SPATIAL ANALYSIS OF THE EFFECTS OF FLOODING ON FOOD SECURITY IN AGRARIAN COMMUNITIES OF SOUTH EASTERN NIGERIA

BY

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DECLARATION

This Thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

This thesis is dedicated to my dad and late mum who always wanted me to get a doctoral degree.

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
CLOs	Community Laison Officers
CSI	Coping Strategies Index
DEM	Digital Elevation Model
FAO	Food Agricultural Organisation
FCS	Food Consumption Score
FEWNETS	Famine Early Warning Systems Network
FFH	Female-headed Household
FGDs	Focus Group Discussions
FGT	Foster-Greer-Thorbecke
FRN	Federal Republic of Nigeria
FSI	Food Security Index
FVI	Food Vulnerability Index
FSLC	First School Leaving Certificate
GIS	Geographic Information System
GPS	Global Positioning System
HFIAS	Household Food Insecurity Access Scale
HFSSM	Household Food Security Survey Module
HND	Higher National Diploma
IDP	Internally Displaced Person
IFAD	International Fund for Agricultural Development
IPCC	Intercontinental Panel for Climate Change
K cal	Kilocalorie
KIIs	Key Informant Interviews
LGA	Local Government Area

MDGs	Millennium Development Goals
MHH	Male-headed Household
MODIS	Moderate-resolution imaging Spectroradiometer
NBS	National Bureau of Statistics
NCE	National Certificate Examination
NIMET	Nigerian Meteorological agency
NPC	National Population Commission
UN-OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OND	Ordinary National Diploma
PCA	Principal Component Analysis
RAs	Research Assistants
SDGs	Sustainable Development Goals
SE	South East or Southeastern
SPSS	Statistical Package for the Social Sciences
SRTM	Shuttle Radar Topography Mission
SSCE	Senior School Certificate Examination
UNDP	United Nations Development Programme
USDA	United States Department of Agriculture
WFP	World Food Programme
WHO	World Health Organisation

ABSTRACT

Several studies have predicted climate change to cause some shifts in food security in the future with sparse research on the relationship between flooding (which is one of the manifestations of climate change) and food security especially in Nigeria. Flooding induced food insecurity by causing a negative shift in any of the dimensions of food security through reducing crop harvest and farm income derived from crop sales; damaging assets; destroying road and farm storage facilities among others. The southeastern Nigeria is generally agrarian and vulnerable to flooding (due mainly to its nearness to River Niger), and has comparative advantage in the production of crops like yams, maize, potatoes and cassava (staples), hence the need to do an in-depth study on the effects of flooding on food security in the region.

In this pursuit, the study assessed the extent to which flooding affected the food security in eight (8) flood vulnerable and agrarian communities in Anambra and Imo States of southeastern Nigeria by examining the interactions between flooding and each of the four dimensions of food security (accessibility, availability, utilization and stability) to capture the multidimensional nature of food security.

Analyses were drawn from imageries (MODIS and SRTM), questionnaire, focus group discussions and key informant interviews. A total of 400 households were sampled using multi-stage, stratified and random sampling methods and the data were analysed using descriptive and inferential statistics. The integrated vulnerability assessment approach using indicators (biophysical and socio-economic) were adopted to compute households' flood vulnerability indices.

The flood vulnerability index analysis shows that majority of households (49%) were less vulnerable to flooding whereas 3.5% and 47.5% were moderately and highly vulnerable to flooding respectively. Igbariam and Ossomala communities were found to be the *flood vulnerability hotspots*, and flood vulnerability indices of the 8 communities were mapped using ArcGIS 10.2 software. The flood vulnerability map showing the spatial variations in the study area's different vulnerability levels would aid flood emergency response team to improve their flood preparedness plans, and to allocate relief materials to flood victims.

The coefficients of the multiple regression model (with p- value $\leq$ 0.05 at 5% level of significance) revealed that the main determinants of households' vulnerability to floods are age, level of education, off-farm incomes, pre-flood awareness, group membership, private land ownership, sufficient food production, available storage facility, use of fertilizer, receipt

of food/aid in time of emergency, phone ownership, canoe ownership, financial support, diversified income, flood experience and severity of flood.

