Turkish Journal of Agriculture - Food Science and Technology

The extent of Vulnerability to Food Insecurity and Household Coping Strategies: Case of Yam Farmers in Ekiti State, Nigeria

Ayoola Ibukun Ogunyemi[1,a], Adewale Isaac Olutumise[2,b,*], Ademola Adegoroye[3,c]

[1]Provost Office, College of Health Sciences, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria
[2]Department of Agricultural Economics, Adekunle Ajasin University, P.M.B 001, Akungba-Akoko, Ondo State, Nigeria
[3]Department of Environmental Resource Management, Brandenburg Technical University, Cottbus-Senftenberg, Germany
[*]Corresponding author

A R T I C L E I N F O	A B S T R A C T
	The study analysed the extent of vulnerability to food insecurity and household coping mechanisms among yam farmers in Ekiti State, Nigeria. Cross-sectional data were used for this study with the aid of a well-designed questionnaire. A multistage sampling procedure was used to select 360 respondents. Multinomial logit (MNL) model and Feasible Generalized Least Square (FGLS) method were employed for the data analysis. The results of the FGLS model showed that 49.3% of the households were food secure and experienced low vulnerability to food insecurity. However, 30.23% of them were food insecure and highly vulnerable; they are considered as chronically food-insecure households. Also, the study revealed that 11.01% of the food secure households may be food insecure in the future if necessary attention and intervention are not given by both households and the government. Again, 9.4% of the households that were experiencing food shortage, as at the time of the study, may recover in the future. The findings of MNL revealed that the age of the household head, main occupation, household size, land size, net household income, and membership in a cooperative society were the main significant factors in yam farming households' decision to use coping strategies. As a result, it is recommended that leveraging the potential role of coping mechanisms already used by households during food shortages, and building a comprehensive human capital development, such as education, will be vital policy options to reduce food insecurity.

[a] ayoolaogunyemi@gmail.com   https://orcid.org/0000-0002-3647-1598   [b] adewale.olutumise@aaua.edu.ng   https://orcid.org/0000-0003-4600-9265
[c] demoo4u31@gmail.com   https://orcid.org/0000-0003-0549-6773

Introduction

Food is critical for human well-being and productivity (Ajayi and Olutumise, 2017). It is an indispensable prerequisite for the survival of mankind and its economic activities. The attainment of food security has been a major challenge, especially in developing countries, and it has been placed as a priority in achieving the most fundamental human rights. Given its significance as a critical factor in economic development, food security has been viewed as a major feature in the recognition of a nation's wealth sustainability (Omotesho and Muhammad-Lawal, 2010; Stellah et al., 2020). Food security is characterized as a situation in which all people have access to enough, secure, and nutritious food at all times to meet their food requirements to live an active and healthy life (FAO, 2009). When food security is attained, the ideal environment for a more productive populace will thrive and people will be patriotic and contented (Amaza, 2018).

Contrary to popular belief, farming households are the most vulnerable to food insecurity and poverty in Africa, especially smallholder farming households (Ogunniyi et al., 2021). People's propensity to fall or remain below a pre-determined food security line is referred to as vulnerability. The food security line could be caloric-based (i.e., food requirement) or it could include all basic needs (Zeller, 2012). Therefore, the accumulation of events over time determines vulnerability. The likelihood of households being food insecure in the future is determined by their current socioeconomic circumstances, risk factors prevalent during the given timeframe, or other relevant issues, and their ability to handle the risks (Babatunde et al., 2008). However, the response to these adverse events or shocks is known as coping strategies. Food-coping strategies are the mechanisms used by households when meeting their needs are interrupted by one or a combination

of factors such as drought, low wages, or high food prices (Ninno et al., 2003). The range of coping and adaptive strategies differs according to the particular conditions. Household coping strategies form a continuum ranging from risk minimization to risk absorption, and ultimately, risk-taking. Asset accumulation, investing, and income diversification are also part of risk management. Risk absorption necessitates the use of savings and current food supplies (Jinhong et al., 2016). The final stage is risk-taking, which entails households taking desperate measures such as breaking up families by relocation, consuming survival or famine foods, and selling personal belongings (Van der Veen and Tagel, 2011; Myslym et al., 2020). The issue of hunger and food insecurity has global dimensions and is likely to continue, and even worsen, in the future unless immediate, decisive, and coordinated action is taken to address the situation (FAO, IFAD, UNICEF, WFP and WHO, 2021). In 2010-2012, there were still 820.7 million undernourished people worldwide; 805 million in developing countries, and 15.7 million in developed countries (FAO, 2015). However, in terms of the regions, Africa and sub-Saharan Africa have 218.5 million and 205.7 million undernourished people, respectively (FAO, 2015). Nigeria has an energy intake of 1730Kcal and an average protein supply of 64g per capita per day, which is far below the minimum recommended daily intake of 2500 – 3400Kcal (FAO, IFAD and WFP, 2013). This demonstrates that Nigeria is dealing with the problem of an unbalanced diet, which causes a variety of deficiency symptoms.

