

Technology Of Vulnerability To Food Insecurity By Rural Farming Households In Western Nigeria; A Case Of Ekiti State

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Abstract: Determining vulnerability to food insecurity is instrumental to addressing food insecurity challenges in developing countries. Nigeria's population growth rate is increasing faster than her food production rate per annum. Against this backdrop, this study examined the determinants of vulnerability to food insecurity in Ekiti state, Nigeria by applying statistical and econometric tools. Understanding the causes, determinants and level of food insecurity would help policy makers to design and implement more effective policies and programmes for the poor and thereby helps to pave way to improve food security.

A three-stage random sampling procedure was used to elicit cross sectional data from a total of 150 rural farmers across 5 Local Government Areas of Ekiti State using a semi-structured questionnaire. The Coping Strategy Index (CSI) was used to determine vulnerability to food insecurity status of the households and ordered logit regression was used to identify the determinants of vulnerability.

Findings revealed that 35.33% of the households were moderately vulnerable while 33.33% and 31.33% were mildly and severely vulnerable respectively in the study area. Borrowing food, eating seed stock, begging for food and reducing meals were the major coping strategies adopted by the households. The ordered logit regression result shows that being a female household head increases the probability of being vulnerable. Age of household head was found to be significant ($p < 0.05$) and negatively influencing Vulnerability to food insecurity. Household dependants and number of coping strategies were found to be significant ($p < 0.05$) and positively influencing Vulnerability. Education level, farm income and labour hour use were found to be significant ($p < 0.1$) and negatively influencing vulnerability. Marital Status, Access to extension and off-farm occupation were significant ($p > 0.05$) and negatively influencing household vulnerability to food insecurity among the households.

The study concluded that policies that address the major determinants of vulnerability such as education, off-farm occupation, access to extension services and income diversifications with emphasis on women's empowerment are likely to enhance resilience of rural farming households to food insecurity in the study area.

Key words: Vulnerability, Technology, Food insecurity, Determinant, Ologit, Ekiti State

INTRODUCTION

1.1 Background Information

Agriculture provides food, employment and a means of livelihood for more than 60 percent of the productively engaged population in Nigeria (Attah, 2012). Evidence suggests that Nigerians food production is increasing at less than 2.0% while population growth rate is estimated to be 2.5% per annum, (NPC (2012): Aku, 2012). Just like most African economies, Nigeria's rural agricultural sector is characterized by small-scale resource-poor farmers and also by informal traders cutting across both gender groups (Omonona, 2009).

Food security and food insecurity are at opposite extremes of a spectrum. The importance of investigating food security is necessitated by the recent events of increasing population (Ogundari, 2017). Sub-Saharan Africa is the most vulnerable region to food insecurity and Nigeria is one of the food deficit countries in sub-Saharan Africa (FAO, 2015). The global understanding of food security comprises of various concepts such as ecological, social, economic and political aspects that help to recognize the choices and problems that determine whether people have enough resources to consume the food they need and desire. In Nigeria, poverty is mainly a rural phenomenon with agriculture accounting for the highest incidence over the years (Adepoju and Yusuf, 2012).

According to FAO (2010), "Food security is a condition that 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 healthy life". Thus the increasing evidence of change in population and available food production has generated contention and empirical question. This suggested disparity indicate that low rate of food production and high rate of population growth can generate high rate of food demand, thereby causing food Demand-Supply gap which can give rise to food insecurity.

Vulnerability may be conceived as the threat that welfare may be compromised at a future date and this threat may be derived from two factors: first, those with high levels of welfare variability, and second, those with systematically low levels of welfare (Chaudhuri *et al.* 2002). In literature, the idea of vulnerability is used with different implications. Much of the disaster management literature use vulnerability with reference to a natural hazard (Alwang *et al.*, 2016) while the food security literature, and part of the social risk management and poverty literature (Mansuri and Healy 2014; Dercon 2013a; Holzmann and Jørgensen 2011) define vulnerability in terms of an unfavorable future outcome. Vulnerability refers to people's propensity to fall or stay below food security threshold within a certain timeframe (Løvendal and Knowles (2005)).

1.2 Statement of the Problem

Nigerian food production is increasing at less than 2.0% while population growth rate is estimated to be 2.5% per annum (NPC 2012; Aku, 2012). According to Njoku (2012), Nigeria spends over 13 trillion Naira annually on the importation of basic food items including

wheat, rice, sugar and fish. During the period 2014-2016, the level of undernourishment in sub-Saharan Africa rose to about 220 million countries in sub-Saharan Africa (FAO, 2015). This has led to many rural farmers adopting some coping strategies against food shortage related shocks in Nigeria.

In spite of the efforts of national governments and the international community to reduce hunger and food insecurity in the context of the Sustainable Development Goal's (SDG's) and other initiatives, the proportion of food insecure people in developing countries has been on the increase since the mid 1990's (FAO, 2015). Malnutrition is widespread in Nigeria and rural areas are especially vulnerable to chronic food shortages, unbalanced nutrition, erratic food supply, poor quality foods, high food costs and even total lack of food (Isaac, 2009). The cost of inadequate diets to families and nations are considerably high and this includes increased vulnerability to diseases and parasites, reduced strength for task requiring physical effort, reduction of the benefit from schooling and training programs and general lack of vigor, alertness and vitality (Kurosaki, 2010). The outcome of these is a reduction in the productivity of people in the short and long terms, sacrifice in output and incomes, and increasing difficulty for families and nations to escape the cycle of food poverty.

The global increase of food price and the global financial crisis has put challenges on and increases food insecurity in rural areas (Eyob, 2017). This is further driven by unemployment, underemployment, rising cost of living, household composition, low asset ownership, low level of education, high dependency on the informal sector, and increased population pressure due to natural growth and rural-urban

when compared to 180 million recorded between 1990 and 1992 and Nigeria is one of the food deficit

migration. Thus it is important to better understand the role of shocks and the strategies that households rural communities can adopt in order to reduce the likelihood of food insecurity.

This study therefore analyzed the technology of household's vulnerability to food insecurity by the rural households and examined deeply the factors that affect households' food insecurity in the study area. In order to deal with the problems, the following research questions were put forward;

1. How vulnerable are the households to food insecurity in the study area?
2. Do households differ in vulnerability by socio-economic characteristics?
3. What are the factors determining vulnerability of the households to food insecurity?
4. What are the coping strategies adopted by the households against food-shortage and related shocks?

1.3 Objectives of the Study

The general objective of this study is to examine the technology of vulnerability to food insecurity among rural farming households in Ekiti State, South Western Nigeria while the specific objectives of the study are to:

1. determine the level of vulnerability of households to food insecurity in the study area,
2. profile households' vulnerability by their socio-economic characteristics,
3. identify the factors determining vulnerability of the households to food insecurity,

4. examine the coping strategies adopted by the households against food-shortage and related shocks.

1.4 Justification for the Study

Food security comes at the forefront for survival when we refer to economic development (Opiyo, 2014). Despite the relevance that food security is gaining over the years, several aspects remain under investigated (Santeramo, 2015). Studies have been conducted on the determinants of vulnerability to food insecurity in Nigeria by categorizing household's vulnerability into two groups ("vulnerable and non-vulnerable" or "food secure and food insecure"), but few studies have explicitly categorized vulnerability status of households to food insecurity into three groups in the study area (i.e. mildly vulnerable, moderately vulnerable and severely vulnerable to food insecurity). This study will however examine the factors determining the vulnerability of household to food insecurity in the study area by differentiating the households' vulnerability status into three levels such as mild, moderate and severely vulnerable groups because it is important to not only know the households who are vulnerable but to also know how critically vulnerable these households are, because different levels of vulnerability will require different levels of intervention and policy recommendation.

A number of methods are open to the assessment of vulnerability and food insecurity in developing countries with conflicting results in few cases. Some of these methods include Foster-Greer-Thorbecke 1984 (FGT), Household Coping Strategy Index (CSI), New Zealand Index of Individual Deprivation (NZiDep), Sen's (1988) Entitlement approach, the outcome approach which measures vulnerability in

terms of expected poverty (VEP), the Utility-based approach (VEU), Vulnerability as uninsured Exposure to Risk (VER), The Commonwealth Vulnerability Index (CVI), etc. But few studies have used Coping Strategy Index and ordered logit to measure and analyse vulnerability levels of households in the study area. Out of the above mentioned methods, the Household Coping Strategy Index (coupled with factor analysis) was adopted for the purpose of this study because of its strength advantage of assessing in terms of frequency and severity of what the households do when they don't have adequate food and don't have money to buy food. The Vulnerability was assessed in terms of expected Poverty (VEP) which has a strength advantage of being measured with a cross-sectional data. Ordered logistic regression was also used because the dependent variable has more than two categories and the values of each category have a meaningful sequential order.

This study will generate results that can be used as a reference source when setting programmes relating to poor and pro-poor rural residents in Ekiti State; identification of the degree and characteristics of households who are vulnerable to food insecurity can allow for targeted food security strategies. It will yield policy recommendations that could underpin the efforts of national government and the international community to reduce hunger and food insecurity in the context of the Sustainable Development Goal's and other initiatives such as Agricultural Transformation Agenda, and the Green Alternative programme of President Buhari led administration.

1.5 Organization of the Study

This study is divided into five chapters. Chapter one presents the introduction of the study. Chapter two presents review of related literatures (including theoretical, methodological and empirical review) and conceptual framework, chapter three presents the research methodology. Results and discussion are presented in chapter four while summary, conclusion and policy recommendations are presented in Chapter Five.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Theoretical Review

A number of theories are common in literature that explain the causes/pattern of food insecurity in developing countries. Examples include Population-Driven Theory which is based on Malthusian work, Surplus-Extraction Theory which explains economic underdevelopment and technical innovation in terms of local class relations and the particulars of the system of surplus extraction that is in place, the "Lewis Model of Economic Growth which focus on the process of labor transfer and the growth of output and employment in the modern sector. Accordingly, this study is guided by two theories of food security namely, "Malthusian and Anti-Malthusian" Theory and the "Entitlement Approach to Food Security". The Entitlement to Food theory contends that food insecurity occurs due to people lacking

entitlement to access food, and Malthusian theories which argues that population increase causes food scarcity; and Anti-Malthusian which argue the opposite to the Malthusian theory, thus an increase in population causes increase in food production (Kayunze, 2013).

2.1.1. Malthusian and Anti-Malthusian Theory

Malthusian and Anti-Malthusian theories take two contentious positions in relation to food availability and population growth. Kayunze *et al.*, (2012:44) argues that food insecurity is caused by having too many people compared to the amount of food produced. Population increases in a geometrical manner and food production increases only in an arithmetical ratio. This means that a strong and constantly operating check on population from the difficulty of subsistence is a necessity. However, other Anti-Malthusians argue that there can never be too many people in a country.

Education may lead to lower birth rates, and therefore reducing family size and expansion of food production for example during the green revolution of India in the 1970s as a result of improved agricultural technology is difficult today because the environmental changes has left farmers with few options to improve food crop output. Demands for water irrigation water the use of additional fertilizers on currently available crop varieties has little or no yields increase while Malthusians are pessimistic and argue that in future there will be too little food for the increasing population, Anti-Malthusians comments that improved agricultural technology will increase food production (Kayunze *et al.*, 2012).

2.1.2. The Entitlement Approach to Food Security

The entitlement approach to hunger discusses the ability of people to command food through the legal means available in the society. Entitlements are defined as the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces (Young *et al.*, 2013).

According Santeramo (2015), people's exchange on entitlements reflects their ability to acquire food. Sen sub-divides these entitlements as follows: (a) production-based entitlements, (b) own-labor entitlements, (c) trade-based entitlements, and (d) inheritance and transfer entitlements. He argues that people do not usually starve because of an insufficient supply of food at the local, national, or international level, but because they have insufficient resources, including money ('entitlements') to acquire it.

Some of the limitations of Sen's work include the entitlement approach which views famines and other food-related emergencies as economic disasters. His approach concentrates on rights within the given legal structure in that society, but some transfers are illegal acts, and therefore not accommodated by the entitlement approach nor can they be measured easily (Young *et al.*, 2013). Research into people's responses to famine, often referred to as "coping strategies" has shown that their priorities in times of food stress are to preserve productive assets to protect livelihoods, rather than to meet immediate food needs.

Understanding the severity of food insecurity is essential for determining the best type of coping strategies (Young *et al.*, 2013). Eyob (2017) also argue that during war, the ratio of food producers to food consumers falls, employment-based entitlements, during a war cash crop production and marketing networks collapse, employment opportunities (demand for agricultural labor, petty trading activities) contract and farmers and pastoralists are attacked for food and livestock. Entitlement theory has been criticized on two further counts. First, it implies a straightforward sequence of Entitlement failure leading to hunger and then to malnutrition, starvation and death. Second, it implies that people's actions are largely determined by their need to consume food (Young *et al.*, 2013).

(a) Production Based Entitlement

Improving agriculture technology will lead to a reduction in hunger and food insecurity, agriculture has played and will continue to play this fundamental role. It contributes to two main key criteria, increasing the availability of food at prices that poor people can afford and providing improved job and income that will provide poor people the means to access increased food crop production.

(b) Inheritance and transfer entitlements (from the state, or private gifts and loans).

Transfer entitlement provides a mechanism of social order and cooperation governing the behavior of set of individual within a given community. Transfer entitlement support values and produce and protect interests. Thus, can help mitigate food insecurity at the household level, for example by households giving food one another.

