rice production and marketing incentives that will make the rice production enterprise pay off. The results agree with:

Table 1. Socio-economic characteristics of the respondents

Age	**Frequency**	**Percentage**
≤ 30	42	10
31- 40	74	17.6
41-50	133	31.7
51-60	115	27.4
>60	56	13.3
Total	420	100.00
Mean	47.2	
Sex		
Male	286	68.1
Female	134	31.9
Total	420	100
Marital status		
Single	17	4.0
Married	244	58.1
Divorced	72	17.1
Widowed	49	11.7
Separated	38	9.1
Total	420	100.00
Edu		
No formal	12	2.9
Up to primary (1-6)	96	22.9
Up to secondary (7-12)	212	50.6
Beyond secondary(>12)	99	23.6
Total	420	100.00

Source: Author's compilation

Table 2. Distribution of rice farmers by food security and vulnerability status

Variable	Frequency	Percentage
Food security status		
Food secure (1st round)	272	64.8
Food insecure (1st round)	148	35.2
Food secure (2nd round)	237	56.4
Food insecure (2nd round)	183	43.6
Vulnerability to food insecurity status		
Vulnerable	212	50.5
Not-vulnerable	208	49.5

Source: Authors' computation

3.2 Food Security and Vulnerability Status of the Rice Farmers

Table 2 shows the distribution of rice farmers by food security and vulnerability status. The results show that more than one-third of the rice farming households were food insecure during the first round of the survey. However, in the second round of the survey, food insecurity declined by 12.8 points compared with a difference of 29.6 points recorded during the first round of the survey. The improvement in food security over the period of the survey could be linked to the seasonality effect. Table 2 further shows that nearly half of the rice farming households are vulnerable to food insecurity. This suggests that there is a need for rice farming households to be protected against agents of vulnerability.

3.3 Factors Influencing Rice Farming Households' Vulnerability to Food Insecurity

The results of the model of vulnerability to food insecurity estimated using Tobit regression are reported in Table 3. In general, the model performs well. The goodness of fit measure, R2, is 0.73 which is sufficiently high for the model using cross-sectional data. Also, Prob>Chi2 is significant at 1%.

The results showed the following relationship for each of the explanatory variables and vulnerability. Sex significantly and negatively influenced respondents' vulnerability to food insecurity at a 1% level of significance. This implies that households headed by females were more vulnerable to food insecurity than male-headed households. This result may be because female-headed households generally have less access to productive resources which are usually crucial to income-generating enterprises (like rice farming) that can enable them to purchase food. The result is in line with Ojo, Amos, Balogun, and Oluwatayo (2023), who found that male-headed households are less food insecure than female-headed households. The age of the household head is significant at 1% and it is positively related to vulnerability. This implies that the likelihood of a household becoming vulnerable to food insecurity increases with the age of the household's head. This could be because as the household's head gets older (aged), he/she becomes less economically active which in turn affects his/her productivity and consequently increases his/her vulnerability to food insecurity A 10% increase in age of the household's head would lead to 0.03% increase in vulnerability to food insecurity. Ojo et al., [17] reported similar findings that households headed by older persons are more vulnerable to food insecurity.

In line with *apriori* expectation, adult equivalence size has a positive and significant effect at a 1% level of significance on the probability of being vulnerable to food insecurity. This implies that large-size adult equivalent households were likely to be more vulnerable because large-size households mean many mouths to share the available food. Therefore, such households tend to be under pressure to replenish their fast-exhausting stock of food which may pose a challenge. A 10% increase in respondents' adult equivalence would lead to a 0.17% increase in vulnerability to food insecurity. Similarly, Ogunyemi, Olutumise, and Adegoroye [24] also found that households having large members are more susceptible to vulnerability to food insecurity than small-sized households because per capita food intake decreases as household size increases. Marital status is significant and has a negative relationship with vulnerability. This implies that married households were less likely to be vulnerable to food insecurity. The reason is that married households can pool resources together / complement efforts of each other to ensure that the household's food