Also, a significant number of studies have been carried out on food insecurity in Africa, especially in Nigeria, using diverse approaches and food-related variables. Most studies have linked food insecurity with farmers' efficiency, productivity, poverty and other welfare indicators (Babatunde and Qaim, 2010; Devereux and Maxwell, 2011; Asogwu and Umeh, 2012; Egwuda, 2014; Ajayi and Olutumise, 2017; Osabohien et al., 2018; Omotayo et al., 2018; Fanny et al., 2021). It was also unveiled from the literature that recent studies focused on vulnerability to food insecurity. The studies of Betts et al. (2018), Yoade et al. (2018), Sileshi et al. (2019), Braun (2020), Pakravan-Charvadeh et al. (2021) examined vulnerability to food insecurity either as a whole or in relation to other variables but none of the studies captured the dynamics of food insecurity among households. The study is unique in the sense that it does not only measure the extent of vulnerability but predicts the future transitory in between food secure and food-insecure households. This kind of research is very scarce in the literature, most especially in Nigeria, and particularly, among the yam-based households in the area.

Therefore, the policy relevance of this study, unlike other studies in the literature, is an eye-opener to the transitory future of food insecurity and the existing coping mechanisms to opt-out of food insecurity. The factors influencing the preference of coping strategies will assist in policy formulation that would address the dynamics in future food insecurity both in Nigeria and other developing countries. Other rationales for this study are that efforts to ensure food security can be viewed as an investment in human resources that will result in a more productive society. Also, an understanding of the situation of food security at the household level and how people cope with food insecurity by adopting different mechanisms is very important. Such understanding allows policymakers to better plan and take actions that address specific problems in society. This study thus analysed vulnerability to food insecurity and household's coping strategies adopted by yam farmers in Ekiti State, Nigeria**.** It specifically examined the extent of vulnerability to food insecurity among yam farming households and investigated the factors influencing the choice of coping strategies employed by yam farmers.

Materials and Methods

The research was carried out among yam farming households in Ekiti State, Nigeria. Yam is the most important staple food in Ekiti State. It is their primary source of income and food security. The state's climate is suitable for the agrarian activities of its large population, which grows crops such as cocoa, oil palm, and arable crops such as yam, maize, and cassava. Data were gathered from primary sources using a well-structured questionnaire and an interview schedule. For this analysis, a multistage sampling technique was used. The first stage involved the purposive sampling of two (2) Local Government Areas in each of the state's three (3) Agricultural Development Project (ADP) zones based on their agrarian nature and high yam tuber production, especially by migrant farmers. The second stage involved choosing four (4) communities from each of the Local Government Areas using a simple random sampling technique. In the third stage, fifteen (15) yam farming households from each of these communities were selected at random. The total sample size was 360 yam farmers. The number of copies of questionnaire retrieved and valid for the analysis was 320.

Data Analysis and Analytical Tools

Data collected were analysed using the Feasible Generalized Least Square method (FGLS) and multinomial logit model (MNL).

Feasible Generalized Least Square method (FGLS): Vulnerability to food insecurity was calculated using a three-step process following Capaldo et al. (2010). Let C_h indicate kilocalorie consumption of an individual household, h and X_h be vectors of observable household characteristics such as household size, location, educational attainment of the household head, etc. that serve as explanatory variables of per capita kilocalorie consumption. Thus, the household's calorie consumption for an individual can be mathematically expressed as follows:

$$C_h = X_h\beta = \beta_i x_{h1} + ... + \beta_2 x_{h2} + ... + \beta_i x_{h1} \quad (1)$$

Where β is a vector of parameters for the households, and when we consider all households in a single multivariate equation, we get:

$$C = X\beta = \begin{cases} \beta_i x_{11} + ... + \beta_2 x_{12} + ... + \beta_j x_{hj} \\ \beta_i x_{h1} + ... + \beta_2 x_{h2} + ... + \beta_i x_{h1} \\ \beta_i x_{H1} + ... + \beta_2 x_{H2} + ... + \beta_i x_{H1} \end{cases} (2)$$

Where $C = [c_1 \ldots c_h \ldots c_H]$ and $X = [X \ldots X_h \ldots X_H]$

The first step in the three-step generalized least squares (GLS) method is to estimate the multivariate equation and obtain the estimated $\hat{\beta}$ of the parameters that describe calorie consumption. Also, the residual component was computed from equation (3) below.

$$u = [u_1 \ldots u_h \ldots u_H]$$
$$C = [\![X\hat{\beta} + u]\!] \tag{3}$$

As a second step, we assess their dependence on the same explanatory variables (*Xs*) through a set of parameters, $\hat{\beta}$ as presented in equation (4):

$$u = X\hat{\beta} + \varepsilon \tag{4}$$

Where ε is the residuals of equation (3), depicting residuals' properties that *u* does not have. Looking at the deterministic part of the equation (4) after heteroskedasticity has been corrected for, one can derive a consistent estimate of the household variance of food consumption $\hat{\sigma}_u^2$

In the last step, $\hat{\sigma}_u^2$ is used to compute each household's vulnerability to food insecurity. Assuming that vulnerability distributes normally, each household's probability of food insecurity is given by a determination in equation (5) as:

$$v_h \sim N(E(u_h), \hat{\sigma}_u^2) \tag{5}$$

In this context for a given household *h*, the vulnerability is defined as the probability that each household faces the challenge of falling below the minimum energy requirement in the future.