Households were further classified into four food security levels (food secure (A), food insecure without hunger (B), moderately food insecure with hunger (C) and severely food insecure with hunger (D) using the HFSSM (developed by the USDA) prior to and after flood episodes. The results revealed that 33.3%, 40.2%, 13% and 13.5% households fell into the A, B, C and D food security levels respectively prior to flood events and 7.2%, 39.3%, 15.7% and 37.8% correspondingly fell into the A, B, C and D food security levels after flood events. The implication is that flooding affected food security negatively by increasing the number of food insecure households to 92.8%, indicating a 26.1% reduction in the number of food secure households and a 26.5% increase of food insecure households from normal. Igbariam community was the most affected community as it recorded the highest (72.1%) *food insecurity hotspots (*households that experienced extreme food insecurity with hunger) after flooding, followed by Ossomala community.

The result of the binary logistic regression model showed that, the statistically (5%) significant variables (with p-value ≤ 0.05) that influence household food security status in south eastern, Nigeria are; sex, marital status, level of education, off-farm income, monthly income, dependency ratio, sufficiency in food production, livestock ownership, village poultry/poultry ownership, irrigation practice and flooding. Flooding was the only factor with a negative coefficient (-1.11) with an odds ratio of 0.33, implying that flooding induces food insecurity. The Ordinal Regression Analysis result indicated flooding as a limiting factor that affects food security negatively in the study area.

The ANOVA results revealed significant inter-household differences in vulnerability to flooding and determinants of food security as well as a significant variation between female-headed and male-headed households with female-headed households being the most vulnerable to food insecurity, and households headed by younger people being the most vulnerable to flooding.

Furthermore, the outcomes of the analysis indicate that most of the adaptation strategies employed were self-devised strategies that provided temporary means of survival in times of food shortages and flooding at the household level. Therefore, sustainable policies and strategies having more institutional undertone (e.g. social security, food safety nets for flood victims) are among the suggested efforts to minimize the effects of flooding and food insecurity.

CHAPTER ONE

INTRODUCTION

1.1 Background

Flooding is generally a condition of complete or partial inundation of normally dry areas due to overflow of tidal or inland waters or from abnormal and rapid accumulation of runoff (Jeb and Aggarwal, 2008). "Floods are the most recurring, widespread, disastrous and frequent natural hazards of the world" (Odufuwa, Adedeji, Oladesu and Bongwa, 2012:70). According to the UN-Water (2011), floods have caused about half of all observed disasters worldwide, and 84% disaster deaths in the world are attributed to flooding, with an average of 20,000 deaths per year, which makes only a few countries immune to floods.

The growing flood scenarios in different parts of the world have resulted in loss of human lives, displacement of people, loss in properties and general damage to the environment (Nzeadibe et al., 2011). Several scholars (Madzwamuse, 2010; Speranza, 2010; Nzeadibe et al., 2011) have noted developing countries to be the most vulnerable to these impacts due to their low adaptive capacity. For instance, since 1900, floods have claimed more than 10,000 lives in the United States alone (Adeoye et al., 2009) and in India over 14 million Indians were victims to the flood of August 2007 in Sathya Sai Baba (Aderogba, 2012). Most disastrous floods in China had been caused by the unstable Huang Ho (Yellow River) and hundreds of thousands of people in Bangladesh were killed as a result of the pervasive flooding of the low-lying delta of the Ganges and Brahmaputra rivers caused by the combination of high tides and tropical cyclone storms in 1970, 1985 and 1991 (Pearce and Leib, 2006 in Adeoye et al., 2009). Documentation shows that many lives have been lost due to flooding while several have been rendered homeless and billions of Naira properties have been destroyed as a result of devastating floods across Nigeria (Opalana, 2005; Jeb and Aggarwal, 2008; Etuonovbe, 2011; Olorunfemi, 2011).

Incidences of destructive floods in Nigeria occurred in Akure (1996, 2000, 2002, 2004, 2006), Osogbo (1992, 1996, 2002), Yobe (2000), Ibadan (1985, 1987, 1990, 2011), Makurdi in 2008 and Sokoto in 2010, Ogbaru, Egbema and Oguta in 2012. Also, coastal cities such as Lagos, Yenegoa, Calabar, Uyo, Port Harcourt, and Warri experience floods frequently (Folorunsho and Awosika 2001; Ologunorisa, 2004; Mordi 2011; Amaize 2011; Olajuyigbe et al., 2012).