requirement is satisfied. From experience, most time, husband and wife are not likely to experience an incidence of shock at the same time, therefore, provided that they are both engaged in income-generating activities, if one experiences shock the other will provide the food needs of the household. The finding is in agreement with Ojo, Akin-Olagunju, Yusuf, and Yusuf [17] who found that spouses whose union is still intact are less likely to be vulnerable to food insecurity because of the advantage they have to pull resources together towards purchasing food for the household. The size of cultivated farmland is significant and has a negative relationship with vulnerability. This implies that the larger the size of land cultivated, the less the probability of being vulnerable to food insecurity. The result is in agreement with Sileshi et al. [16] who found that the size of cultivated farmland decreases vulnerability by increasing household's future food consumption. The number of years spent in school to acquire an education is significant and has a negative relationship with vulnerability. This indicates that educated heads of households are less likely to be vulnerable to food insecurity. This may be attributed to better awareness of educated heads of households to improved farm technologies, market information/intelligence, and other livelihood opportunities than the uneducated heads of households. This shows that human capital is an important factor in reducing vulnerability to food insecurity. A 10% increase in respondents' number of years spent in school would lead to a 0.04 decrease in vulnerability to food insecurity. The result supports Ojo [32] and Bello et al. [33] who found that households headed by educated people are less vulnerable to food insecurity. Membership of the association is significant and has a negative relationship with vulnerability. This indicates that heads of households that are members of associations (rice producers, rice farmers cooperatives) are less likely to be vulnerable. This may be because being members of an association can enable them to exploit several opportunities therefrom. Firstly, through association, members become aware of important information (usually first-hand) relating to improved technology, farm inputs availability, more profitable market outlets, and insurance windows among others. Secondly, heads of households that belong to an association can enjoy economies of scale to the extent that they produce and sell at competitive prices. This will reduce their costs of production, increase the level of output and income, and ultimately lead to positive welfare outcomes (reduced vulnerability) for such households. The result conforms with Okonkwo et al. [34] who found that membership in an organization reduced farm households' probability of being vulnerable to food insecurity. Agricultural commercialization is significant and has a negative relationship with vulnerability. This indicates that households that are commercialized are less likely to be vulnerable to food insecurity. This may be because commercialized households generated large quantities of marketable surplus in addition to home consumable food. Literature posits that smallholder farmers are net food buyers as such they need to buy food that they do not produce to escape vulnerability to food insecurity. Households that commercialize can allocate income realized from their marketable surplus in many ways that have implications for vulnerability to food insecurity. Commercialized households may use their income to buy food not produced by them. They may save such income or spend it on purchasing assets. Allocating income to savings or the purchase of assets has important implications for households' insurance against vulnerability. Again, households that commercialize can engage in a contract / outgrower scheme with a potential buyer. This arrangement can enable them to get advance payment/credit, part of which respondents can use to smoothen consumption before harvest is due. The result is consistent with Ojo et al. [35] who found that farmers who commercialized were less vulnerable to food insecurity than their counterparts who did not commercialize. Extension contact is significant and has a negative relationship with vulnerability. This shows that heads of households that have contact with agricultural extension workers are less likely to be vulnerable to food insecurity. This may be explained in terms of a wide range of opportunities that have important welfare outcomes (reduced vulnerability) inherent in having contact with extension agents. These opportunities include a better attitude to farming, improved farming technology skills and knowledge acquisition, market linkages, farm inputs availability awareness, climate change adaptation strategies, etc. Therefore, heads of households that have contact with agricultural extension workers tend to be less vulnerable because they are equipped with the skills and knowledge required to prevent, mitigate, or cope with the occurrence of shock that can make them vulnerable to food insecurity. The result aligns with Cheber, Beyene, Haji, and Lemma [36] who found that having access to extension services

decreases the risk of vulnerability to food insecurity because extension services broaden the knowledge and skill of households concerning the use of improved agricultural practice and technology. Illness has a significant and positive relationship with vulnerability to food insecurity at a 1% level of significance. This implies that households having one or more members of them who are sick are likely to be more vulnerable. The result conforms to Mthethwa and Wale (2020) reported similar results that households having sick members are highly vulnerable to food insecurity because they expend their productive and economic resources on paying medical bills rather than spending them on income-generating activities and obtaining access to food. Fulani herdsmen challenge has a significant and positive relationship with vulnerability. This implies that households that experienced Fulani herdsmen challenge are more likely to be vulnerable to food insecurity. This could be attributed to either fear of insecurity or loss of crops by such households. Households faced with Fulani herdsmen challenge are skeptical about going to farm because of being attacked/kidnapped by Fulani herdsmen. Even when they go to the farm, they do not concentrate on their farm work because of divided attention. They want to complete farm work/activities earmarked for the day while being on red alert to escape in case the Fulani herdsmen appear on their farm. In contemporary Nigeria, farm families see the appearance of the Fulani herdsmen on farms as a danger signal or serious security threat. This situation has been adversely affecting farmers' output, their income, and food prices and invariably vulnerability to food insecurity. There have been several reports of attack/ killing of farmers and destruction of their crops by the Fulani herdsmen and their cattle. The result agrees with Olanrewaju and Balana [37] who found that trauma that resulted from conflict such as Fulani herdsmen-farmers' conflict increases the probability of a household running out of food implying being vulnerable to food insecurity. Cash transfer is significant and has a negative relationship with vulnerability. This indicates that households that receive cash transfers are less likely to be vulnerable. This may be because the cash received may be spent on purchasing food to increase households' stock of food. A 10% increase in cash transfers received by a household would lead to a 3.86e-06 decrease in vulnerability to food insecurity. Bhalla et al. [38] earlier reported similar results after they found that households who received cash transfers were less vulnerable to food insecurity.