Multinomial Logit (MNL) Model: In addition, the multinomial logit (MNL) model was used to examine the factors influencing food insecure households' choice of coping mechanism in the study area. As also depicted in Myslym et al. (2020) and Olutumise et al. (2021), the MNL model is expressed as follows:

$$P(y = j|x) = \frac{exp(x\beta_j)}{\left[1 + \sum_{j=1}^{J} exp(\chi\beta_j), j=1\ldots\ldots J\right]}. \tag{6}$$

where y denotes a random variable taking on the values {1,2…J} for a positive integer J, and let x denote a set of conditioning variables. In this case, y was the coping options or categories, and x will contain different household characteristics. Differentiating equation (6) with respect to the explanatory variables yields marginal effects of the explanatory variables as follows:

$$\frac{\partial p_j}{\partial x_k} = P_J \left(\beta_{jk} - \sum_{J-1}^{J-1} P_J \beta_{JK} \right) \tag{7}$$

The marginal effects, also known as marginal probabilities, are functions of the likelihood. They calculate the predicted change in the probability of making a specific choice in response to a unit change in an independent variable (Green, 2000). In developing the empirical model using multinomial logit estimation, the dependent variable was the coping mechanisms. The coping mechanisms were grouped into five categories as follows:

Y_1 = Casual Labour-based coping mechanism, Y_2 = Asset-based coping mechanism, Y_3 = Food Adjustment-based coping mechanism, Y_4 = Borrowing-based coping mechanism, Y_5 = Assistance-based coping mechanism.

However, the scale of measurements and summary statistics of the explanatory variables that were selected as probable factors influencing the household's calorie consumption and choice of coping mechanisms by rural households in the area are presented in the Table 1.

Table 1. Description and summary statistics of the variables

Variable	Definition	Mean	Std.Dev
Age	Age of household head (years)	47.00	11.85
Household size	Number of people residing in a household	6.00	3.00
Education	Educational status of the household head (1 = educated, 0 = non-educated)	0.72	0.39
Farm size	Total land cultivated for yam in hectare (ha)	2.27	1.57
Gender	Gender of household head (1 = Male, 0 = Female)	0.89	0.23
Off-farm work	1 if household engages in off-farm activities, 0 otherwise	0.76	0.41
Household asset	1 if household owns a television set, 0 otherwise	0.55	0.43
Membership of cooperative society	1 if household is a member in cooperatives, 0 otherwise	0.13	0.33
Distance to market	Distance to the nearest input market (km)	6.89	0.48
Access to credit	1 if household have access to credit facilities, 0 otherwise	0.23	0.56
Marital status	1 if household is married, 0 otherwise	0.73	0.28
Farming experience	The number of years spent by household head in farming (years)	20.10	11.35
Extension visits	1 if household head is contacted, 0 otherwise	0.31	0.49
Number of dependants	Number of individuals depending on the household head exclude the biological members (numbers)	4.52	4.11
Main occupation	1 if food crop farming is the main occupation, 0 otherwise	0.96	0.33
Total annual income	Farm income in monetary unit (naira)	500,120.18	389,981.87
Consumption	Household head daily per capita calorie consumption (kcal)	2,470.05	1,645.63

Note: 1 USD = 445 Naira

Results and Discussion

Vulnerability of Households to Food Insecurity

The result of the coefficient of determination (R^2) was 0.672, implying that 67.2% of the variations in the values of food consumption were explained by the explanatory variables (Table 2). Furthermore, several predictor's coefficients have the expected signs and are statistically significant. The results showed that the age of the household head had a significant negative correlation with food consumption. This means that older families were more vulnerable and, as a result, more likely to face decreased food intake in the future. This is probably because the capability to access sufficient calories declines with age. The result is also in agreement with Agboola et al. (2004) that age has an inverse but significant relationship with calorie consumption. It was also shown that households with larger family sizes and a large number of dependants were more likely to be vulnerable in the future as shown in the negative relationship with expected consumption and variance. The expectation of food intake is significantly decreased when the household size is large. It is well known that families with a large number of children are, on average, poorer. As expected, household asset and access to credit had positive correlations with the level of food consumption and variance of food consumption. The higher the household asset and access to credit, the higher the expected food consumption will be and such household is less likely to be vulnerable to food insecurity in the future. The result is also in agreement with previous studies (Devereux et al., 2003; Agboola et al., 2004) which found out that household's asset and access to credit had a positive and significant relationship with calorie consumption. The education of household head had a positive correlation on food consumption and variance. The results showed that households with an educated head were less likely to be vulnerable to food insecurity in the future. The finding concurs with Schultz's hypothesis that educated individuals are less vulnerable; they adapt more easily to changing circumstances. A household head who participates in off-farm work and cooperative society is predicted to be less vulnerable to food insecurity. Off-farm work and membership in cooperative society had a strong positive correlation to food consumption and variance. This implies that participation in off-farm activities and cooperative society would increase household income; thereby, making them less vulnerable to future food insecurity. The result did not show the effect of gender, extension visit and farm size on the distribution of future consumption. This is contrary to the findings of UNICEF (2009) that the higher the land size, the higher the expected food consumption will be. This may be as a result of the limited land size available to yam farmers in the study area.