(c) Trade-based entitlements

Food prices vary seasonally, but poor households often sell their crops just after harvesting at lowest price because of an urgent need for cash for credit payments, school fees and medical bills (Bauch, 2013). Market forces in terms of supply and demand for food affect food prices hence the extent to which various people have access to food through buying it. The supply of food can be compounded by poor infrastructure, or poorly integrated food markets in famine-prone areas as well as high transport costs and risks. According to Graaf (2016), high transport costs, small markets and lack of infrastructure are the main common factors that affect agricultural production and food security negatively in all SSA countries. Food production greatly affect food markets, because it takes time for planted seeds to bear fruits, food production cannot be expanded rapidly, and the supply of food will be inelastic with regard to demand. Consequently, where the level of food supply is low, relative to its demand, the prices will tend to rise. On the other hand, where the supply is greater than the demand, prices will tend to fall (Graaf, 2016).

(d) Own-labour entitlements (waged labour and professions)

Own-labour entitlements help people to generating sufficient income to allow people to access food. Improving access to food through increasing incomes can be seen as helpful to look at the impact of increasing agricultural productivity in three main areas which have direct impact on farmers' incomes, including those of smallholders, impact in terms of increasing rural employment opportunities and rural wage rates including those in the non-farm rural economy and wider impact on economic growth and poverty reduction more generally. In response to a decline in people's

entitlements, people actively try to protect their livelihoods. These livelihoods are normally termed as coping strategies and they can be as short-term and long term coping strategies in responses to declining food entitlements (Young *et al.*, 2013).

2.2 Methodological Review

2.2.1 Approaches to Vulnerability Analysis

There are three main approaches to vulnerability measurement, Vulnerability as Expected Poverty (VEP), Vulnerability as low Expected Utility (VEU) and Vulnerability as Uninsured Exposure to Risk (VER). Both the VEP and the VEU approaches employ the same measure in analyzing vulnerability, the VEU approach, however, takes into consideration covariate shocks unlike VEP, while the VER assesses whether observed shocks generate welfare losses (Oni and Yusuf 2008). Many authors have used the three approaches in literature. Chaudhuri (2000, 2001) used VEP, Ligon and Schechter (2003) applied the VEU approach, and Skoufias (2002), Quisumbing (2002), Oni and Yusuf, (2008) adopted VER. This study used the VEP approach because of data limitation. There are shortcomings in using cross-sectional data approach to infer vulnerability because it captures only idiosyncratic risks and does not address covariate risks (community and national related risks) (Oni and Yusuf 2008).

In theoretical terms, vulnerability may be conceived as the threat that welfare may be compromised at a future date. This threat may be derived from two factors: first, those with high levels of welfare variability, and second, those with systematically low levels of welfare. Nevertheless, whichever the source of vulnerability, the concept is clearly tied to welfare outcomes.

Applications of vulnerability methods are closely linked to the way welfare is measured, there are three relevant approaches. The first is to assess vulnerability as expected poverty (VEP). This strand of studies seeks to estimate the probability that welfare may fall below some norm or minimum expected standard of living in the future (Chaudhuri *et al.* 2002). The second is quantifying vulnerability as low expected utility (VEU). Researchers in this area argues that using the VEP methodology is inconsistent with the expected utility framework, and proposes a measure of vulnerability to address these concerns (Ligon and Schechter, 2014). Finally, the last approach is vulnerability as uninsured exposure to risk (VER). This setting, contrary to the previous ones, stems from an ex-post, backward looking perspective, which concentrates on observed past outcomes rather than on an aggregate measure of vulnerability (Tesliuc and Lindert, 2002; Cruces, 2005; Cruces and Wodon, 2007 as cited by Kurosaki (2012)).

Generally there is no established consensus in the literature regarding the most appropriate approach to the analysis of vulnerability. Furthermore, most analyses of vulnerability focus on poverty, rather than on food insecurity. Traditional approaches tend to emphasize the role of assets in reducing vulnerability. Even more crucially, some of the most common methodologies that purport to analyze vulnerability are static in nature, and thereby fall short of an appropriate assessment of the dynamic nature of vulnerability (Scaramozzino, 2006).

2.2.2 The Concept of Vulnerability and its Measurement

In literature, the idea of vulnerability is used with different implications. Much of the disaster management literatures use vulnerability with reference to a natural hazard (Alwang *et al.*

2016) while the food security literature, and part of the social risk management and poverty literature (Mansuri and Healy 2014; Dercon 2013a; Holzmann and Jørgensen 2011) defines vulnerability in terms of an unfavorable future outcome. This dichotomy is, to some extent, driven by the underlying policy questions that are sought to be addressed. Humanitarian aid and disaster management tend to focus on short-term responses targeted at people who require relief assistance following a natural hazard, these being the vulnerable. Looking at vulnerability relative to a social welfare outcome, on the other hand, is concerned with guaranteeing a minimum welfare threshold in terms of food security, through short as well as longer-term measures. Vulnerability surrounding an individual's or a household's human condition concerns the potential now of a negative outcome in the future. The concept is forward looking and implicitly also accounts for uncertainty surrounding future events. Poverty, on the other hand, is usually treated in static, non-probabilistic terms (Ravallion, 2012). It generally concerns not having enough now, whereas vulnerability is about having a high probability now of suffering a future shortfall. In practice, the poor are often also vulnerable, but both groups are typically not identical (Baulch, 2013).

The concept of vulnerability as risk of shortfall can be expressed as a probability statement regarding the failure to attain a certain threshold of well-being in the future. To construct such a vulnerability indicator, one must identify a focal variable (x) e.g. food consumption, income, etc.; estimate the ex-ante probability distribution ($f(x)$) of ex post outcomes with respect to this focal variable x_{t+1} ; define a threshold (z) with respect to this focal variable (i.e. a poverty line/food security threshold); and determine a probability related

threshold (θ) (i.e. a vulnerability line) such that a person will be considered vulnerable if the probability that his/her focal variable falls below the threshold z , exceeds (θ).

For the task at hand vulnerability is defined relative to the negative outcome of food insecurity following Løvendal and Knowles (2005). Thus, vulnerability refers to people's propensity to fall, or stay, below this food security threshold within a certain timeframe. Since vulnerability is linked to the uncertainty of events, everyone is vulnerable to food insecurity, but some more so than others. Vulnerability can be thought of as a continuum. The higher the probability of becoming food insecure, the more vulnerable one is. While 'the vulnerable' in established practice are often implicitly understood to be those with a probability of becoming food insecure above a certain predetermined threshold, no standard exists that defines this threshold. For the purpose of this study it is assumed that a cut-off point exists and so the term vulnerable refers to people below such predetermined threshold.

Using the social risk management approach, the conceptual framework drawn by FAO (2015) shows that vulnerability is the result of a recursive process: current socio-economic characteristics and exposure to risks determine households' future characteristics and their risk-management capacity. At every point in time households' current food security status is affected by their past status and affects their future status.

2.2.3 A Model of vulnerability to food Insecurity

Christiaensen and Boisvert (2001) have proposed the main economic model of vulnerability to food insecurity by drawing on the analysis of vulnerability to poverty. They define vulnerabi-

lity as the probability, (V_t) that the household's expected dietary energy consumption X_{t+1} measured in Kilocalories, will fall below a threshold z :

$$V_{t,\alpha} = F(z) \int_{\alpha}^{\infty} (z - x_{t+1})^{\alpha} \frac{f(X_{t+1})}{F(z)} dx_{t+1}$$

Vulnerability, in this formulation, is null when ever $X_{t+1} \geq Z$

When, instead, expected dietary energy consumption is below the threshold, the index depends on α . interestingly, for $\alpha=0$, vulnerability does not depend on the extent of the shortfall. The author consider vulnerable only those households whose index falls below a vulnerability threshold called θ .

The index is used to evaluate mathematically, the future nutritional adequacy of a two-calculable time/period consumption plan stemming from inter-temporal optimization right in the presence of imperfect capital markets.

Uncertainty and risks enter this model in the form of an uncertain future income (and, therefore, consumption), whose value is predicted through assumptions on the stochastic properties of the environment. However, two periods are considered, the households' problem is solved with static optimization. This is possible because there is no endogenous state variable in the model. As a result the model's applicability is limited to scenarios in which there are no assets lasting more than one period. If one were to introduce such assets in order to account, for example, for livestock or machinery, static optimization techniques would no longer be applicable and the model would change significantly.

To combine the vulnerability index linearly with other indices of current deprivation defined over a (0,1) interval and respecting the usual ax

items of poverty indicators. The authors define the j th dimension of individual i 's deprivation as:

$$P_j(x_{ij} | z) = \begin{cases} 1 & \text{if } x_{ij} = 0 \\ 0 & \text{if } x_{ij} < z \\ f(x) & \text{if } x_{ij} \geq z \end{cases}$$

Aggregating the indices of different dimensions of deprivation, they obtain:

$$fis_i = \sum_j a_j P_j(x_{ij} | z), \quad \sum_j a_j = 1, \quad a_j < 1$$

In this index, that can be averaged to obtain a population index, the relative importance of current deprivation and vulnerability to future deprivation are given by the weights α_j .

Then the future food consumption can be determined assuming a logarithm of the linear based distribution and using a regression that generates a heteroskedastic residual.

Then the estimate is used to calculate the vulnerability index, the estimates is then combined linearly, with equal weights, with an index of current food deprivation.

Algebraically, for a generic household h , let C_h indicate kilocalorie consumption and X_h be a vector of characteristics assumed constant over time, such as household size, location, etc. Assuming for simplicity a linear dependence, we can express each household's calorie consumption as follows:

$$c_h = X'_h \beta = \beta_1 x_{h1} + \dots + \beta_2 x_{h2} + \dots + \beta_J x_{hJ} \tag{4}$$

Where;

(β) is a vector of parameters that are the same for all households (note the absence of the index).

Considering all households in one multivariate equation, we have:

$$C = X\beta = \begin{bmatrix} \beta_1 x_{11} + \dots + \beta_2 x_{12} + \dots + \beta_J x_{1J} \\ \vdots \\ \beta_1 x_{h1} + \dots + \beta_2 x_{h2} + \dots + \beta_J x_{hJ} \\ \vdots \\ \beta_1 x_{H1} + \dots + \beta_2 x_{H2} + \dots + \beta_J x_{HJ} \end{bmatrix} \tag{5}$$

where $C = [c_1 \dots c_h \dots c_H]'$ and $X = [X'_1 \dots X'_h \dots X'_H]$.

The 3GLS procedure consists of estimating the multivariate equation obtaining estimates β of the parameters that explain calorie consumption but for a residual component.

A great number of methods are available for measuring and analyzing vulnerability to food insecurity in the literature. Some of these methods include: Sen's Entitlement Approach

to Food Insecurity, Household Coping Strategy Index (CSI) model, Vulnerability as Expected Poverty (VEP), Vulnerability as low Expected Utility (VEU), Vulnerability as Uninsured Exposure to Risk (VER), The Commonwealth Vulnerability Index (CVI), The Environmental Vulnerability Index, Value-at-Risk (VaR) analysis, etc.

2.2.4 Value-at-Risk (VaR) analysis

In the context of food security, VaR can be defined in terms of the critical threshold level of the nutritional outcome consistent with a small (given) probability of the outcome falling below this level, over a given time horizon. The key aspects of the definition are the degree of confidence required of the measure and the level of the nutritional outcome that is used as a benchmark. In principle, it is of course possible to consider a number of alternative confidence levels and threshold benchmarks. As an example, VaR analysis could lead to estimate that, with a 95 percent confidence, a given household will not experience food insecurity during the next six months, in terms of its nutritional outcome relative to a pre-specified benchmark. A higher level of confidence would be associated with increased food security, or equivalently with reduced food insecurity. Thus, if a household is 99 per cent confident that it will not experience food insecurity during the next reference period, the household can be regarded as relatively safe under most circumstances. By contrast, if a household were only 50 per cent confident that it will not experience food insecurity, then it would usually be regarded as vulnerable. The VaR analysis enables the household to assess the amount of resources that ought to be set aside in order to achieve food security, for any chosen level of confidence. If the household faces a relatively high probability of being food insecure in the future, the VaR methodology could lead to an estimation of the critical resources that are necessary in order to overcome its vulnerability.

The main disadvantage of this method is that it is complex to interpret in terms of policy because the calculation of VaR for a group of individuals must consider the covariance

structure between their likely future food security outcomes. This is because, consistent with the basic principles of risk management and portfolio analysis, the risk of a group of individuals can be lower (or greater) than the sum of the individual risks, depending on how the uncertain outcomes are correlated with each other and with the external shocks (Elton, Gruber, Brown and Goetzmann, 2006).

2.2.5 Sen's Entitlement Approach to Food Insecurity: The entitlement to food theory contends that food insecurity occurs due to people lacking entitlement to access food. This is an approach to hunger which discusses the ability of people to command food through the legal means available in the society. Entitlements are defined as the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces (Young *et al.*, 2013).

According to Sen, (1981) as cited by Santeramo (2015), people's exchange on entitlements reflects their ability to acquire food. Sen subdivides these entitlements as follows: (a) production-based entitlements, (b) own-labor entitlements, (c) trade-based entitlements, and (d) inheritance and transfer entitlements.

Some of the limitations of this method is that work include the entitlement approach which views famines and other food-related emergencies as economic disasters. This approach concentrates on rights within the given legal structure in that society, but some transfers are illegal acts, and therefore not accommodated by the entitlement approach nor can they be measured easily (Young *et al.*, 2013). Research into people's responses to famine, often referred to as "coping strategies", has shown that their priorities in times of food stress

are to preserve productive assets to protect livelihoods, rather than to meet immediate food needs.