Table 3. Factors influencing rice farmers' vulnerability to food insecurity in the study area

Variable	Coefficient	Std. Error	Marginal Effect
Sex	-0.0030	0.004	-0.034
Age	-0.003***	1.68e-05	-0.003***
Adult Equivalence	0.0020***	7.12e-04	0.017 ***
Rice Farming system	0.00139	0.004	0.147
Marital Status	-0.0346***	0.004	-0.349 ***
Cultivated farm Land	-0.192***	0.002	0.198 ***
Years of Formal Education	-0.006***	4.97e-04	-0.004 ***
Membership of Agricultural Production Group	-0.0230***	0.005	-0.234 ***
Agricultural Commercialisation Status	-0.0327***	0.004	-0.326 ***
Contact with Extension Agent	-0.204***	0.006	-0.207 ***
Incidence of Illness	0.0092***	0.004	0.089 ***
Incidence of Crop loss	0.00302	0.004	0.299
Fulani Herdsmen Challenge	0.0288***	0.003	0.027 ***
Cash transfer	-5.15e-07*	2.96e-07	-3.86e-07 *
Savings	-2.04e-07	3.38e-08	-1.44e-07
Constant	0.261***	0.013	
Number of Observations	420		
Log likelihood	-851.975		
Prob > $\mathbf{chi^2}$	0.0000***		
$\mathbf{Pseudo\ R^2}$	0.727		

Source: Author's compilation

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

Table 4. Coping strategies adopted against food inadequacy in the study area

Coping Strategies	Never	<1day/wk	1-2days/ wk	3-6 days/ wk	Daily	Mean
Limit portion size at meal times	13(3.1)	25(5.9)	46(10.9)	101(24.0)	235(55.9)	4.2
Reduce number of meals/day	76(18.1)	38(9.0)	50(11.9)	80(19.0)	176(41.9)	3.6
Borrow food or rely on others	244(58.1)	63(15.1)	50(11.9)	13(3.1)	50(11.9)	2.0
Consume less expensive/preferred foods	109(25.9)	50(11.9)	17(4.0)	29(6.9)	256(60.9)	3.9
Buy food on credit	176(41.9)	25(5.9)	34(8.1)	25(5.9)	160(38.1)	2.9
Collect willd food	302(71.9)	76(18.1)	13(3.1)	8(1.9)	21(5)	1.5
Send household members to eat elsewhere	315(75)	21(5)	17(4.0)	8(1.9)	59(14)	1.8
Reduce adult consmption	218(51.9)	21(5)	29(6.9)	38(9.0)	113(26.9)	2.5
Rely on casual labour for food	168(40)	71(16.9)	38(9.0)	25(5.9)	118(28.1)	2.7

Source: Author's compilation

3.4 Coping Strategies Adopted by Rice Farmers Against Vulnerability to Food Insecurity

Table 4 presents the coping strategies adopted by rice farmers against vulnerability to food insecurity. The results show that "Limit portion size at meal times" ranked highest among the coping strategies they adopted. Next in rank is "Consume less expensive/preferred foods, followed by "Reduce the number of meals/day, and then "Buy food on credit"' Furthermore, rice farmers adopted "Rely on casual labour for food" and "Reduce adult consumption" as the fifth and sixth coping strategies against vulnerability to food insecurity respectively. Bekele and Abdissa [39] previously reported similar findings [40-44].

4. CONCLUSION

Following scanty literature on the vulnerability and coping strategies adopted by rice farming households in the study area, the study adds to the existing knowledge by investigating factors influencing vulnerability to food insecurity among rice farming households in Ekiti state, Nigeria, and the coping strategies they adopted. The study used cross-sectional data collected from 420 rice-farming households. The descriptive statistics show that rice cultivation is a labour-intensive and male-dominated enterprise practiced mostly by married people who have acquired varying levels of education. Furthermore, the probit results show that being young, married, cultivating a large farm, being educated, being a member of the agricultural group, engaging in agricultural commercialization, having contact with agricultural extension agents, and receiving cash transfers reduce vulnerability to food insecurity. Conversely, large adult equivalent, illness and being a victim of Fulani herdsmen attack promotes vulnerability to food insecurity. Also, farmers adopted several coping strategies to move on with the challenge of vulnerability to food insecurity. From the foregoing results, there is a need for the government to review the existing land policy to enable rice farmers to have access to as much land as they wish to cultivate. Not only that, the government should invest in farmer education through improved agricultural extension services, and encourage farmers to join groups engaged in market-oriented production through group credit delivery and access to modern technology and infrastructure respectively. Furthermore, prioritization of cash transfer to farmers, intensification of family planning campaigns, and resolution of farmer-herder conflict by legislating that cattle owners should own cattle ranchs. The government should prioritize resolving the ongoing farmer-herder conflicts, which significantly affect farmers' productivity and food security. Ensuring safety and security for farmers will encourage them to focus on their agricultural activities without fear of attacks or crop destruction. Therefore, future research should focus on longitudinal studies to track changes in household vulnerability over time. This can help in understanding the long-term effects of various interventions and the dynamic nature of food insecurity.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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