The extent of Vulnerability to Food Insecurity

The degree of vulnerability to food inadequacy for each household was calculated based on the mean estimation results and the above-estimated variance (Table 3). Households were considered as being food insecure when their vulnerability levels exceeded some threshold. A value of 0.5 was used based on the vulnerability profile for rural households following Chaudhuri (2003). The vulnerability index is calculated for each household based on expected food consumption expenditure and its variance. The average likelihood of a household falling below the food security level is approximately 0.38. After calculating the vulnerability index for each household, households with a vulnerability index greater than or equal to 0.5 were classified as highly vulnerable, whereas households with a vulnerability index less than 0.5 were classified as low vulnerable. According to the findings, 11.01 per cent of respondents were likely to be vulnerable to food insecurity in the future. Also, about 9.4% of the sample households that were food insecure, as at the time of the study, were observed to be able to change their situation in the future. However, 41.24 per cent of the sampled households were extremely vulnerable to food insecurity, with a vulnerability index of 0.78. The implication of this is that there is a need to give an urgent intervention to achieve food security in the study area.

Table 2. Regression Results of Expected per Capita Food Consumption

Independent Variable	Initial Model			FGLT Model		
	Coefficient	T-Value	P-Value	Coefficient	T-Value	P-Value
Age of Household Head	0.042 (0.005)***	-7.99	0.001	-0.068 (0.021)***	-3.18	0.001
Household Size	-0.317 (0.055)***	-5.77	0.001	-0.138 (0.065)**	2.121	0.022
Household Asset	0.005 (0.0018)**	2.93	0.012	1.917 (0.811)**	2.36	0.018
Education of HH Head	0.2415 (0.039)***	6.04	0.001	1.622 (0.802)**	2.02	0.014
Farm Size	0.009 (0.062)	0.15	0.677	1.332 (0.752)	1.77	0.322
Off-Farm Work	0.013 (0.003)***	4.09	0.001	0.164 (0.067)**	2.09	0.037
Gender	0.738 (0.152)	4.65	0.001	-1.06 (0.707)	-1.50	0.134
Membership of Coop	0.373 (0.124)***	3.00	0.002	0.120 (0.055)**	2.16	0.024
Distance to Market	-5.112 (3.461)	-1.47	0.141	0.006 (0.186)	0.03	0.971
Access to Credit	0.908 (0.099)***	9.14	0.001	0.373 (0.15)**	2.48	0.012
Main Occupation	-0.064 (0.027)	-2.37	0.018	0.383 (0.124)***	-3.08	0.001
Marital Status	0.857 (0.162)***	5.29	0.001	-0.138 (0.110)	-1.25	0.210
Farming Experience	0.039 (0.068)	-0.616	0.538	0.068 (0.121)	0.56	0.601
Extension Visit	0.112 (0.548)	0.205	0.837	-1.061 (0.707)	-1.50	0.134
Number of Dependant	0.184 (0.082)**	-2.24	0.037	-1.203 (0.420)**	-2.86	0.024
	Observations =	320				
	R2 =	67.2%				

Table 3. Extent of Vulnerability to Food Insecurity

Current status	Highly Vulnerable $\daleth \geq 0.5$	Low Vulnerable $\daleth \leq 0.5$	Total	
Food Secure	11.01% (0.68)	49.3% (0.12)	60.31	(0.25)
Food Insecure	30.23% (0.80)	9.4% (0.22)	39.63	(0.58)
Total	41.24% (0.78)	59.1% (0.16)	100	(0.38)

* Numbers in parenthesis are the average probability of vulnerability

Table 4. Disaggregation by Different Food Status Transition

Food Security Category	Number of households	Percent
Permanent food secure	158	49.3
Transitory food secure	35	11.01
Transitory food insecure	30	9.4
Permanent food insecure	97	30.23

Table 5. Maximum likelihood estimates of factors influencing food insecurity coping mechanisms