The most devastating of all these flood events is that of August-October 2012 in Nigeria which pushed rivers over their banks and submerged hundreds of kilometres of urban and rural lands (Ojigi, Abdulkadir and Aderoju, 2013). The United Nations Office for the Coordination of Humanitarian Affairs (UN-OCHA, 2012) noted this 2012 flood to be the worst floods ever experienced in Nigeria in the past 40 years. It estimated that over 7,705,378 Nigerians were affected by the floods with 2,157,419 internally displaced persons (IDPs). Over 90% of the 36 States of the country were affected between July and October, 2012 with 363 deaths and more than 618,000 damaged houses (UN-OCHA, 2012). Massive destruction of farmlands was reported within this period (2012) which resulted to food insecurity in parts of the country as significant proportion of areas (including the south eastern region) that produce the three main tuber food crops in Nigeria (namely yam, cassava and sweet potato), were affected by the floods (FEWS NET, 2012; FEWS NET, 2013).

The United Nations Development Programme (UNDP, 2008) had predicted climate change to slow down the progress in human development achieved over the last decade with emerging threats on water availability, food security and agricultural production with another 600 million people rendered malnourished due to sea level rises, droughts, heat waves, rainfall variations and floods. Climate change has been noted to represent abnormal climatic situations that can affect agricultural production through their impact on temperature changes and water availability (Syaukat, 2011), and would intensify the existing hunger and food insecurity problems in developing countries which already contend with chronic food problems. Empirical studies show that the increased intensity and frequency of storms, flooding and drought undoubtedly have implications on food security and agricultural production (FAO, 2007; Ngoh, Teke and Atanga, 2011; Yaro, 2013 and Pacetti, Caporali and Rulli, 2017).

Despite increasing global agricultural production (Ibok, Idiong, et al., 2014), large numbers of people remain hungry and malnourished (Ambali et al., 2015). An estimated 925 million people were undernourished in 2010, out of which about 900 million people live in developing countries (FAO, 2010) with an estimated 217.8 million living in sub-saharan African in 2014-2016 (FAO, 2015). In addition, more than 70% of the undernourished people live in rural areas where agriculture is dependent upon directly or indirectly (Bashir, Schilizzi and Pandit, 2012).

Similarly, IFAD (2009) noted that, about 1.2 billion people cannot meet their most basic

needs for sufficient food every day especially poor women, men and children who belong to indigenous populations living in rural environments mostly in developing countries, such as Nigeria and who are subsistence farmers. Consequently, Nigeria has been listed among the 55 Low Income Food Deficit (LIFD) countries due to the high prevalence of undernourishment especially among agricultural households (Ambali et al., 2015). Thus, a juxtaposition of Nigeria's poverty level and vulnerability to climate-induced flooding threatens food security in the country.

Food security, according to FAO (1996:4; 2008a:9) "exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". Food security in the above context consists of four dimensions viz; food accessibility, availability, utilization and stability, and these dimensions must be fulfilled for food security objectives to be realized.

A state of food security entails that: adequate food is available; all people have physical and economic access to the food they require; availability and access are ensured over time (stability), and the food is efficiently utilised. Attaining food security requires not just attaining an adequate level of good nutrition and food consumption, but maintaining this level at low risk over time (FAO, 2008a).

Food insecurity on the other hand, exists even if one of these conditions is not met or there is any negative shift (e.g. caused by flooding) in any of these dimensions of food security. In the last decade, consideration has been centred on means of eradicating food insecurity and hunger in the world. A number of global agreements, for instance those agreed upon at the World Food Summit in 1996 and the Millennium Summit in the year 2000, had goals and particular targets set for joint action in minimizing the incidence of food insecurity and hunger. The 1996 World Food Summit aimed to halve by 2015, the number of hungry people; in the same way, the hunger target of the Millennium Development Goals (MDGs) set out to halve the prevalence of hunger by the same target date, 2015 (FAO, 2005; FAO 2008a).

The recently adopted Sustainable Development Goals (SDGs) lays emphasis on ending hunger, achieving food security and improving nutrition and promoting sustainable agriculture by 2030 in Goal 2. FAO (2008a) has noted that all hungry people are food insecure, though, not all food insecure people are hungry, and the term 'hunger' has been used to distinguish a subset of food insecure people while people suffering from hunger as a

result of inadequate access to food may be considered ‘currently food insecure’. Poverty is undoubtedly a cause of hunger, hence a relationship exist between hunger, poverty and food insecurity. Understanding this relationship can clarify how poverty and hunger reduction programmes can contribute to strengthening food security and vice versa.