2.2.6 Vulnerability as Expected Poverty (VEP): This strand of studies seeks to estimate the probability that welfare may fall below some norm or minimum expected standard of living in the future (Chaudhuri *et al.* 2002). The VEP has a strength advantage of being measured with a cross-sectional data. It has the ability to identify households exposed to risks but who are not poor. In this approach vulnerability is defined as the probability of being poor in the future and basically can take on two forms. It is either the ex-ante risk that a household that is currently not poor will fall below the poverty line or the risk that a household that is currently poor will remain poor. This can be formally expressed as: $V_t = \text{Prob}(C_{(t+1)} < Z)$

2.2.7 Vulnerability as low Expected Utility (VEU)

Following VEP, vulnerability as low expected utility (VEU) focuses on the magnitude of the difference in welfare/utility associated with a certainty equivalent level of welfare (a benchmark) and the household's own expected welfare/utility (Ligon and Schechter 2008). Researchers in this area argues that using the VEP methodology is inconsistent with the expected utility framework, and propose the VEU measure of vulnerability to address this concern.

2.2.8 Vulnerability as Uninsured Exposure to Risk (VER): Vulnerability as uninsured exposure to risk (VER) is an ex post assessment of the extent to which a negative shock caused a welfare loss and there is no attempt to construct an aggregate measure of vulnerability (Hoogeveen *et al.* 2004). This setting, contrary to

the previous ones, stems from an ex-post, backward looking perspective, which concentrates on observed past outcomes rather than on an aggregate measure of vulnerability (Tesliuc and Lindert, 2002; Cruces, 2005; Cruces & Wodon, 2007 as cited by Kurosaki (2012)).

2.2.9 The Commonwealth Vulnerability Index (CVI):

The CVI was developed based on three years of intensive research carried out with the mandate of the Commonwealth finance ministers and endorsed by the heads of government. The index was based on two principles: first, the impact of external shocks over which the country affected has little or no control; and second the resilience of a country to withstand and recover from such shocks. In this framework, therefore, vulnerability means exposure to exogenous shocks over which the affected country has little or no control, and relatively low resilience to withstand and recover from such shocks.

The CVI is a country-level index, which ranks developing countries according to measurable components of exposure and resilience to external shocks. The construction of the index is based on the observation that income growth volatility is the most apparent manifestation of vulnerability (Commonwealth Secretariat 2012). The three sources of this volatility that are used in the index are the lack of diversification (as measured by the United Nations Conference on Trade and Development's diversification Index); the extent of export dependence (as indicated by the share of exports in GDP); and the impact of natural disasters (as represented by the portion of the population affected, reflecting the cumulative frequency and impact of these events over a period of 27 years).

2.2.10 The Environmental Vulnerability Index

The Environmental Vulnerability Index (EVI) has just been developed by the South Pacific Applied Geoscience Commission (SOCAP) and the United Nations Environment Programme (UNEP). It was developed through consultations with governments, institutions and leading experts throughout the world. According to UNEP and SOPAC (2013) the EVI has been developed to provide a rapid and standardized method for characterizing vulnerability in an overall sense, and identifying issues that may need to be addressed within each of the three pillars of sustainability, namely environmental, economic and social aspects of a country's development. The main aim for the creation of the EVI is to promote sustainable development across the world and cooperation on issues relating to the world's natural life-support ecosystems. The EVI is based on 50 indicators for estimating the vulnerability of the environment of a country to future shocks (Markus P. (2005)).

2.2.11 Household Coping Strategy Index (CSI): The Coping Strategy Index (CSI) is an international tool intended for use as an indicator of household food security. It asks a series of questions about the way households manage to cope with a lack of food and the results are expressed in a simple numeric score. It is a relatively simple and quick method, easy to understand, and correlates well with more complex measures of food security (Maxwell *et al.*, 2016). The simplified form can be used to observe the changes through time in the CSI score, to indicate whether household food security status is declining or improving. The coping strategies fall into the following four major categories (Maxwell *et al.*, 2016):

1. **Dietary change:** here, where Households change their favorite diet and start to

consume less preferred or less expensive food.

2. **Using short-term strategies:** this strategy involves households increasing their food supplies, by borrowing, purchasing on credit, begging or consuming wild foods and immature crops or even seed stock.
3. **Reducing the number of people in the household:** Here, Households reduce the number of the household members that they have to feed by sending some of them to eat elsewhere, for example, by sending children to eat with their neighbors.
4. **Reducing the portion sizes of meals:** This involves some household members staying the whole day without food favoring certain household members (Maxwell *et al.*, 2016).

2.2.12 Household Vulnerability Index and Principal Component Analysis

Principal Component Analysis (PCA) is a dimension-reduction tool that can be used to reduce a large set of variables to a small set that still contains most of the information in the large set. The PCA is a factor model in which the factors are based on summarizing the total variance. With PCA, unities are used in the diagonal of the correlation matrix computationally implying that all the variance is common or shared. Principal Component Analysis (PCA) seeks a linear combination of variables such that the maximum variance is extracted from the variables and can be used to develop weights for different indicators to produce a household vulnerability index (HVI) so as to classify households according to their level of vulnerability for the application of ordered logistic regression.

For the purpose of this study, the CSI methodology was adopted out of the above listed methods because it is a relatively simple and quick method, easy to understand, and correlates well with more complex measures of food insecurity (Maxwell *et al.*, 2016). Also the model can be used to observe the changes through time in the CSI score, to indicate whether household food security status is declining or improving. The Vulnerability was assessed in terms of Vulnerability expected Poverty (VEP) which has a strength advantage of being measured with a cross-sectional data.

Following Babatunde *et al.*, (2008), and Douglas and Martin (1994), CSI and factor analysis respectively was used to produce a household vulnerability index (HVI) so as to classify households according to their level of vulnerability. Ordered logistic regression was used to examine the determinant of vulnerability to food insecurity and the level of vulnerability to food insecurity by the households respectively. Ordered logit was chosen because the dependent variable has more than two categories and the values of each category have a meaningful sequential order where a value is indeed higher than the previous one.

2.3 Empirical Review

Various studies carried out in developing countries have highlighted a number of factors considered as determinants of household's vulnerability to food insecurity status. Adepoju and Yusuf (2012) in the study on poverty and vulnerability in rural South-west Nigeria reported that a total of 324 (55.7%) households were vulnerable using the relative poverty line of N3313.57 estimated for the study. This result indicates that vulnerable households were higher than the proportion actually poor in South Western Nigeria. This finding is in line

with findings from other studies by Chaudhuri *et al.*, (2002) and Kasirye (2007) in which the proportion of vulnerable is greater than the proportion of households actually poor. Adepoju and Yusuf (2012) also recommended in this study that poverty alleviation programs must focus not only on those factors which aggravate poverty but also vulnerability in order to employ several specialized approaches to tackle these multifarious problems.

Hussaini *et al.*, (2016) identified the determinants of food insecurity among farming households in Katsina State, north western Nigeria using a cross sectional sample survey, Focus Group Discussion and Key Informant Interview, coping strategy index and ordered logit. They found that majority (73%) of the households were vulnerable to food insecurity, 44% were less food insecure, while 17% and 12% were moderately food insecure and severely food insecure respectively. They concluded that food insecurity was high in the study area and therefore recommended that the farming households be provided with opportunities to diversify their livelihood activities.

Ogundari (2017) in a study on Categorizing households into different food security states in Nigeria: the socio-economic and demographic determinants found that households that consume only home produced food have high probabilities of being food insecure, while households that consume only market-purchased food are less likely to be food insecure. According to him, the implication of this finding is that harmonization of food security indicators helps identify households with different nature of food (in) security problems that require different types of policy interventions most especially in Nigeria. He recommends that market-based intervention policies that facilitate households' access at all

time to healthy foods of their choice should be given priority.

Greenwell and Pius (2012) in a study in Malawi on food security found that household food security is determined by credit access, age, sex of the household head, extension information, assets or wealth and education. Logistic, ordinary least square, and quintile regressions were used as an estimation method. In this literature age was found to have negative association with the food security status. The justification given is that even if young farmers tend to be less experienced, yet they are more food secure due to their dynamic and energetic nature. Ahmed (2015) used ordered logit regression to assess determinants of household food security and coping strategies in Ethiopia using method of CARE and WFP (2003). Biophysical, demographic and socio-economic data was collected and descriptive statistics such as mean, standard deviation, percentage and frequency distribution. Univariate analysis such as one way ANOVA and Chi-square tests were also employed to describe characteristics of food secure, food insecure without hunger, food insecure with moderate hunger and food insecure with severe hunger categories. The survey result shows that about 23% of sampled farmers were food secure.

A study in Pakistan by Asghar and Muhammad (2013) found that household size, household income, irrigation facility, and age determine food security. In contrast to the results by Greenwell and Pius (2012), Asghar and Muhammad (2013) found that age has a positive impact on household food security and justified that experience has more weight for a household status to be in food security. Adepoju and Kayode (2013) studied Food Insecurity Status of Rural Households during the Post-planting Season in Nigeria and

reported that almost half (49.4 percent) of rural households in the country were food insecure during the post-planting period, they however recommended that Identified food insecure households should be targeted for safety nets which could be in form of subsidized food prices during the post-planting period, as well as improved access to credit facilities especially in the rural North-Central, North-Eastern, South-Eastern and South-Western zones.

Nkegbe *et al.*, (2017) studied Food security in the Savannah Accelerated Development Authority Zone of Ghana using an ordered probit with household hunger scale approach. The study used data set from the baseline survey of the USAID's Feed the Future program. The instrumental variables include dietary diversity and food frequency, spending on food, Consumption behaviors, experimental behavior, and self-assessment measures. The result estimates show that crop producers, multiple crop producers, yield and commercialization are key policy variables that determine food security. A key policy implication of this result is in tandem with one of the inter-mediate results of the Ghana Feed the Future Initiative which seeks to increase competitiveness of food value chains through increased productivity and market access.

Welderufael (2014) studied the incidence of household food insecurity and the determinants of vulnerability to food insecurity respectively in Ethiopia and found that about 48% households were vulnerable to food insecurity in Amhara region in 2013, with much higher for rural households. The results obtained shows that those households with large family sizes; lower consumption expenditure, old age households, unemployed and male heads were more food insecure in urban areas. They

recommended policies should promote diversification of livelihoods and equal opportunities and rights to access resources, particularly in rural areas.

Opiyo *et al.*, (2014) analyzed household vulnerability to climate-induced stresses in pastoral rangelands farms of Kenya and found that 27% of households were highly vulnerable, 44% were moderately vulnerable and 29% of households were less vulnerable to climate-induced stresses. They recommend that policies that address these determinants of vulnerability with emphasis on women's empowerment, education and income diversifications are likely to enhance resilience of pastoral households. Yusuf and Oni (2008) analyzed the Determinants of Expected Poverty among Rural Households in Nigeria and found that both idiosyncratic and covariate factors affect the expected log per capita consumption of rural Nigerians. The implications for policy arising from their study's conclusion are that the appropriate region-specific policy for mitigating against expected poverty in the rural South West and North East zones would involve consumption smoothing strategies (e.g., meal subsidies, school feeding and food stamp programmes).

Thuita, Mwadime and Wangombe (2013) examined the effect of access to microcredit by women on household food security in three urban low income areas in Nairobi, Kenya and found that, households of microcredit clients consumed more nutritious and diverse diets compared to those of non-clients reflected in the dietary diversity scores for the two groups which were significantly different. Participation in microcredit programs led to improved food security in the households of clients. The study provides evidence that access to micro finance credit influences household food consumption

patterns positively in urban low income areas. This result is in line with a similar study by Alarcon *et al* (2016) for smallholder farm households in west highland of Guatemala who found that lack of access to credit and cash crop production displace food crops and household consumption of own production is reduced; Thus the household's vulnerability to food insecurity tends to increase.

Adepoju and Obayelu (2013) to analyze Livelihood diversification and welfare of rural households in Ondo State, Nigeria. They found that household size, total household income and primary education of the household head were the dominant factors influencing the choice of livelihood strategies adopted by the respondents and they recommend that the promotion of non-farm employment as a good strategy for supplementing the income of farmers as well as sustaining equitable rural growth. According to a study in Bangladesh by Majumder *et al.*, (2012) profession and crop cultivated, farm size and professional support found to be significant determinant of the household food security; In this study, it seems that variables like age and other household characteristics are not controlled.

Bahiigwa (2017) showed that inadequate labor, inadequate land, not growing enough food during the seasons and soil infertility, poor health, lack of planting materials, lack of oxen for ploughing were the main factors contributed to household food insecurity in Uganda. Asmamaw, Budusa and Teshager (2015) in the analysis of vulnerability to food insecurity in the case of Sayint district of Ethiopia, report that livestock ownership and access to off-farm employment opportunities were the most significant determinants of a household's vulnerability to food insecurity.

Fumane (2013) carried out a research on the gender analysis of determinants of vulnerability to food insecurity in South Africa and found that food insecurity is more prevalent in female-headed households (63.8%) compared to male-headed household (42.9%). The results of the regression analysis indicates that in male-headed households, vulnerability to food insecurity increases with age of the household head but it would decrease with an increase in household income and the employment status of the household head.

Babatude *et al.*, (2008) in their study of determinants of vulnerability to food insecurity among male and female-headed households in Kwara state of North-central Nigeria found out that, off-farm income, total household income and available labor hours were significantly higher in male than female-headed households. Furthermore, farm size and crop output were significant in determining vulnerability to food insecurity in male-headed households. In the female-headed households, age, education of household's head and off-farm income were the significant determinants. In both the types of households, food expenditure, household size and number of labor hours were identified as significant determinants of vulnerability to food insecurity.