Explanatory Variables	Food adjustment-based coping mechanism	Borrowing-based coping mechanism	Assistance-based coping mechanism	Asset-based coping mechanism
Age	0.3056 (0.001)***	0.2096 (0.001)***	0.5534 (0.001)***	0.0664 (0.018)**
Education	0.2023 (0.644)	0.3717 (0.028)**	-0.0853 (0.876)	-42.3248 (0.992)
Main Occupation	-0.5811 (0.242)	0.3130 (0.127)	-0.4830 (0.413)	-13.7540 (0.997)
Household size	0.7966 (0.001)***	0.9398 (0.570)	0.1998 (0.413)	-13.1838 (0.995)
Farm size	-0.5016 (0.498)	1.0802 (0.020)**	0.3411 (0.694)	32.4509 (0.995)
Total Annual Income	-1.91e-07 (0.026)**	-5.09e-06 (0.010)**	-3.89e-06 (0.038)**	0.00003 (0.999)
Membership of Cooperative Society	-3.5013 (0.015)**	3.9766 (0.002)***	-3.1211 (0.073)	-0.18733 (1.000)
Extension Visit	1.214 (0.243)	-0.6774 (0.253)	2.4120 (0.066)	-29.654 (0.998)

Figures in parenthesis are the P-Value, *** and ** were Significant level at 1% and 5%; Number of observations = 320
Prob >chi^2 = 0.001; Log likelihood = -101.87; R^2 = 0.67.

Table 6. Marginal Effects of Factors Influencing Food Insecurity Coping Mechanisms

Explanatory Variables	Food adjustment-based coping mechanism	Borrowing-based coping mechanism	Assistance-based coping mechanism	Asset-based coping mechanism	Casual based coping mechanism
Age	0.065 (0.025)**	-0.0282 (0.051)	0.0282 (0.001)***	-2.77e-08 (0.988)	-0.2422 (0.001)***
Education	0.0036 (0.842)	0.0144 (0.985)	-0.0020 (0.990)	-3.00e-06 (0.992)	0.0074 (0.789)
Main Occupation	0.01423 (0.218)	0.0966 (0.078)	0.0098 (0.495)	-6.06e-07 (0.997)	-0.0774 (0.001)***
Household size	0.0125 (0.036)**	-0.0154 (0.887)	0.0104 (0.814)	1.05e-06 (0.995)	0.0221 (0.025)**
Land size	-0.0453 (0.016)**	-0.1464 (0.168)	0.0048 (0.946)	-1.45e-06 (0.993)	-0.0955 (0.016**
Total Annual Income	3.28e-09 (0.967)	7.05e-07 (0.337)	-8.93e-09 (0.040)**	-4.47e-12 (0.999)	1.39e-07 (0.005)***
Membership of Cooperative Society	-0.0685 (0.036)**	0.5332 (0.004)***	0.0466 (0.724)	8.46e-08 (1.000)	-0.3245 (0.018)**
Extension Visit	0.02304 (0.409)	0.0815 (0.641)	-0.0180 (0.938)	1.63e-06 (0.998)	0.0414 (0.522)

Figures in parenthesis are the P-Value, *** and ** were Significant levels at 1% and 5%

However, as shown in Table 4, the vulnerability indicator was calculated using the expected food calorie consumption and its variance for each household, based on the categorization of respondents based on different levels of food status. About 49.3% of households in the study area enjoyed a stable level of food security, being food secure and having low vulnerability to food insecurity. However, 30.23% of the population was undernourished and highly vulnerable. They are considered chronically food-insecure households. Moreover, 9.4% of households that were currently undernourished have the tendency to be food secure in the future (transient food insecure) and 11.01 per cent of households in the study region that were currently food secure are at risk of becoming undernourished (food insecure) in the future.

Factors Influencing the Choice of Food Insecurity Coping Mechanism

The multinomial logit model was estimated by normalizing one category called state or the baseline category. The reference point in this study was the least used coping mechanism (asset-based coping mechanism). Table 5 shows the maximum likelihood calculated multinomial logistic coefficients, which show the direction of the effect of the independent variables on the dependent variables. The likelihood ratio statistics, as shown by the value (115.97) of χ^2 statistics, was highly significant at a 1%, implying that the model has a strong explanatory potential. This also suggests that the independent variables account for a reasonable proportion of the observed differences in food insecurity coping mechanisms. Statistically, a year increase in yam farmer's age increases

the probability of household relying more on food adjustment-based coping mechanism, borrowing-based coping mechanism, assistance-based coping mechanism, and casual labour-based coping mechanism. This implies that a household with an aged head would likely adopt any of these mechanisms rather than selling their assets in order to leave properties for their children. Also, an increase in household size would increase the probability of the household choosing food adjustment-based coping mechanism over selling their assets to cope with the current food insecurity challenges. i.e., a unit increase in household size increases the probability of household adopting food adjustment based coping mechanism over selling their properties by 7.9%. A household head with a large farm size would likely adopt a borrowing-based coping mechanism in managing his large hectares of land than selling off their properties. A household would prefer to borrow from either relatives, friends, cooperatives or banks to cushion the challenge of food insecurity and payback after harvesting their farm produce than selling their properties. Again, a reduction in the total annual income would increase the likelihood of household adopting food adjustment-based coping mechanism, borrowing-based coping mechanism and assistance-based coping mechanism over selling off their assets. However, an increase in the annual income of a household head would likely reduce the probability of the household depending on any of these mechanisms. This shows that households that manage to earn high income from any source are not likely to depend on food aid or assistance, borrow from friends or family or skip a meal for another. Likewise, participation in cooperative society would likely reduce the probability of households choosing food adjustment-based coping mechanism but increases the likelihood to adopt borrowing-based coping mechanism. This is because cooperative society allows households to build the concept of self-help, access financial assistance at concessional rates and obtain goods and services at low prices. Education and extension visit was not significant at 5% in any of these coping mechanisms, this implies that there were no significant differences in terms of coping mechanisms adopted by households based on their level of education and extension services.