It is therefore against this background that this research is geared towards assessing the spatial effects of flooding on food security of agricultural households in the study area. The findings of this research are undeniably going to assist vulnerable groups strengthen their adaptation capacity and ultimately enhance their well-being.

1.2 Statement of Problem

Agriculture is the mainstay of Nigeria’s economy (IFAD, 2012). The agricultural sector has been noted to contribute about 40% to Nigeria’s economy; employs about two-thirds of the total labour force and provides a livelihood for about 90 per cent of the rural population (Federal Republic of Nigeria, 2008; FAO 2011; National Bureau of Statistics, 2012). Yet, subsistence farming dominates agriculture in the country with up to 90 per cent of Nigeria’s food being produced by small-scale farmers, who cultivate small plots of land and depend mainly on rainfall and on very little or no irrigation systems. However, widespread poverty and poor agricultural output in the country have resulted in widespread food insecurity, with some studies suggesting that about 70 percent of Nigerians are food insecure (Orewa and Iyanbe 2009; Obayelu, 2010; Kuku-Shittu et al., 2013).

Nigeria moved from being self-sufficient in food production in the 1960s to being heavily reliant on food imports in the 1980s (Fasoranti, 2006) and this has led to a continuous increase in the level of food insecurity in the country since the 1980s. Food insecurity rose from about 18% in 1986 to about 40% in 1998 (Sanusi, Badejo and Yusuf, 2006) while its food security index score stands at 37.1 out of 100 in 2015 (EIU, 2015). This is not surprising given that about 83.3% and 82.2% of the population lived below the poverty line in 2004 and 2010 respectively (World Bank, 2015a).

South eastern Nigeria is in the Niger Delta region which is known for its vulnerability to flooding due to its location; nearness to the River Niger. The region is generally agrarian and has comparative advantage in the production of crops like yams, maize, potatoes and cassava that form the staple food in Nigeria.

Flooding has been a serious environmental problem faced in parts of this region and this is

evident in the work of Adewuyi and Olofin (2014) who noted that, while most parts of Nigeria were affected by the 2012 devastating floods, the southern axis (South South and South East regions) of the country suffered most with 13 of the extreme flooding incidences lasting for more than 14 days in 2012. Consequently, it affected food production, crop harvest, income sources, roads and other facilities.

The effects of flooding on health and the environment in Nigeria had been extensively discussed and these range from obstruction of traffic, submerging roads, disruption of economic activities, coastal erosion, loss of property to loss of lives, displacement of people, water pollution and diseases (Folorunsho and Awosika 2001; Ologunorisa, 2004; Jeb and Aggarwal, 2008; Ogba and Utang, 2008; Adeloye and Rustum, 2011; Etuonovbe, 2011; Olorunfemi, 2011; Odufuwa et al., 2012; Duru and Chibo, 2014; Adewuyi and Olofin, 2014) while studies on flood effects on food security is lacking. Several studies on food security carried out in Nigeria (Sanusi et al., 2006; Omonona and Agoi, 2007; Muhammad-Lawal and Omotesho, 2008; Ibrahim et al., 2009; Asogwa and Umeh, 2012; Adepoju and Adejare, 2013; Ahmed and Dotti, 2014; Ibok, Idiong, et al., 2014; Ibok, Bassey, et al., 2014; Atoloye, Ogunba and Samuel, 2015) had concentrated mostly on food security pattern and coping strategies; food security status and determinants of food security among households.

The determinants of household food security noted by scholars include; household size, farm size, income, level of education, sex and age of head of household, livestock ownership, credit access, marital status among others (Arene and Anyaeji, 2010; Bashir et al. 2012 and Ahmed and Dotti, 2014; Djangmah (2016); Goshu, 2016; Ajaero, 2017; Dawit and Zeray, 2017), and flooding has been claimed by Ramakrishna, Gaddam and Daisy (2014) and Zakari et al. (2014) to have negative impacts on food security in Khammam (India) and Niger Republic respectively.