A study by Bashir *et al.* (2012) in Pakistan concluded that household's monthly income and household head's education levels were positively impacting household food security. On the other hand, household heads' age and family size were negatively associated with household food security. The African Food Security Urban Network (AFSUN) conducted a food security survey of 11 Southern African cities. Their studies found strong links between

urban poverty and high levels of food insecurity at the household level (Crush *et al.*, 2012). Carter *et al.*, (2013:7) found that incidents of food insecurity are much higher in female headed households compared to male headed households. Females are most likely to be single parents than their male counterparts and this increases the burden of taking care of the needs of a household. A study conducted by Kassie *et al.*, (2012:14) in Kenya concluded that the change in chronic food insecurity between female-headed households and male-headed households is statistically significant.

Irin (2012), conducted an analysis of livelihood and food security status of households and vulnerable groups in Zimbabwe, Zambia and Malawi. It was found that female-headed households were more vulnerable to food insecurity in the three countries; rural women were poorer than men and had turned to casual agricultural labour as a primary source of income, this is similar to the result of Akinsanmi and Doppler (2005) that female-headed households in the South-eastern Nigeria were poorer and more vulnerable than their male counterpart.

As indicated above, several studies have identified some determinants of household vulnerability and argued that certain groups of households are more vulnerable to food insecurity and poverty. In order to know those households who are really mildly vulnerable, moderately vulnerable and those groups who are severely vulnerable to food insecurity in the study area, this study therefore extends on the above findings by categorizing the households into three (mild, moderate and severe) vulnerability levels to food insecurity and used ordered logit method of analysis.

2.4 Conceptual Framework

The conceptual framework for this study is derived from 1981 concept of entitlement to food by Sen. The entitlement approach to hunger discusses the ability of people to command food through the legal means available in the society. The dependent variable in this study is vulnerability to food insecurity which was proxied by Coping Strategy Index (CSI).

The independent variables in this study include food expenses, farm income, age of household head, and access to extension services, sex of household head, number of household dependent, household size, off-farm occupation, and number of days incapacitated by sickness.

The conceptual framework assumes that the independent variables have influence on the dependent variable which is vulnerability to food insecurity. The conceptual framework also assumes that the intermediate variables also have influence on background variables. These variables include agro-ecological factors, (drought, pest and diseases, postharvest management); institutional factors, (agricultural extension services, markets, and food prices); cultural factors, (land owned, seasonal feasting), and Social factors (loss of off farm job).

Factors contributing to food insecurity indicate a probability of failure to attain a certain threshold level of energy requirement for a healthy life. In the household level, less land ownership, drought or water scarcity, loss of off-farm jobs, poor technology, food price fluctuation are the main risk factors. Others include weak agricultural extension services, poor division of labour at the household level, financial inability to use improved seeds, fertilizers, pesticides, and herbicides and bad

farming practices leading to various environmental hazards.

Background variables in the conceptual framework consist of the short-term and long-term coping strategies. Income generating activities have influence on the dependent variable, access to food and farming activities which also have influence on household's income; which again influences the access to food which also affects the independent variables.

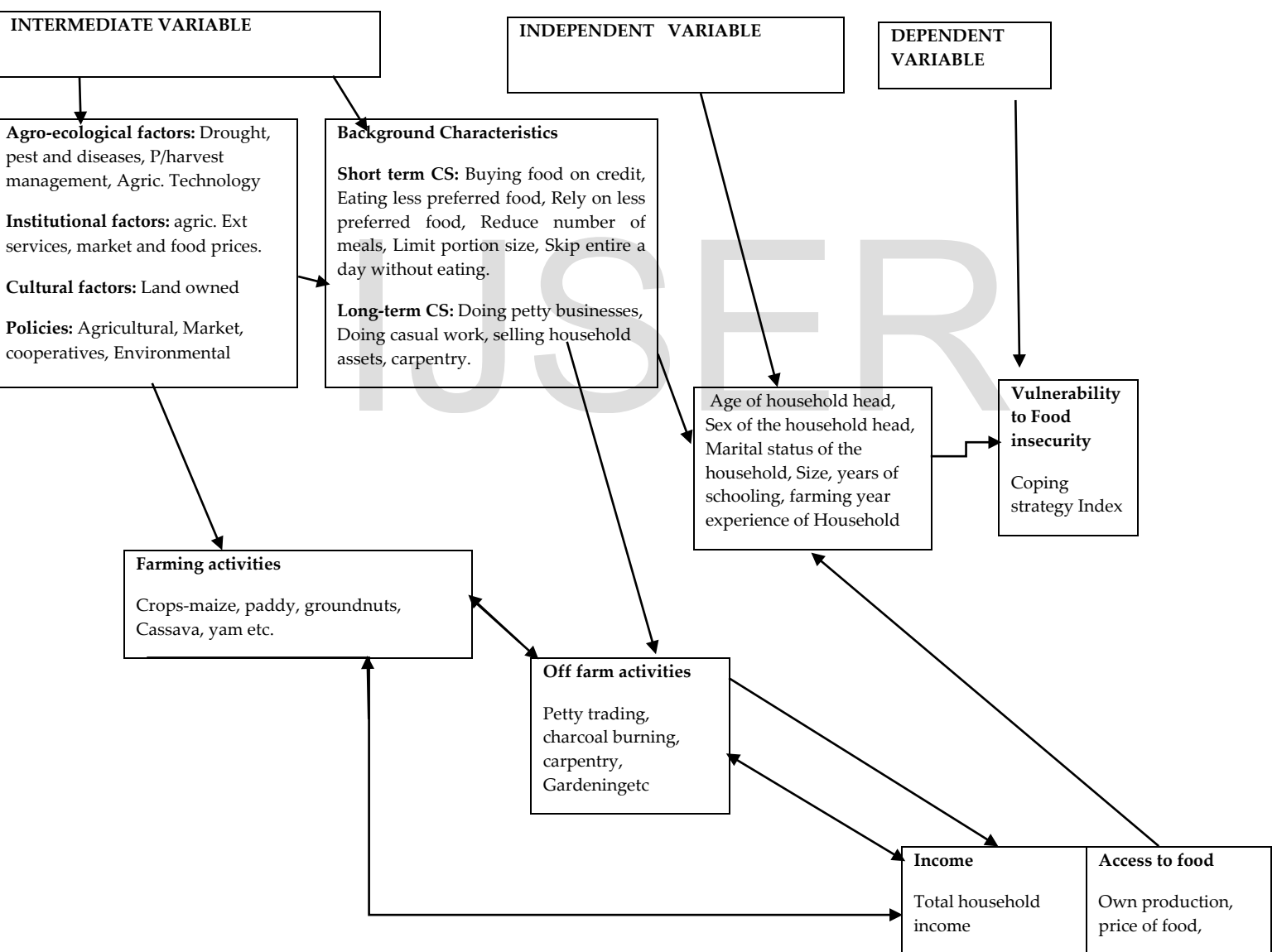


Fig 1: Conceptual framework for food insecurity and coping strategy. Adapted from: Sen (1981)

CHAPTER THREE RESEARCH METHODOLOGY

3.1 The Study Area

This study was carried out in Ekiti State of Nigeria. The state is located on latitude $7^{\circ} 15'$ North and longitude $4^{\circ} 45'$ and $5^{\circ} 45'$ east of the Greenwich meridian. The inhabitants of the state are mainly farmers, civil servants and petty traders. The state enjoys tropical climate with two seasons, namely rainy season (April-October) and dry season (November- March). The strategic location of the state allows both farm and non-farm activities to thrive side by side in the state and it has a good mix of male and female farmers.

Agriculture is the main occupation of the people and it provides income and employment for over 75% of the population in the state. The farmers in the state grow food and cash crops on both domestic and commercial scale. These include yam, beans, cassava, maize, plantain, cocoa, cashew, timber, colanut, palm produce, citrus, vegetable, mango, and cashew (Ministry This study was based on primary data collected through a cross-section survey of representative rural farming households in Ekiti state in South-western region of Nigeria. The data was

of Agriculture, Fisheries and forest Resources, Annual Report, 2006).

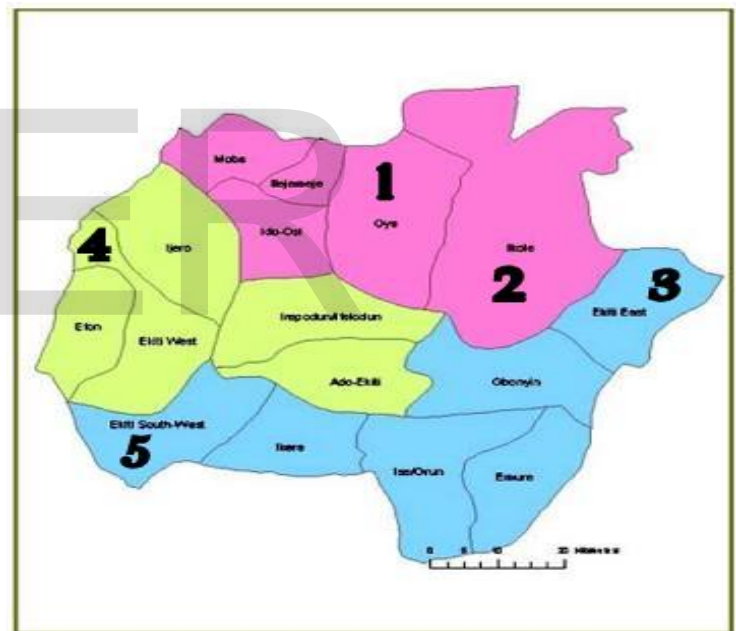


Figure 2: Map of Ekiti State with Numbers 1-5 Indicating the Sampled Area

Source: Adapted From Wikipedia, 2017

3.2. Sources of Data

obtained through field survey using semi-structured questionnaire.

3.3 Sampling Procedure and Sampling Size

A three-stage sampling procedure was used for this study. The first stage involved the random selection of five local governments out of the sixteen local government in the state. Secondly, three rural farming communities were randomly selected from each of the five local governments giving a total of 15 communities. In the last stage, ten (10) farming households were randomly selected from each community to give a total of 150 respondents that were sampled.

3.4 Limitations of the Study

This study used VEP because of data limitations and only captured the idiosyncratic risks and does not address covariate risks (community and national related risks like rainfall, radiation, notable diseases, price level and unemployment rates, among others.) affecting the households. Also, the study was only based on a cross-sectional sample survey of representative farm households but does not use panel data which could capture both cross-sectional and longitudinal characteristics of households in the study area.

Also, the study is limited to only food crop farmers in the study area such as yam, cassava, beans, maize, plantain, and rice growers.

3.5 Analytical Technique

Descriptive statistics, ordered logistic regression, Household Coping Strategy Index (CSI), and Likert scale were used to analyze the data for this study.

3.5.1 Socio-Economic characteristics of the farmers

Descriptive statistical technique was used to describe the socio-economic characteristics of the farmers. This technique involved the

construction of frequency distribution table and percentage which were used to describe the socio-economic profile of the farmers in the study area.

3.5.2 Level of Vulnerability to Food Insecurity by the Households (Objective 1)

CARE and WFP (2003) Household Coping Strategy Index (CSI) tool and factor analysis were used to generate the level of household food insecurity vulnerability in the study area. The CSI index is considered appropriate for studies on measuring vulnerability to food insecurity (Migotto *et al.*, 2005). The CSI index was calculated by multiplying the frequency and consensus severity of using a set of eleven coping strategies against food shortage related shocks. Following Douglas and Martins (1994), factor analysis was used to group the index into three levels of vulnerability (Mild, moderate and severely vulnerable).

3.5.3 Profile of Households' Vulnerability Level by their Socio-Economic Characteristics (Objective 2)

Descriptive statistical technique was used to profile the vulnerability level of the farmers by their socio-economic characteristics. This technique involved the construction of frequency distribution table and percentage which were used to describe the socio-economic profile of the farmers with respect to their vulnerability status in the study area.

3.5.4 Identify the Factors Determining Vulnerability of the Households to Food Insecurity (Objective 3)

Ordered Logistic regression was used to analyze the factors determining vulnerability of

the households to food insecurity. Ordered logit is a statistical technique that can sometimes be used with an ordered (from low to high) dependent variable (Long and Freese, 2001). Ordered logit was chosen because the dependent variable for this study has more than two categories and the value of each category has a meaningful sequential order where a category is ranked higher than the previous one. Following Greene (2006), the ordered logistic model is specified below:

$$Pr(Y_i > j) = \frac{\exp(\alpha_j + X_i \beta_j)}{1 + [\exp(\alpha_j + X_i \beta_j)]} \quad j = 0, 1, 2$$

Where Y_i = the dependent variable reflecting the 3 categories of vulnerability to food insecurity by the households:

$Y_i = 0$; Households who are mildly vulnerable (base group)

$Y_i = 1$; Households who are moderately vulnerable

$Y_i = 2$; Households who are severely vulnerable

α_j = the intercept term

3.5.5 Examine the Coping Strategies adopted by the Households against Food-Shortage Related Shocks (Objective 4)

Likert scale was used to analyze the coping strategies adopted by the household against food shortage related risks. The Likert scale of perception analysis was based on the coping behaviors which the households felt most severe, severe and least severe in the study area. The process involved the construction of frequencies and percentages based on a four point response scale specified below:

I. Strongly Agree =4

β_j = vector of parameter to be estimated

The explanatory variables are:

X_1 = Age of the household head (years)

X_2 = Household size

X_3 = Sex of household head (Male=1, otherwise =0)

X_4 = Marital status

X_5 = Farm income (naira)

X_6 = Education of household head (years)

X_7 = Food expenses (naira)

X_8 = Access to extension services (yes = 1, 0 = otherwise)

X_9 = Number of days incapacitated by sickness

X_{10} = Labor hours use (hour)

X_{11} = Off-farm occupation (Yes = 1, 0 = otherwise)

X_{12} = Number of dependants

X_{13} = Farm size (hectare)

X_{14} = Number of coping strategies

X_{15} = Non-food Expenses (Naira)

II. Agree =3

III. Strongly disagree =2

IV. Disagree = 1

Likert scales are survey questions that offer a range of answer options, from one extreme attitude to another and are quite popular because they are one of the most reliable ways to measure opinions, perceptions and behaviors (Monkey, 2017).