Table 6 shows the marginal effects of the Multinomial logit, which calculates the predicted change in the likelihood of making a specific choice in response to a unit change in an independent variable.

The age of the respondent is found to be significant and positively influences assistance-based coping mechanism and food adjustment-based coping mechanism at 1% and 5%, respectively. According to the findings, the probability of a household head choosing assistance-based and food adjustment-based coping strategies rose by 6.5 percent and 2.8 percent, respectively, with age. On the other hand, the results showed that the likelihood of a household head choosing a casual labour-based coping mechanism decreased by 24.22% with an increase in age. The possible explanation is because older farmers have lesser strength and rely mainly on assistance from either their children/families or the government. However, younger farmers often engaged in casual labour after farm work to get more money and cater for their domestic needs and obligations in society. Furthermore, education of

household head was not found significant, implying that there was no significant difference in terms of coping mechanisms adopted by households based on their education level. Again, household size was found to be significant and positively influenced households to choose casual labour-based coping mechanisms at a 5% level of significance. One extra person in the household increases the likelihood to adopt casual labour by 2.2%. This result suggests that the larger the household, the more the food demand and the more the households participate in casual labour to feed the household members. However, household size was also found to be significant at a 5% level in influencing households to adopt adjustments in food consumption as a coping mechanism. To feed larger households requires more resources (income) which are lacking for many rural households in the study area. Hence, the larger the household, the more the odds to choose adjustment-based coping mechanism and this increases at 36% with an addition of one extra person in the household. This is in agreement with the study of Ajayi and Olutumise (2017).

Land size was found to be significant at 5% and negatively influenced households to choose casual labour-based and food adjustment-based coping mechanisms. The results showed that a unit decrease in farm size will increase the likelihood of choosing casual labour-based and food adjustment-based coping mechanisms by 16% and 45%, respectively. This implies that households with small land have difficulties producing food that can feed the whole household and tend to rely on casual labour and food adjustment-based coping mechanisms. The possible explanation for this was that the majority of the respondents in the study area were migrant farmers who got their land through an unsecured means (lease, rent, gift etc.); hence, they have no control over the use of land. Cooperative membership was found to be significant at 1% and positively influenced household to opt for the borrowing-based coping mechanism by 53.3%. Being a member of a cooperative society allows households to build the concept of mutual self-help in everyday life. Once confronted with food insecurity, lending and borrowing food or money to buy food becomes easier among members of the same cooperative. However, being a member of a cooperative society was found to be significant and negatively influenced both food adjustments-based and casual labour-based coping mechanisms. The results showed that a unit decrease in membership of cooperative society increases the likelihood of choosing either food adjustments-based or casual labour-based coping mechanisms. This implies that a household's head that does not belong to any cooperative society will rely more on food adjustment and casual labour-based coping mechanisms to cope with food insecurity challenges. The total annual income was found to be significant and negatively influenced the household to opt for an assistance-based coping mechanism at 5%. This showed that households which managed to earn high income from any source were not likely to depend on food aid or assistance. Total household income was also found to be significant and negatively influenced casual labour-based at 1%. This implies that a unit increase in the total annual income decreases the likelihood to choose casual labour-based coping mechanism to cope with food insecurity challenges in the study area. The main

occupation was found to be significant and negatively influenced the household to opt for casual labour-based coping mechanism at 5%. This implies that households that engaged mainly in farming would do less casual labour work i.e., a unit decrease in households' main occupation, increases the likelihood to participate in casual labour by 7.4% to cope with food insecurity challenges in the area. The extension visit to households' heads was not significant at 5%, implying that there was no significant difference in terms of coping mechanisms adopted by households based on their access to extension services.