Unfortunately, the knowledge of the effects of flooding on food security in the study area (Anambra and Imo States' agrarian communities) which are vulnerable to flooding and have comparative advantage in the production of staples (cassava, potatoes, maize) in Southeastern Nigeria, is still lacking. Therefore, this study explored that gap to examine the spatial analysis of the effects of flooding on food security in these agrarian communities, by showing the spatial variations of households' flood vulnerability levels and quantifying the number of food secure/insecure households in relation to the factors influencing households' flood vulnerability and food insecurity. The study findings would be relevant in policy formulation

geared towards strengthening peoples' adaptation capacity to flooding and achieving Sustainable Development Goals especially Goal 2 related to food security.

1.3 Objectives of the study

General objective

The main objective of this research was assessing the effects of flooding on food security in agrarian communities of the Southeastern region of Nigeria to determine if flooding affects food security positively or negatively and to which extent it does.

Specific objectives

The specific objectives are as follows;

i. To determine the nature (extent, frequency, severity) of floods in the study area;
ii. To determine variations in households' vulnerabilities to floods in the study area;
iii. To assess the food security status and its determinants in the study area;
iv. To assess the effects of flood on households' food security in the study area;
v. To examine households' adaptive capacities to flooding and food insecurity in the study area;

1.4 Justification of the study

It has been noted that the global mean temperature has increased by 0.74 °C in the last 100 years, and is expected to rise to between 1.1 and 6.4 °C by the end of the twenty-first century, depending on projected scenarios (Intergovernmental Panel on Climate Change (IPCC), 2007), which could lead to extreme climate variability and weather-related events like flooding (Syaukat, 2011). Evidence shows that more intense and recurrent weather events (heat and cold waves, floods, droughts, heavy storms), rising irregularities in seasonal rainfall patterns and rising sea levels (including flooding) are already having direct impacts not only on food production, but also on incidence of food distribution infrastructure, food emergencies, livelihood assets and human health in both urban and rural areas (FAO, 2008b; Emaziye, Okoh and Ike, 2013).

In the same light, it has been estimated that on average, about 500 weather-associated disasters now take place per year, compared with about 120 weather-related disasters in the

1980s. Of these disasters, the occurrence of floods has increased six fold over recent period, affecting more and more people, especially in coastal areas, where most of the world's population now lives (Oxfam, 2007; WHO 2008). Similarly, the United Nations Development Programme (UNDP) (2008) predicted that climate change might slow down or

even reverse the progress in human development achieved over the last decade with its emerging threats on nutrition, water availability, agricultural production, food security and access, and public health. It also predicted that the impacts of climate change such as sea level rises, heat waves, droughts, rainfall variations and floods could render another 600 million people malnourished and about 1.8 billion people worldwide could face water scarcity by 2080 (UNDP, 2008).

Furthermore, the 2012 floods in Nigeria which was noted to be the worst in over 40 years (UN-OCHA, 2012) have been reported to subsequently cause food insecurity in parts of Nigeria (FEWS NET, 2013) yet, there is no existing in-depth study on the effect of flooding on food security in the south eastern region of Nigeria.

This gap makes this study on the spatial analysis of effects of flooding in the agrarian communities in south eastern region of Nigeria imperative, because knowing the extent to which flood can affect food security as well as mapping the flood vulnerability and food insecurity hotspots (i.e. summarizing the number and location of flood vulnerable and food insecure people) that have been carried out in this study, would help in suggesting the optimal adaptation strategies against such events. It would also assist policy makers in designing sustainable food security policies and flood emergency programmes for the region.

Moreover, the differential households' abilities to cope and determinants of food security investigated in this research will help in policies formulation which will increase peoples' resilience. In addition, the findings of the research would serve as baseline for comparative studies related to flood and food security.

1.5 Scope and limitations of the study

The study focused on the spatial effects of flooding on households in the agrarian communities of the Southeast region of Nigeria. The research was carried out in Anambra and Imo States because of their vulnerabilities to flooding and they were the only two and worst affected States in the region by the Nigerian 2012 devastating floods in addition to being agrarian. The research was mostly questionnaire-based majorly because there are no existing data on the food security status at household level in the study area. Since data were collected at household level, the unit of analysis is households. Indicators were used to assess the food security status of households and the FAO (1996) definition of food security has been adopted for the study. Due to financial and temporal constraints only four Local

Government Areas (LGAs) were studied, that is, two in Anambra State and two in Imo State (see Section 3.3). In addition, the inability of most farmers to keep farm inventory on input and output or quantify their harvest, led to the adoption of response (yes or no) to self sufficiency in own food production question as a measure to assess food availability dimension of food security. River discharge data for the period of study was also inaccessible, so, flood analysis was mainly questionnaire-based.