3.6 Definition and Measurement of Variables

I. Vulnerability level (Y_i)

This is the dependent variable reflecting the 3 categories of vulnerability to food insecurity by the households. These levels are mildly vulnerable (base group), moderately vulnerable and severely vulnerable.

II. Age (X_1): This referred to the numbers of years of the farmers from birth. Being a continuous variable, it was measured in years. According to Opiyo (2014), age is an important socio-economic factor determining how vulnerable a household could be and as people get older, their strength reduces making them to be more vulnerable especially if there is little or nothing to fall back on. The estimated coefficient of age was expected to be positive on the vulnerability to food insecurity

III. Household Size (X_2)

This refers to the total number of persons living and eating in the house and it is measured by the number of members within a household (Feleke *et al.*, 2005:355). This includes wives, children, and dependents. Increase in family size tends to increase the level of consumption of food and is a major determinant of vulnerability in developing countries (Babatunde *et al.*, 2008). The estimated coefficient of this variable was expected to be positive with respect to the vulnerability.

IV. Sex of Household Head (X_3)

This simply means the gender of the household head. This was measured as dummy with male receiving a score of 1 and otherwise a score of 0. The expected sign of the coefficient of this variable on the vulnerability was positive for female and negative for male.

V. Marital Status (X_4)

The estimated coefficient of marital status was expected to be negative. Married people tend to

have more children who can work on farm and more experiences of the cultural and social environment.

VI. Farm Income (X_5)

This means the streams of income flow from the farm output. This usually comes from sales of crops like cassava, cocoa, mango yam, maize etc. the expected sign of the coefficient of this variable was expected to be negative on the vulnerability.

VII. Education of Household Head (X_6)

This refers to the years spent in school towards achieving a formal academic learning skill. This is a categorical variable grouped into primary, secondary and tertiary levels of education. The estimated coefficient of this variable was expected to be negative.

VIII. Food Expenses (X_7)

This is the amount of money spent on food per month by the household. It was measured in naira. The sign of the coefficient was expected to be negative. This variable was measured in naira.

IX. Access to Extension Services (X_8)

This was measured as dummy with those households having access to extension services receiving a score of 1 and otherwise 0. Access to extension refers to access to improved information and feedback mechanism by the farmers from the change agents. This variable was included because access to extension services can improve productive capacity of the farmers as they get useful and practical information on production and technological advancement. The expected coefficient sign of

this variable was expected to be negative on the vulnerability.

X. Number of days Incapacitated by Sickness (X₉)

This refers to the days the farmers were unable to work on the farm due to one form of illness or the other. This variable was measured as discrete. The estimated sign of the coefficient of this variable was expected to be positive.

XI. Labor Hour use (X₁₀)

This means the number of minutes spent working on the farm. The estimated coefficient of this variable was expected to be negative. This variable was measured in hours.

XII. Off-farm Occupation (X₁₁)

This was measured as dummy with those who have access to extension services receiving a score of 1 and otherwise a score of 0. Off-farm occupation simply refers to the activities that bring money to the farmer outside their main farming occupation such as baking, carpentry, hawking, and security guards etc. The expected sign of the coefficient of this variable was expected to be negative on the vulnerability.

XIII. Number of Dependants (X₁₂)

This means the number of people who are eating from the family pot but do not contribute to welfare or the productive activities of the household. This variable was included to know the effect of the increase in size of household on vulnerability to food insecurity.

XIV. Farm Size (X₁₃)

This is the measurement of the length and breadth of the total farm land used in cultivation. This was measured in acres. The expected sign of the coefficient of this variable with respect to vulnerability was negative.

XV. Number of Coping Strategy (X₁₄)

This means the frequency of the behaviors the households used to adapt to food insecurity threat per month. The expected sign of the coefficient of this variable was positive. The higher the number of coping strategies used, the more food insecure a household is (Babatunde *et al.*, 2008).

XVI. Non-Food Expenses (X₁₅)

This means the amount of money spent on items that are not consumed as food such as clothes, household utensils, soap, shoes, wedding ceremony, payment of school fee, light bill, hospital bill etc. This variable was measured in Naira and the expected sign of the coefficient of the variable was expected to be positive.

Table 1: Expected signs of variables used in the regression.

Variable	Type	Expected signs	Authorities
Age of respondent	Discrete	+ve	Babatunde <i>et al</i> (2008), Fumane (2013), Welderufael (2014)
Household size	Discrete	+ve	Fumane (2013), Alarcon <i>et al</i> (2016) Welderufael (2014)
Education of household head (years)	Discrete	-ve	Babatunde <i>et al</i> (2008), Welderufael (2014)
Farm size	Continuous	-ve	Welderufael (2014), Bogale (2009)
Off-farm income	Continuous	-ve	Bogale (2009), Opiyo (2014)
Food expenses	Continuous	-ve	Carter, <i>et al</i> (2013), Alarcon <i>et al</i> (2016)
Access to extension services	Dummy (yes =1; 0= otherwise)	-ve	Welderufael (2014), Yusuf <i>et al</i> (2011)
Number of days incapacitated	Discrete	+ve	Opiyo (2014), Babatunde <i>et al</i> (2008),
Labor hours use	Continuous	-ve	Carter, <i>et al</i> (2013), Baulch (2013).
Gender	Dummy (male=1, 0=otherwise)	+ve	Welderufael (2014), Baulch (2013).
Off-farm occupation	Categorical	+ve	Welderufael (2014), Yusuf <i>et al</i> (2011)

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results and discussions of the socio-economic characteristics of the farmers, their levels of vulnerability, the variability in their vulnerability by socio-economic characteristics, the determinants of vulnerability and the coping strategies adopted by the households.

4.1 Socio-Economic Characteristics of the Farmers

4.1.1 Age of Household Head

Table 2 above revealed that 69.33% of the rural farmers were within the age range of 41-50 years with mean of 45 years. This implies that more than two-third of the farmers are strong and active and they can participate actively in farming activities. The result also revealed that the majority (98%) of the farmers were less than 61 years old, this implies that a large proportion of the farmers were within their prime age of 21 to 60 years. The possible explanation of this is that the food crop farmers in the study area belong to the middle age classes who are physically energetic and mentally strong to accept innovations on farming dynamics.

Table 3 above revealed that the majority (56.67%) of the rural farmers were married while 35.33% were divorced. The implication of this is that majority of the farmers tend to be united with better understanding as they carry out farming activities.

4.1.3 Household Size of Respondents

Table 4: Distribution of Respondents by Household Size

Table 2: Distribution of Respondents by Age

Age of respondent (years)	Frequency	Percentage	Cumulative Mean age Frequency
≤ 40	29	19.33	19.33
41-50	104	69.33	88.67 45
51-60	14	9.33	98.00
> 60	3	2.00	100
TOTAL	150	100	

Source: Field survey, 2017

4.1.2 Marital Status of Respondents

Table 3: Distribution of Respondents by Marital Status

Marital Status	Frequency	Percentage	Cumulative Frequency
Married	85	56.67	56.67
Divorced	53	35.33	92.00
Widowed	12	8.00	100
TOTAL	150	100	

Source: Field survey, 2017

Household Size	Frequency	Percentage	Cumulative Frequency
≤ 3	30	20.00	20.00
4-7	103	68.67	88.67
≥8	17	11.00	100
TOTAL	150	100	

Source: Field survey, 2017

Table 4 above revealed that the majority (68.67%) of the farmers had 4 to 7 family members who eat from the same pot. The table household in the study area. This finding is in conformity with previous study by Jacobs (2009) who found that households with many members consume more food than small households in rural farming communities.

4.1.4 Sex of Household Head

Table 5: Distribution of Respondents by Sex

Table 5 above revealed that 70% of the households were headed by males while 30% were headed by females. This means that rural farming was carried out more by families who have males as their heads. This result is consistent with the study of Welderufael (2014) who found that majority of farming household in rural community are headed by males.

4.1.5 Level of Education of Respondents

Table 6: Distribution of Respondents by Level of Education

Education Level	Frequency	Percentage	Cumulative Frequency
Primary	52	34.67	34.67

4.1.6 Farm Income of Respondents

Table 7: Distribution of Respondents by Farm Income

Farm Income (N)	Frequency	Percentage	Mean Income
≤ 3000	4	2.67	
3001-13,000	110	73.33	12,992
13,001-23,000	30	20.00	

also revealed that 11% of the farmers have highest number of household members. This means that more than one-tenth of the household consumed more food than other

Sex of Household Head	Frequency	Percent	Cumm Frq
Female	45	30.00	30
Male	105	70.00	100
TOTAL	150	100	

Source: Field survey, 2017

Secondary	14	9.33	44.00
Tertiary	84	56.00	100
TOTAL	150	100	

Source: Field survey, 2017

Table 6 above shows that majority (56%) of the households were highly educated. While 34.67% and 9.33% of the farmers had primary and secondary education respectively. This means that more than half of the farmers had tertiary education and able to think and use improved technology that can improve their welfare. This result is in line with previous studies by Fumane (2013) and Swain *et al.*, (2012) and who found that better educated people are able to improve the quality of labor for generating income and livelihood.

>23,000	6	4.00
TOTAL	150	100

Source: Field survey, 2017

Table 7 above revealed that the majority (73.33%) of the respondents earn between 3001 and 13,000 naira per month. The minority (about 24%) of the farmers earn above the mean income of 12,992 naira. Household income is regarded as the most critical determinant of household food security status (Jacob, 2009). The implication is that 2.67% of the farmers who earn less than or equal to 3000 naira may tend to be more food insecure than other household who earn higher amount of farm income in study area.

4.1.7 Farming Experience of the Respondents

Table 8: Distribution of Respondents by Farming Experience

Experien ce (Years)	Frequen cy	Percenta ge	Cumulati ve Frequenc y
≤ 2	6	4	4
3-5	37	24.67	28.67
6-9	94	62.67	91.33
≥10	13	8.67	100
TOTAL	150	100	

Source: Field survey, 2017

Table 8 revealed that the majority (62.67%) of the farmers had 6-9 years of experience. About 8% of the respondents have experience more than 10 years. The implication is that less than 10% of the farmers have more experience of farming and this may make them better in terms of farming methodology, disease and pest management, and other risks and contingencies

that affect farming than those who have relatively little farming experiences.

4.1.8 Farm Size of the Respondents

Table 9: Distribution of Respondents by Farm Size

Farm Size (Hectar e)	Frequenc y	Percentag e	Cumulati ve Frequency
≤ 0.4	36	24.00	24.00
0.8 - 1.2	63	42.00	66.00
≥1.6	51	34.00	100
TOTAL	150	100	

Source: Field survey, 2017

Table 9 above revealed that majority (42%) of the farmers had farm sizes between 0.8 and 1.2 hectares. It also showed that 34% of the farmers had the highest farm size in the study area. The possible implication is that 34% of the farmers tend to be more relatively food secure because increase in farm size leads to more cultivation and this may consequently attract more output and income. This result is in line with the findings of Bogale and Shimelis (2009) who found that increased farmland size is a major determinant of income and food security among developing countries.

4.1.9 Off-farm Occupation of the Respondents

Table 10: Distribution of Respondents by Off-farm Occupation

Occupati on	Frequen cy	Percenta ge	Cumulati ve Frequenc y
----------------	---------------	----------------	-------------------------------------

Not Engaged	101	67.33	67.33
Engaged	49	32.67	100
TOTAL	150	100	

Source: Field survey, 2017

As shown in table 10 above, 67.33% of the farmers were not engaged in off-farm occupation while only 49% of them engage in off-farm occupation. Off-farm occupation tends to increase the well-being of the households. It means that more than 60% of the farmers were worse-off in terms of food security and additional income flow from off-farm activities. This result is consistent with the findings of

Carter, *et al.*, (2013) and Baulch (2013) who found that off-farm occupation and income are instrumental to the socio-economic life of rural farmers in Africa.

4.2 Level of Households Vulnerability to Food Insecurity

Result (Table 11) showed that, out of 150 households that were sampled, only 33.33% were mildly vulnerable, 35.33% were moderately vulnerable while 31.33% were severely vulnerable to food insecurity in the study area.

Table 12: Distribution of Households by Vulnerability Level

Vulnerability category	Frequency	Percentage
Mildly vulnerable	50	33.33
Moderately vulnerable	53	35.33
Severely vulnerable	47	31.33
Total	150	100

Source: Field Survey (2017).

4.2.1 Classification of Households by Vulnerability Index

Classification of households into vulnerable groups is essential to know the cut-point for the household food insecurity status for necessary intervention programs (Ogundari, 2017). Table 13 below revealed the distribution of the respondents with respect to their vulnerability

index. The result shows that households who range between 0-0.4 are the vulnerable ones who are still able to cope, those with index 0.41-0.46 are the ones that need urgent but temporary external assistance to get out of shocks while the ones with emergency levels are those with index between 0.47 and 0.84.