Conclusion and Policy Implications

The study has critically examined the extent of vulnerability of food insecurity and household coping mechanisms among yam producers in Ekiti State, Nigeria using econometric tools. The study concludes that age, household size, household asset, education, membership of cooperative society, and dependants are the critical factors of policymaking for the food consumption in the area. This also contributes to the level of vulnerability to food insecurity because the food consumption level goes a long way in determining the food security and the living standard of the individuals in a society. It was also concluded that many of the yam producers were far below the average probability of food security threshold. Some of them were undernourished and highly vulnerable. This implies that there is chronic food insecurity situation in the area. Although many of the sampled farmers were vulnerable to food insecurity, approximately 11.01 per cent of food secure households can become food insecure in the future if necessary attention and intervention are not given by both households and the government. On the other hand, 9.4% of households that were experiencing food shortage may recover in the future. Having established the extent of vulnerability in the area, the farming households have devised several means to cushion and cope in order to advert or reduce the hazardous effect of food insecurity in the area. The study ascertained that the coping mechanisms revolved around four categories, namely: food adjustment-based; borrowing-based, assistance-based, asset-based, and casual labour-based coping mechanisms. Therefore, the study established the main factors that contributed to the choice of coping strategies employed by yam farming households and these include the age of household head, main occupation, household size, land size, net household income and membership of the cooperative society. Also, it can be safely asserted that coping strategies (casual labour-based and borrowing-based) significantly enhanced yam farmers' income and food status in the area. Based on the outcome of these findings, it could be recommended that government and non-governmental organisations should encourage yam farmers to invest more in income-generating activities or casual labour works during the off-peak farming periods to enable them to increase their income, and thus, be able to improve their livelihood and food security status. In addition, leveraging the potential role of coping mechanisms already used by households during food shortages to reduce food insecurity should be considered and implemented as policy options. Comprehensive human capital development policy is a key factor that can be used to mitigate the high level of vulnerability to food insecurity among rural yam households. Findings have shown that education of household heads significantly reduces the likelihood of vulnerability to food insecurity. Moreover, family planning policy is considered necessary to withstand the high level of vulnerability to food insecurity among yam farming households due to increase in the number of dependants among farming households. Lastly, more yam farmers should be encouraged to form and join viable cooperative societies to access financial assistance at concessional rates, obtain goods and services at low prices, thereby, improve their standard of living.

Acknowledgements

Author's Contribution

Dr. Olutumise, A.I. developed the methodology, analysed the data with a significant contribution to the interpretation of the results. Dr. Ogunyemi, A.I. wrote the introductory section and also contributed immensely in the compilation of the manuscript. Mr. Adegoroye, A. helped in the data collection, analysis and presentation of the results with the references.

References

Agboola PO, Ikpi AE, Kormawa PM. 2004. Factors influencing food insecurity among rural farming households in Africa: Results of analysis from Nigeria. Internet Discussion Paper, November, 2004; available at http://www.pjbs.org/pjnonline/ab577. [accessed May 13 2020].

Ajayi CO, Olutumise AI. 2017. Determinants of food security and technical efficiency of cassava farmers in Ondo State, Nigeria. International Food and Agribusiness Management Review, 21(7), 915 – 928.

Amaza P. 2018. Impact on household food security of promoting sustainable agriculture among farming households in Borno State, Nigeria. 10th International Conference of Agricultural Economist, July 28 – August 2, 2018, Vancouver.

Asogwu BC, Umeh JC. 2012. Food insecurity determinants among rural farming households in Nigeria. International conference on Ecology, Agriculture and Chemical Engineering (ICEACS' 2012), December 18-19, Phuket Thailand.

Babatunde RO, Qaim M. 2010. Impact of Off-Farm Income on Food Security and Nutrition in Nigeria. Food Policy, 35, 303-311. http://dx.doi.org/10.1016/j.foodpol.2010.01.006.

Babatunde RO, Omotesho OA, Olorunsanya EO, Owotoki GM. 2008. Determinants of vulnerability to food insecurity: A gender-based analysis of farming households in Nigeria. Indian Journal of Agricultural Economics, 63(1), 1 – 10. DOI: 10.22004/ag.econ.204567.

Betts R et al. 2018. Changes in climate extremes, fresh water availability and vulnerability to food insecurity projected at 1.5°C and 2°C global warming with a higher-resolution global climate model. Phil Trans Roy Soc A. https://doi.org/10.1098/rsta.2016.0452

Braun YA. 2020. Environmental change, risk and vulnerability: poverty, food insecurity and HIV/AIDS amid infrastructural development and climate change in Southern Africa. Cambridge Journal of Regions, Economy and Society, 13(2), 267 – 291. https://doi.org/10.1093/cjres/rsaa008

Capaldo J, Karfakis P, Knowles M, Smulder M. 2010. A Model of Vulnerability to Food Insecurity. The Food and Agricultural Organization of the United Nation. ESA Working Paper No. 06 – 12. Available at www.fao.org/economic/esa [accessed May 13 2020].

Chaudhuri S. 2003. Accessing Vulnerability to Poverty. Concepts, empirical methods and illustrative examples, Mimeo, Columbia University. Internet Discussion Paper, November, 2003; Available at https://www.semanticscholar.org/paper/.[accessed May 13 2020].

Devereux S, Maxwell S. 2011. Food Security in sub-Saharah Africa. Economics Letters, 12 (6), 12 -37.

Egwuda D. 2014. Food Security and Productivity of Urban Food Crop Farming Households in Southern Nigeria. Agricultural Science, 2(3), 01-12.

Fanny W, Jos B, Jacques T. 2021. Value Chain Upgrading through Producer Organisations: Linking Smallholder Vegetable Farmers with Modern Retail Markets in Indonesia. International Journal on Food System Dynamics, 12(1), 68 – 82. DOI: http://dx.doi.org/10.18461/ijfsd.v12i1.76.

Food and Agriculture Organisation (FAO). 2009. The State of Food Insecurity in the World. Food and Agriculture Organization of the United Nations. Viale delle Terme di Caracalla, 00153 Rome, Italy.

Food and Agriculture Organisation (FAO). 2015. The State of Food Insecurity in the World 2015. Rome.

FAO, IFAD, WFP. 2013. The State of Food Insecurity in the World 2013. "The multiple dimensions of food security; Rome, FAO.

FAO, IFAD, UNICEF, WFP, WHO. 2021. The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. https://doi.org/10.4060/cb4474en)

Green WH. 2000. Econometric Analysis, 4th ed. Prentice Hall, Upper Saddle River, New Jersey: Prentice-Hall.

Jinhong W, Ruoxi L, Wenxin W, Zhongmei L, Bizhen C. 2016. Income Diversification: A Strategy for Rural Region Risk Management. Sustainability 2016, 8, 1064; doi:10.3390/su8101064. Retrieved from: www.mdpi.com/journal/sustainability.

Myslym O, Remzi K, Arben K, Ilir T. 2020. Factors Influencing Consumers' Perceptions of Safety Risk of Fresh Domestic Tomato in Albania – a Multinomial Econometric Approach. International Journal on Food System Dynamics, 11(4), 387 – 401. DOI: http://dx.doi.org/10.18461/ijfsd.v11i4.62.

Ninno DC, Dorosh AP, Smith CL. 2003. Floods, food security and coping strategies: Evidence from Afghanistan.Journal of International Association of Agricultural Economics, 52(1), 1-171.

Ogunniyi AI, Omotoso SO, Salman KK, Omotayo AO, Olagunju KO, Aremu AO. 2021. Socio-economic Drivers of Food Security among Rural Households in Nigeria: Evidence from Smallholder Maize Farmers. Social Indicators Research, 155, 583–599. https://doi.org/10.1007/s11205-020-02590-7.

Olutumise AI, Ajibefun IA, Omonijo AG. 2021. Effect of Climate Variability on Healthcare Expenditure of Food Crop Farmers in Southwest, Nigeria. International Journal of Biometeorology, doi:10.1007/s00484-021-02079-z. Epub ahead of print. PMID: 33474613.

Omotayo AO, Ogunniyi AI, Tchereni BHM, Nkonki-Mandleni B. 2018. Understanding the link between Households' poverty and food Security in Southwest Nigeria. The Journal of Developing Areas, 52(3), 26 – 37.

Omotesho OA, Muhammad-Lawal A. 2010. Optimal food plan for rural households' food security in Kwara State, Nigeria: The goal programming approach. Journal of Agricultural Biotechnology and Sustainable Development, 2(1), 007-014. Available online http://www.academicjournals.org/JABSD.

Osabohien R, Osabuohien E, Urhie E. 2018. Food Security, Institutional Framework and Technology: Examining the Nexus in Nigeria Using ARDL Approach. Current Nutrition & Food Science, 14, 154-163. DOI:10.2174/1573401313666170525133853.

Pakravan-Charvadeh M, Savari M, Khan H, Gholamrezai S, Flora C. 2021. Determinants of household vulnerability to food insecurity during COVID-19 lockdown in a mid-term period in Iran. Public Health Nutrition, 24(7), 1619-1628. doi:10.1017/S1368980021000318.

Sileshi M, Kadigi R, Mutabazi K, Sieber S. 2019. Analysis of households' vulnerability to food insecurity and its influencing factors in East Hararghe, Ethiopia. Journal of Economic Structure, 8, 41. https://doi.org/10.1186/s40008-019-0174-y

Stellah M, Johanna J, Chinwe IS, Stephan R, Boniface K. 2020. Learning and Adaptation in Food Systems: Insights from Four Case Studies in the Global South. International Journal on Food System Dynamics, 11(4), 312 – 328. DOI: http://dx.doi.org/10.18461/ijfsd.v11i4.57.

UNICEF. 2009. State of the World's Children, Maternal and Newborn Health. UNICEF, New York.

Van der Veen A, Tagel G. 2011. Effect of policy interventions on food security in Tigray, Northern Ethiopia. Ecology and Society 16(1), 18. [online] URL: http://www.ecologyandsociety.org/vol16/iss1/art18/

Yoade AO, Olatunji SA, Adeyemi OO. 2018. Vulnerability to Food Insecurity Among Rural Households in Sub-Saharan Africa. International Scientific E-Journal, 4(4), 72 – 84. Available at http://www.are-journal.com

Zeller M. 2012. Review of Poverty Assessment Tools Research Report. International FoodPolicy Research Institute, 2 (3), 48-76.