Table 12: Classification of Households according to the Range of their Vulnerability Index

Vulnerability category	HH situation	Vulnerability Index	HH Percentage
Mildly vulnerable	In a vulnerable situation but still able to cope	0 to 0.4	33.33
Moderately vulnerable	Needs urgent but temporary external assistance to recover	0.41 to 0.46	35.33
Severely vulnerable	Emergency level HHs	0.47 to 0.84	31.33
Total			100

Source: Field Survey (2017).HH=Household

4.2.2 Description of Model Variables by Vulnerability Categories

As shown in Table 14 below, majority of households in the severely vulnerable category were headed by females, someone with household size more than 3 persons, household headed by persons above 50 years old, those who adopt more than 9 coping strategies against food shortage related shocks, those who have more than 2 dependents, those households with no off-farm occupation. Majority of households in the moderately vulnerable category were the ones with no access to extension service, farm income more than ₦23, 000/month, households who use more than 7 hours on labor per day. Majority of households in the mildly vulnerable group are those with

food expenses more than ₦23, 000/month. By contrast, a household is likely to be less vulnerable when they are headed by a male, the household head is literate, not divorced or widowed and when they have access to extension services.

Table 13: Statistical Description of Model Variables by Vulnerability Category

Vulnerability variables	Vulnerability Category		
	Mildly vulnerable	Moderate	Severely vulnerable
Age of HH head: 50+Years	3(6)	6(11.32)	8(17.02)
HH size: less than 4 persons	10 (20)	8(15.09)	12(25.53)
Sex of HH head: female	15(30)	10(18.87)	20(42.55)
Marital status: married	28(56)	28(52.83)	29(61.70)
Educational level: Primary Education	13(26)	16(30.2)	23(48.94)
Farm size: more than 1 acres	35(70)	38(71.70)	41(87.23)
Labor hours: more than 7hours/day	19(38)	21(39.6)	9(19.1)
Farm income: more than N23, 000/month	2(4)	3(6)	1(2)
Food expenses: more than N20,000/month	6(12)	1(1.89)	1(2)
Dependants: More than 2 persons	0	4(7.5)	7(14.9)
HH C.S: more than 9 coping strategies	9(18)	10(18.9)	27(57.4)
Visit by extension officers: no access to extension services	36(72)	44(83.01)	38(80.9)
Days incapacitated by sickness: < 4days	49(98)	49(92.45)	46(97.8)
Non-food expenses: >N20000/ month	(2)	0	3(6.4)
Off-farm occup.:No off-farm occupation	27(54)	35(66.04)	39(82.98)

Source: Field Survey (2017). HH=Household. (Number in parentheses are percentages)

4.2.3 Food Insecurity Level of the Households

Descriptive statistics was applied to the coping behavior data and the results (Figure 3 below) indicated that 19%, 11%, 29%, 25% and 16% of the households were food secure, food insecure, mildly food insecure, moderately food insecure and severely food insecure respectively. This means that less than one-fourth of the households are severely food insecure in the study area when it comes to using the coping strategies.

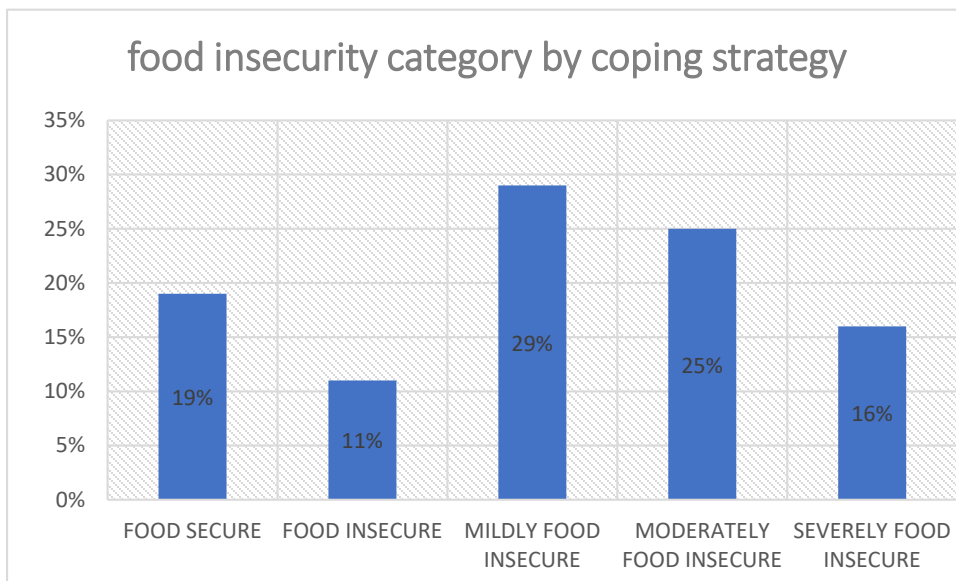


Figure 3: Food Insecurity Level by Coping Behavior

Source: Field survey, 2017

4.3 Profile of Household Vulnerability Status by Socio-Economic Characteristics

Profiling household’s food insecurity risk in terms of livelihood and socio-economic attributes have become an in excludable part of vulnerability measures (Ravallion, 2012). This aspect of the study juxtaposed the farmers’ social and economic profile vis-a-vis their respective vulnerability categories.

4.3.1 Age of Household Head

Table 14 below revealed that 8, 11 and 10 out of every 29 farmers who are less than 41 years old were mildly, moderately and severely

vulnerable respectively in the study area. A total number of 104, 14 and 3 out of 150 households had ages between 41 and 50, 51 and 60, and greater than 60 respectively in the study area. This means that more than one-third of the households were relatively mildly vulnerable to food insecurity. This may be due to the fact that they are in between the productive age of 41 and 50 years. The table also revealed that farmers who were more than 60 years old were severely vulnerable to food insecurity in the study area. This finding is in line with the findings of Kurosaki (2017) who found that elderly people tend to be less food secure in developing countries.

Table 14: Distribution of Household Vulnerability by Age

Age(years)	Mild	Moderate	Severe	Total
≤ 40	8(16)	11(20)	10 (21)	29
41-50	39 (78)	36(67.92)	29(61.7)	104
51-60	3 (6)	5(9.43)	6(12.77)	14
>60	0	1 (1.9)	2 (4.3)	3

Total **50** **53** **47** **150**

Source: Field survey (2017). Figures in parentheses are percentages

4.3.2 Household Size of Respondent

Table 15 below revealed that 10, 8 and 12 out of every 30 farmers who headed household size which were less than 4 members were mildly, moderately and severely vulnerable respectively in the study area. A total number of 103 and 17 out of 150 households had household sizes between 4 and 7, and greater than 8

members respectively in the study area. The result shows that vulnerability were fairly distributed among household who had households greater than 8 in the study area. The majority (103) of the farmers had between 4 and 7 family members, the possible explanation of this is that more than two-third of the farmers had household sizes below 8 members.

Table 15: Distribution of Household Vulnerability by Household Size

HH size	Mild	Moderate	Severe	Total
≤ 3	10 (20)	8(15.09)	12(25.53)	30
4-7	35(70)	38(71.70)	30(63.83)	103
≥ 8	5(10)	7(13.21)	5(10.64)	17
Total	50	53	47	150

Source: Field survey (2017). Figures in parentheses are percentages

4.3.3 Farm Size of the Respondent

Table 16 below revealed that 15, 15 and 6 out of every 36 households who had farm size less than 0.8 hectares were mildly, moderately and severely vulnerable respectively in the study area. A total number of 63 and 51 out of 150 households had farm sizes between 0.8 and 1.2, and greater than 1.6 hectares respectively in the study area. The result also showed that Majority of the households who are severely vulnerable were those who cultivate lower amount of farmland in the study area and this may be the possible explanation behind their higher vulnerability status. This result is in line with the findings of Bogale and Shimelis (2009) who found that increased farmland size is a major determinant of income and food security among developing countries.

Table 16: Distribution of Household Vulnerability by Farm Size

Farm Size(ha)	Mild	Moderate	Severe	Total
≤ 0.4	15(30)	15(28.3)	6 (12.77)	36
0.8 -1.2	16(32)	20(37.74)	27(57.4)	63
≥ 1.6	19(38)	18(33.96)	14(29.79)	51
Total	50	53	47	150

Source: Field survey, 2017. Figures in parentheses are percentages

4.3.4 Farm Income of the Respondents

Table 17 revealed that 1 and 3 out of every 4 farmers who earn less than 3,000 naira per month were mildly and severely vulnerable respectively in the study area. A total number of 110, 30 and 6 out of 150 households had farm income between 3,001 and 13,000 naira, 13,001 and 23,000, and greater than 24,000 naira per month respectively in the study area. Farm income is crucial to the welfare of the farmers.

The result also revealed that among the farmers, those who were severely vulnerable are those who earn less amount of farm income. This is expected and it is in line with previous study by Bogale and Shimelis (2009) who found that increased in income flow reduces the risk of being food insecure among the pro-poor rural communities in developing countries.

Table 17: Distribution of Household Vulnerability by Farm Income

Farm Income(naira)	Mild	Moderate	Severe	Total
≤ 3,000	1(2)	0	3(6.4)	4
3,001-13,000	39(78)	37(69.8)	34(72.3)	110
13,001 - 23000	8(16)	13 (26)	9 (19.1)	30
≥24,000	2(4)	3(5.66)	1 (2.1)	6
Total	50	53	47	150

Source: Field survey (2017). Figures in parentheses are percentages

4.3.5 Education Level of Household Head

Table 18 below revealed that 13, 16 and 23 out of every 52 farmers who only had primary education were mildly, moderately and severely vulnerable respectively in the study area. A total number of 14 and 84 out of 150 households had secondary and tertiary education respectively in the study area. This means that more than two-third of the

respondents had tertiary level of education and the consequence of this is reflected in their relatively low severity of vulnerability. This is in line with previous studies by Babatunde *et al.*,(2008), and Kayode and Adepoju (2013) who found that education is a significant determinant of food security among rural farming household as it gives farmers opportunity to access credit and other inputs sources.

Table 18: Distribution of Household Vulnerability by Education Level

Education Level	Mild	Moderate	Severe	Total
Primary	13(26)	16(30)	23 (48.93)	52
Secondary	8(16)	3(5.6)	3 (6.38)	14
Tertiary	29 (58)	34(64.1)	21(44.68)	84
Total	50	53	47	150

Source: Field survey (2017). Figures in parentheses are percentages

4.3.6 Number of Dependants of Households

Table 19 below revealed that 43, 43 and 29 out of every 109 households who have less than 3 household dependents were mildly, moderately and severely vulnerable respectively in the study area. A total number of 30 and 11 out of 150 households had between 3 and 5, and greater than 5 dependents respectively in the study area. This means that more than 72% of the farmers had less than 2

household’s dependents in the study area. Result also showed that among the household with the greatest number of dependents, those who are severely vulnerable have the highest number of household dependents. This result is in line with the study of Kassie *et al.*, (2012) who found that increase in household dependents has the tendency to increase vulnerability to food insecurity among rural households.

Table 19: Distribution of Household Vulnerability by dependents

Dependants	Mild	Moderate	Severe	Total
≤ 2	43(86)	43(81)	29(61.7)	109
3-5	7(14)	12 (22.6)	11 (23.4)	30
≥ 6	0	4(7.5)	7 (14.89)	11
Total	50	53	47	150

Source: Field survey (2017).

4.3.7 Sex of Household Head

Table 20: Distribution of Household Vulnerability by Gender

Sex of HH Head	Mild	Moderate	Severe	Total
Female	15(30)	10 (18.86)	20(42.5)	45
Male	35(70)	43 (81)	27 (57.4)	105
Total	50	53	47	150

Source: Field survey (2017).

Table 20 above shows that male-headed households are more vulnerable than female headships. But one must be careful while analyzing this result as sample size in both groups is different. Male headed households are more than 2 times greater than female headed households in study area. About 70% of the households are male headed. This result is

consistent with previous study by Welderufael (2014). However, among the female heads, the number of vulnerable households are more than those who are mildly vulnerable. It should be noted that the logistic regression result shows that female headed households are more vulnerable than male headed households and significant at 10% level of probability.

4.3.8 Marital Status of Respondent

Table 21: Distribution of Household Vulnerability by Marital Status

Marital Status	Mild	Moderate	Severe	Total
Married	28(56)	28 (52.8)	29(61.7)	85
Divorced	16(32)	20(37.7)	17(36.2)	53
Widowed	6 (12)	5(9.4)	1 (2.13)	12
Total	50	53	47	150

Source: Field survey (2017).

Table 21 above revealed that 28, 28 and 29 out of every 83 farmers who were married were mildly, moderately and severely vulnerable

respectively in the study area. A total number of 53 and 12 out of 150 households were divorced and widowed respectively in the study area.

4.3.9 Off-farm Occupation

Table 22: Distribution of Household Vulnerability by Off-farm Occupation

Occupation	Mild	Moderate	Severe	Total
Not Engaged	27(54)	35(66.03)	39(83)	101
Engaged	23(46)	18(33.96)	8(17.02)	49
Total	50	53	47	150

Source: Field survey (2017).

Table 22 above revealed that 27, 35 and 39 out of every 101 household heads who were not employed were mildly, moderately and severely vulnerable respectively in the study area. A total number of 23, 18 and 8 out of 49 households who were employed were mildly, moderately and severely vulnerable respectively to food insecurity in the study area. It means that more than two-third of the farmers were not employed in the study area. The possible implication is that more than two-third

of the farmers has the tendency to be relatively worse-off when it comes to income flow and consequently better welfare because off-farm occupation will generate additional income which can be used to purchase inputs, food and other materials. This result is in line with previous study by Ahmed (2015) who found that off-farm occupation and income tend to improve the livelihood of rural farmers in developing countries.

4.4 Econometric Results

Following Babatunde *et al.*, (2008) and CARE & WFP (2003), Household Coping Strategy Index (CSI) was used to measure vulnerability to food insecurity and factor analysis (following Douglas and Martin (1994)) was used to group the index into three. Although 15 variables were hypothesized to be correlated with vulnerability to food insecurity, the ordinal Logistic regression result confirmed that only 10 factors were significant (at 1%, 5% and 10%) in influencing households' vulnerability.

Accordingly, among variables fitted into the model (Table 23), age of the household head,

marital status, education level, number of household dependents, farm income, non-food expenses, access to extension services, labor hour use, off-farm occupation, numbers of coping strategies were found to be significant in determining household vulnerability to food insecurity.

The chi-squared test p-value is 0.00, indicating that the coefficients of independent variables are not jointly equal to zero. Moreover, the model fit is within the range expected for cross-sectional data with a PseudoR² of 0.175. The Log likelihood of -135.8 and LR chi² of 57.61 show that the model is well fitted.

Table 23: Ordered Logit Coefficient Estimates for the Determinants of Vulnerability to Food Insecurity.

Variables	Coefficient	Standard Error	Z	P> z
Age (X ₁)	0.0934685	0.0286897	3.26	0.001***
Household Size (X ₂)	0.069463	0.096621	0.72	0.472
Sex of HH head (Male) (X ₃)	-0.2498703	0.386263	-0.65	0.518
Marital Status (married) (X ₄)	-0.521623	0.2748845	-1.90	0.058*
Education Level (X ₅)	-0.6669171	0.3094742	-2.16	0.031**
Farm size (X ₆)	-0.0412473	0.117478	-0.35	0.726
Farm income (X ₇)	-6.52e-05	2.66-e05	-2.45	0.014**
Dependents (X ₈)	0.345322	0.1244206	2.78	0.006***
Non-food expenses (X ₉)	9.24e-05	4.85e-05	1.91	0.057*
Access to extension (X ₁₀)	-0.724759	0.4331992	-1.67	0.094*
Labor hour use (X ₁₁)	-0.1977927	0.1022943	-1.93	0.053**
Off-farm occupation (X ₁₂)	-0.6482449	0.3840906	-0.69	0.091*
Food expenses (X ₁₃)	-7.59e-06	3.47e-05	-0.22	0.827
Coping strategy (X ₁₄)	0.1081576	0.0402323	2.69	0.007***
Days incapacitated by sickness (X ₁₅)	0.0630359	0.1416702	0.44	0.656
μ ₁	3.005051			
μ ₂	5.009322			

Source: Field Survey (2017). Number of observation =150, LR chi² (15) = 57.61, Probability> chi² = 0.0000, Pseudo R²=0.1750, Log likelihood = -135.80514. * Significant at 10%, **Significant at 5%, ***Significant at 1%

The estimated cut-off points (μ) satisfy the conditions that μ₁ < μ₂ < μ₃. This implies that these categories are ranked in an ordered way (Knight *et al.*, 2005). The first cut-off point (Y=0 for “mildly vulnerable group”) was used as a mark for the purpose of comparison. Estimated coefficients are presented in table 23 and marginal effects in table 24. The independent variable signs are interpreted with respect to the base, mildly vulnerable.

Estimated coefficients from an ordered logit model are difficult to interpret because they are in log-odds units; as such, the marginal effects (Table 24) are discussed. The marginal effects, calculated at the mean of the continuous independent variables, were provided by STATA 12 based on either continuous or

discrete variables. Marginal effects are interpreted relative to the category and sign. A positive coefficient for a category indicates an increase in that variable increases the probability of being in that category, whereas, a negative coefficient indicates a decrease in probability of being in that category. Nine variables have significant marginal effects (*p* values ≤0.1) in two equations: age of the household head, marital status, education level, and number of household dependents, farm income, non-food expenses, labor hour use, off-farm occupation and numbers of coping strategy used.

A unit increase in age of the household head will cause 1.872% decrease in probability of the household being mildly vulnerable, 0.07%

increase in the probability of the household being moderately vulnerable and 1.799% increase in probability of the household being severely vulnerable to food insecurity in the study area. Age is significant at 1% level of probability and has a positive relationship with food insecurity in both the moderate and severely vulnerable categories but not significant in the moderately vulnerable group. This finding is consistent with previous studies by Opiyo (2014) and Babatunde *et al.*, (2008) who found that elderly farmers are relatively less productive in rural communities of Kenya and Kwara State of Nigeria respectively.

The possible explanation of this result is that as age increases, vulnerability to food insecurity tends to increase in moderately and severely vulnerable households. Age is an important socio-economic factor determining how vulnerable a household could be. Households headed by persons above the mean age of 45 years are more likely to be vulnerable compared with the younger persons in the study area. Consequently, elderly household heads are probably worse off in terms of labor strength and preparing strategies to cushion their families against adverse food security threats and impacts and likely to make them more vulnerable.

The coefficient of marital status (married) of the households is both negative and significant at 10% level of probability in both moderate and severely vulnerable groups. But it is positive in the mildly vulnerable groups. It means that married people who stay together are less likely to increase the probability of being moderately and severely food insecure by 0.04% and 10% respectively than single or married household heads who are separated or widowed in the study area. This result is similar to studies by studies which conclude that married couples

are more likely to be food secure Elijah (2010) and Kaloi *et al.*, (2005) who concluded that married couples were likely to be more food secure than single headed households. Education level coefficient is positive and significant at 5% level of probability in mildly vulnerable households but negative and significant at 5% level in severely vulnerable households while it is negative but not significant in the moderately vulnerable groups. The implication of this is that as more people get educated in the study area, the probability of the households being mildly food insecure increases, the chances of being moderately and severely food insecure decreases respectively. This is due to the fact that education equips individuals with the necessary knowledge of how to make a living. This result conforms to previous study by Welderufael (2014) who found that the effect of education on food security works indirectly by influencing the actions of the farmers in how to make a living.

Household size though not significant, has a positive relationship with food insecurity in both the moderately and severely food secure groups but negatively related to food insecurity vulnerability in the mildly vulnerable group. The implication of this result is that as family size increases by one, households will be more vulnerable to food insecurity than preceding unit for both moderately and severely vulnerable groups. It means that the amount of food for consumption in the household increases thereby that additional household member shares the limited food resources. This result is in conformity with the findings of Welderufael (2014) and (Ikpi and Kormawa, 2004) who found that increase in family size is positively correlated to food insecurity.

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Table 24: Marginal Effects of the Ordered Logit Regression

Variables	Mildly Vulnerable				Moderately Vulnerable				Severely Vulnerable			
	dy/dx	S.E	Z	P> z	dy/dx	S.E	Z	P> z	dy/dx	S.E	Z	P> z
Age	-0.0187	0.0057	-3.24	0.001***	0.00072	0.00279	0.26	0.796	0.0179	0.0056	3.21	0.001***
Household Size	-0.0139	0.0194	-0.72	0.474	0.00053	0.00223	0.24	0.811	0.0133	0.0185	0.72	0.471
Sex of HH head (Male)	0.0488	0.07393	0.66	0.508	0.00034	0.00832	0.04	0.967	-0.0492	0.0777	-0.63	0.526
MaritalStatus (married)	0.1044	0.0551	1.89	0.058*	-0.0040	0.01567	-0.26	0.797	-0.1004	0.0532	-1.89	0.059*
Education Level	0.1335	0.0623	2.14	0.032**	-0.00514	0.02005	-0.26	0.798	-0.1284	0.0598	-2.15	0.032**
Farm size	0.0082	0.0235	0.35	0.725	-0.000318	0.00153	-0.21	0.836	-0.0079	0.0226	-0.35	0.725
Farm income	1.31e-05	1e-05	2.43	0.015**	-5.03e-07	1e-05	-0.26	0.797	-1.26e-05	1e-05	2.42	0.015**
Dependents	-0.0691	0.0249	-2.78	0.006***	0.00266	0.01031	0.26	0.796	0.0664	0.0242	2.74	0.006***
Non-food expenses	-1.85e-05	1e-05	-1.91	0.056*	7.12e-07	1e-05	0.26	0.797	1.78e-05	1e-05	1.88	0.060*
Access to extension	0.1567	0.0993	1.58	0.115	-0.0315	0.03924	-0.80	0.421	-0.1251	0.0666	-1.88	0.061*
Labor hour use	0.0396	0.0205	1.93	0.054**	-0.00152	0.00593	-0.26	0.797	-0.0380	0.0198	-1.92	0.055*
Off-farm occupation	0.1355	0.0832	1.63	0.103*	-0.0177	0.0257	-0.69	0.491	-0.1177	0.0660	-1.78	0.074*
Food expenses	1.52e-06	1e-05	0.22	0.827	-5.85e-08	1e-05	-0.17	0.869	-1.46e-06	1e-05	-0.22	0.827
Coping strategy	-0.0216	0.0081	-2.67	0.008***	0.000833	0.00324	0.26	0.797	0.0208	0.0077	2.67	0.008***
Days Incapacitated by sickness	-0.0126	0.0283	-0.45	0.656	0.00048	0.00216	0.23	0.822	0.0121	0.0273	0.44	0.657

The dy/dx are for the discrete change in the qualitative 0–1 variables. S.E = Standard Error. * Significant at 10%, **Significant at 5%, ***Significant at 1%

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The table also shows that a unit increase in the male headship will lead to 0.0003428 increase in the probability of being in moderately vulnerable group and 0.0488 increase in probability of being in the mildly vulnerable category while it will reduce the probability of being in the severely vulnerable group by 4.9%. The possible explanation is that female headed households are more severely vulnerable to food insecurity than male headed households in the severely vulnerable category. This might be due to the fact that female headed households do have less access to and control over major agricultural resources even though they do much of the agricultural work. In addition, plowing (digging) of land is done manually in the study area as opposite to other parts of the country, where oxen are used for this purpose. This finding is consistent with findings of Kassie *et al.* (2012) who found that female headed households are traditional and physically incapable of performing plowing activities as such, hence, they are found among the poor and lack income and resources that constrain their productivity.

A unit increase in farm income will increase the probability of being in the mildly vulnerable category, reduce the probability of being in moderately and severely vulnerable category respectively. The coefficient of this variable is significant at 5% level of probability for both the mildly vulnerable and the severely vulnerable groups. The negative effect indicates that an increase in monthly farm income will reduce the chances of a household becoming severely and moderately food insecure in the study area. This finding is consistent with previous studies by Bogale and Shimelis, (2009), Bashir *et al.*, (2012).

Income is often used to buy inputs such as improved seed varieties and fertilizer that increase production levels of the household. In

addition, households that have better farm income opportunities are less likely to become food insecure than households who have less or little farm income flow, this is due to the fact that an increase in income will have an effect because the change in income will lead to constant change in expenditure. Thus, the additional income received increases the stable income so that capacity of the households to consume more will increase.

A unit increase in the number of dependent will increase the probability of being in severely and moderately vulnerable category while reducing the probability of being in the mildly vulnerable category. This variable is significant at 1% level of probability in both mild and severely vulnerable group but not significant in the moderately vulnerable category. The implication of this result is that the more dependents a household has, the less likely to be mildly vulnerable and the more likely for it to be moderately and severely vulnerable since a larger proportion of household resources are directed to dependents who cannot contribute much toward household welfare. This finding is consistent with the findings of Opiyo (2014).

The coefficient of Non-food expenses is significant at 10% both for the mildly and severely vulnerable households but not significant for the moderately vulnerable households. This variable has an inverse relationship with food insecurity in the mildly vulnerable groups and a direct positive relationship with the severe and moderately vulnerable groups. The implication is that a unit rise in spending on non-food items will reduce the probability of a household being mildly food insecure and increase the likelihood of the household being moderately and severely food insecure.

A unit increase in Access to extension services will increase the probability of a household being mildly vulnerable. This increase will reduce the chances of being moderately and severely vulnerable to food insecurity in the study area at 10% level of probability respectively. This is because contact with extension services tends to enhance the chances of a household having access to better and improved varieties of crop. Access to extension services is believed to be crucial for food production, because it gives the farmers the opportunity to learn new production techniques that can increase their yield and improve their present and future food security situation. This result is consistent with the findings of Yusuf *et al* (2011) and Lemma (2014)

The coefficient of Labor hour use is negative both for the moderate and severely vulnerable groups respectively implying that a unit rise in hours spent on farm labor will reduce the probability of the households being moderately and severely food insecure. The coefficient for this variable is positive and significant at 5% for the mildly vulnerable group indicating that a unit increase in labor hour will increase the likelihood of being mildly vulnerable by 3.9%. More energy expended at work means greater work done, this can accelerate production, harvesting and processing of crops on the farm thereby contributing to total output and reducing food insecurity likelihood more than the case where less hours are spent on labor This result is consistent with the findings of Carter, *et al* (2013) and Baulch (2013) on the study of food insecurity in new Zealand and West Africa respectively.

A unit increase in off-farm occupation will reduce the probability of a household being moderately and severely food insecure and increase the chances of being mildly food

insecure. This variable is not significant for the moderately vulnerable groups but significant for both mildly and severely vulnerable respectively at 10% level of probability. Access to employment opportunities help to diversify and increase amount of income received by households.

The marginal effects also shows that a unit rise in food expenses will increase the probability of being in mildly vulnerable groups by 0.0015% and reduce the probability of being moderately and severely vulnerable to food insecurity by 0.00000058% and 0.00000146% respectively in the study area. As the number of coping strategies increases, the likelihood of being mildly vulnerable reduces, the chances of being moderately and severely vulnerable increases in the study area. This variable is significant at 1% for the mild and severely vulnerable groups respectively.

4.5 Coping Strategies

Coping strategies refers to the behaviors households adopt to adapt to adverse effect of food insecurity (Hoddinott, 1999). About 11 coping strategies were adopted by the households against food-shortage related shocks in the study area. This depict what the households do when they don't have enough food or money to buy food, this include relying on less preferred food, borrowing food, buying food on credit, gathering wild food, eating seed stock, allowing household members to eat elsewhere, begging for food, limiting portion of food, restricting adult at meal, reducing meal and skipping days without eating.

Likert scale was used to analyze the consensus coping strategies adopted by the households. Figure 3 and table 26 below show the graphical and tabular result of the Likert scale analysis.

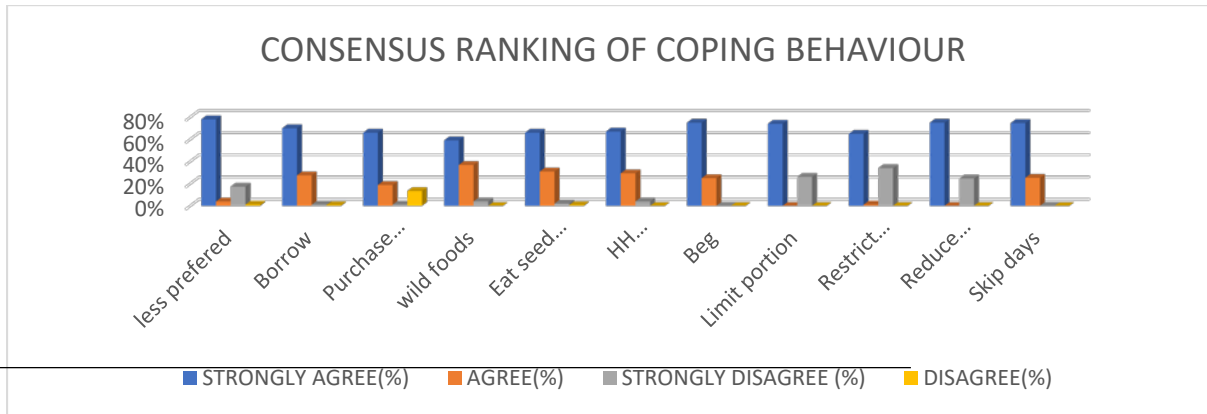


Figure 4: Consensus Ranking of Household Coping Strategies

Source: Field Survey, 2017

The graph above shows that 78%, 74%, and 75% of the total households strongly agreed that relying on less preferred food, limiting portion of food and reducing meals respectively are the least severe coping strategy in the study area. About 70%, 66% and 67% of the total household chose borrowing food, purchasing food on credit and allowing household members to eat elsewhere as moderately severe respectively.

About 59% 75%, and 75% of the households chose gathering of wild foods, begging for food and skipping days without eating as very severe respectively. About 66% and 65% of the households strongly agreed that eating seed stock and restricting adults at meal are severe respectively. The result of the coping strategy consensus ranking are also presented in table 26.

Table 25: Consensus Ranking of Coping Behavior

COPING STRATEGY	RANKING	INTERPRETATION
Less preferred food	1	Least Severe
Borrow food	2	Moderately Severe
Purchase food on credit	2	Moderately Severe
Gathering wild foods	4	Very severe
Eat seed stocks	3	Severe
HMembers eat elsewhere	2	Moderate Severe
Beg for food	4	Very severe
Limit portion of food	1	Least Severe
Restrict Adults at meal	3	Severe
Reduce number of meals	1	Least Severe
Skip days	4	Very severe

Source: field survey (2017).

The result (Table 27) shows that households who rely on less preferred food, borrow, limit portion of food, eat elsewhere and those who never ate wild food have higher number of frequencies.

Table 26: Statistical Description of Use of Coping Strategy

Strategy \ Freq.	Less preferred	Borrow	Buy on credit	wild food	Eat seed stock	HH eat elsewhere	Beg	Limit portion	Restrict adult	Reduce meal	Skip days
Everyday	87(58)	12(8)	17(11.3)	0	0	7(4.67)	12(8)	98(65.3)	15(10)	12(8)	0
3-6 times a week	29(19)	50(33.3)	62(41.3)	7(4.67)	8(5.33)	16(10.67)	93(62)	19(12.67)	42(28)	83(55.3)	8(5.33)
1-2 times a week	28(18)	75(50)	56(37.3)	11(7.33)	1(0.67)	115(76.67)	35(23.3)	27(18)	74(49.3)	40(26.67)	12(8)
Hardly at all	6(4)	13(8.67)	13(8.67)	2(1.33)	69(46)	10(6.67)	7(4.67)	3(2)	14(9.33)	14(9.33)	27(18)
Never	0	0	2(1.33)	130(86.6)	72(48)	2(1.33)	3(2)	3(2)	5(3.33)	1(0.67)	103(68.7)
TOTAL	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)	150(100)

Source: Field survey (2017). (Figures in parenthesis are percentages)

Figure 5 below shows the graphical result of the food security categories by coping strategies that were obtainable in the study area.

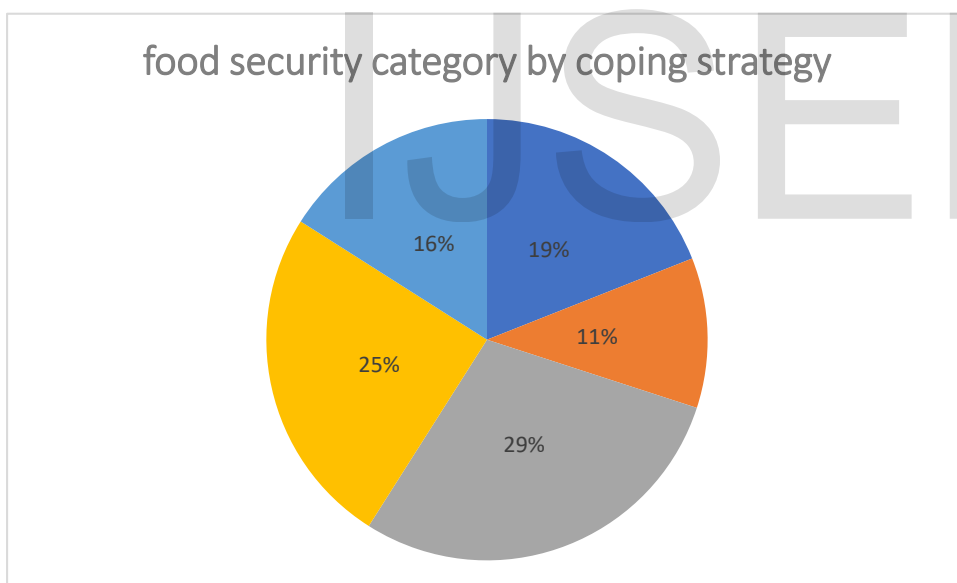


Figure 5: Food Security Category by Coping Strategy

Source: field survey (2017).

The chart (Figure 5) above revealed that households who use the coping strategy everyday are severely food insecure, those who use the coping strategies 3-6 times a week are moderately food insecure, those who use the strategies once or twice a week are categorized as mildly food insecure, households who hardly

use the strategies are food insecure while household who never use any of the coping strategies are food secure. The graph shows that 19%, 11%, 29%, 25% and 16% of the households are food secure, food insecure, mildly food insecure, moderately food insecure and severely food insecure respectively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Major Findings

This study examined the technology of vulnerability to food insecurity among rural farming households in Ekiti state, south western Nigeria. Specifically, the study focused on five objectives which were to: determine how vulnerable the households are to food insecurity in the study area; profile households vulnerability by their socio-economic characteristics; determine whether households differ in vulnerability by socio-economic characteristics; identify the factors determining vulnerability of the households to food insecurity; and examine the coping strategies adopted by the households against food-shortage related shocks in the study area.

A three-stage sampling procedure was used for this study to give a total of 150 respondents that were sampled. Statistical tools used to analyze the data were descriptive Statistics, factor analysis, Likert scale, and ordinal logistic regression, the study also used the subjective approach Coping Strategy Indices (CSI) tool to measure households vulnerability to food insecurity based on respondent's frequency and severity of using coping strategies.

The result obtained on the socio-economic characteristics of the farmers in the study area revealed that majority of the farmers were male (70%), aged between 41 and 50 years (69.33%) with mean age of 45 years, married (56.67%), household size between 4 and 7 members (68.67%), had tertiary education (56%), had between 6 and 9 years farming experience, and not employed (67%). Result of the level of

vulnerability analysis revealed that 33.33%, 35.33% and 31.33% of the farmers were mildly, moderately and severely vulnerable to food insecurity respectively in the study area.

The ordinal regression result revealed that age of the household head, marital status, education level, number of household dependants, farm income, non-food expenses, access to extension services, labor hour use, off-farm occupation, and numbers of coping strategy were found to be significant in determining household vulnerability to food insecurity in the study area.

5.2. Conclusions

Based on the findings from this study, it can be concluded that there is a little difference among the farmers in terms of the three categories of vulnerability to food insecurity; mild (33.33%), moderate (35.33%) and severely vulnerable (31.33%). The vulnerability status is fairly distributed. The findings from the study revealed that the households vary in vulnerability by socio-economic characteristics and that female headed households are more vulnerable to food insecurity than male headed households in the study area. Also, female-headed household have higher frequency of use of coping strategies than the male headships in the study area which may be a reason for their vulnerability status.

The study also concluded from the result of the ordinal regression that an increase in all resources of the farmers will reduce their vulnerability to food insecurity at 1%, 10% and

5% levels of probability respectively. The farmers could reduce their vulnerability if more active youths and more educated farmers are engaged in farming than the elderly ones in the study area, hence it can be concluded that policies that address these determinants of vulnerability with emphasis on women's empowerment, education and income diversifications are likely to enhance resilience of rural farming households to food insecurity.

5.3 Recommendation

Based on the findings of this study, the following recommendations are made; the study indicated that female-headed households were more vulnerable to food insecurity than male-headed households in the study area. Women play a central role for enhancing household food security because in most cases they usually produce or prepare food for other members of their household. It is important that the government assist the local community to empower women by providing them with professional education with regards to ways of improving food access.

Access to extension services and education level were regarded as significant determinant for household food insecurity. It is therefore vital that the government promote agricultural education and extension services in the study area, by encouraging households to participate in food gardening/farming activities as a source

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of generating extra income. It is advised that incentives such as quality seeds are provided to households in order to encourage them to engage in subsistence farming.

The household size and number of dependents were a significant determinant for household food security; therefore it is important to educate the community about family planning in order to encourage households to plan for smaller family sizes, particularly for female-headed households.

The government cannot do everything, off-farm occupation was a significant determinant of vulnerability to food insecurity in the study area, and hence the private sector should implement more strategies through Private-Public-Partnership (PPP) for addressing the issue of food insecurity at household level. This can be done by conducting workshops, entrepreneurial programs and support groups, in which people can be trained to ensure that they improve their dietary intake and quality foods.

The findings revealed that there was disparity in terms of available resources for the different households in the community, policies should promote diversification of livelihoods and equal opportunities and rights to access resources and creation of employment opportunities in the study area.

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Appendix

Table 27: Comparison of Use of Coping Strategies by Household's Types

	Female-Headed	Male-Headed	t-value
	HH	HH	
Weighted sum reflecting frequency and severity of using of coping strategies	44.04 (14.92)	43.02 (13.15)	-0.40
Number of coping strategies	1.72 (0.55)	1.53 (0.50)	-2.00**
Less preferred food	3.314 (0.94)	3.311 (0.85)	-0.12
Borrow food	2.48 (0.79)	2.24 (0.68)	-1.72*
Buy on credit	2.50 (0.84)	2.60 (0.89)	0.69
Gather wild food	0.33 (0.85)	0.22 (0.89)	-0.78
Eat seed stock	0.70 (0.79)	0.49 (0.66)	-0.15*
HH member eat elsewhere	2.10 (0.68)	2.11 (0.53)	0.05
Beg for food	2.64 (0.81)	2.82 (0.65)	1.35*
Limit portion	3.34 (1.02)	3.44 (0.89)	0.58
Restrict adult	2.33 (0.93)	3.44 (0.89)	-0.23
Reduce meal	2.55 (0.78)	2.73 (0.81)	1.28*
Skip days	0.53 (0.87)	0.42 (0.84)	-0.73

Source: field survey, 2017. *, **,***, indicate that the mean differences between the male and female-headed households are significantly different from zero at 10%, 5% and 1% respectively.

Table 28: Analysis of Objectives

S/ N	OBJECTIVES	DATA REQUIRED	ANALYTICAL TOOLS
1	To Determine how vulnerable the households are to food insecurity in the study area?	Frequency and severity of relying on less preferred and less expensive foods, borrowing food, Purchasing food on credit, gathering wild food, harvesting immature crops, Consuming seed stock.	Coping Strategy Index (CSI), Factor Analysis
2	To profile households vulnerability by their socio-economic characteristics	Age of the respondent (years), Sex of the respondent, Household size, level of Education (Years), Farm size (acres), off-farm occupation (naira), Food expenses (naira). Household dependent	Descriptive statistics,
3	To Identify the factors determining vulnerability of the households to food insecurity	Number of coping strategies, access to extension, Days incapacitated by sickness, off-farm occupation, labour hour use, non-food expenses, number of dependents, farm income	Ordered Logit
4	To examine the coping strategies	Frequency and severity of relying on less preferred and less expensive foods, borrowing food, buy on credit, gathering wild food, harvesting immature crops, Consuming seed stock, Sending household members to eat elsewhere, Limiting portion, Restrict adults , Reducing meals, skip days	Likert Scale, frequencies and percentage.

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CERTIFICATION

This is to certify that this project was carried out by:

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTERS
IN AGRICULTURAL ECONOMICS**

MARCH, 2018.

Under my supervision.

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