1.6 Definition of Concepts

Adaptive capacity: is the ability of people to adjust or adapt to changes e.g. their capacity to maintain their livelihoods in times of food insecurity and flooding

Agrarian community: is an agricultural community where farming forms the major source of livelihoods of people.

Flooding: "A flood is the build up of too much water which rises to overflow land which is not normally submerged. It comprises overflow of a river as a result of long-lasting seasonal rainfall, accumulation of rainwater in low-lying areas and excessive runoff caused by absence/inadequate storm drainage" (Ward, 1978:15). Flooding in this study is treated as an event.

Dietary diversity is defined as the number of different foods or food groups eaten over a reference time period, irrespective of the consumption frequency.

Food frequency: is defined as the frequency (in terms of days of consumption over a reference period) that a definite food item or food group is taken at each home (household) (WFP, 2008).

Food group: is defined as a combination of food items with related caloric and nutrient content.

Food security: food security as operationalised in this study exists when households do have adequate physical food for consumption, and have the social or economic access to satisfactory food for a healthy life at all times.

Food accessibility: is a measure of the ability to obtain/secure food. This is determined by affordability of food and money spent on food.

Food availability: is associated with the produced food's physical quantities; food processed, stored, exchanged and distributed. It has to do with "Sufficient food".

Food system stability: deals with the phrase "at all times" in the food security definition by FAO (1996; 2008a). It deals with the importance of reducing the risk of negative effects on

the other three dimensions: food accessibility, food availability or food utilization. It is the temporal determinant as used in this study which defines the ability to access and utilize adequate levels of nutritious food over time.

Food utilization: entails to the consumption of food and how essential nutrients are acquired from consumed food by a person. It covers the diet's nutritional value, in addition to access to potable water; its composition, preparation methods and safety of food.

Hunger: is regarded as a severe stage of food insecurity, rather than as a distinct or disconnected condition from the more common experience of food insecurity.

Resilience: is defined as the ability of the household to quickly recover from shocks and stresses induced by flooding and food insecurity.

Vulnerability: refers to those "biophysical and socio-economic factors that influence people's ability to cope with flooding and food insecurity" (Adger et al., 2004).

1.7 Theoretical Framework

1.7.1 Food Insecurity and Vulnerability Information Management Systems Framework

This study adopted the Food and Agricultural Organisation-Food Insecurity and Vulnerability Information Management Systems (FAO-FIVIMS) theoretical framework developed by the FAO between 1999 and 2003 (Figure 1.1). This theoretical framework was adopted because it is a useful tool for conducting food security analysis. It answers the basic questions of who is food insecure, where they are located, and why they are in this condition, both in transitory and chronic situations as agreed by Verduijn (2005). The framework explains the linkages among various food security dimensions and factors influencing them at National, sub-national, community level, household level and individuals' level. "It helps identify appropriate entry points for support to strengthened livelihoods, household food security and nutrition" (FAO, 2008a:7). "It presents food insecurity as a complex phenomenon, attributable to a range of factors that vary in importance across regions, countries, households and social groups, as well as over time. These factors have be grouped in four clusters representing potential vulnerability in the areas of the socio-economic and political environment; the performance of the food economy; care practices; and health and sanitation. Most importantly, it shows a common understanding of possible causes of low food consumption and poor nutritional status" (Verduijn, 2005:12). "The concept of underlying "socio-economic, political, institutional, cultural and natural factors" in FAO-FIVIMS framework highlights the need to consider how these factors impact on different dimensions

of food security (food availability, food access, stability, food utilization), while also affecting care practices, in addition to conditions related to health and sanitation" (FAO, 2008a:8).

However, it shows how climate variables (such as changes in weather events which could lead to flood or drought) impact on the natural environment (e.g. houses, marketing and storage infrastructure, productive assets, roads, human health and electricity grids) where food components exist and indirectly affect the dimensions of food security (FAO, 2008b).

In addition, the concept of food economy concept determined by food consumption is shown as being determined by; food access at household level (as determined by income transfers, relative purchasing power, poverty/incomes, quality of transport and market infrastructure), and care practices (including cultural practices, knowledge linked to food preparation and intra-household food allocation).

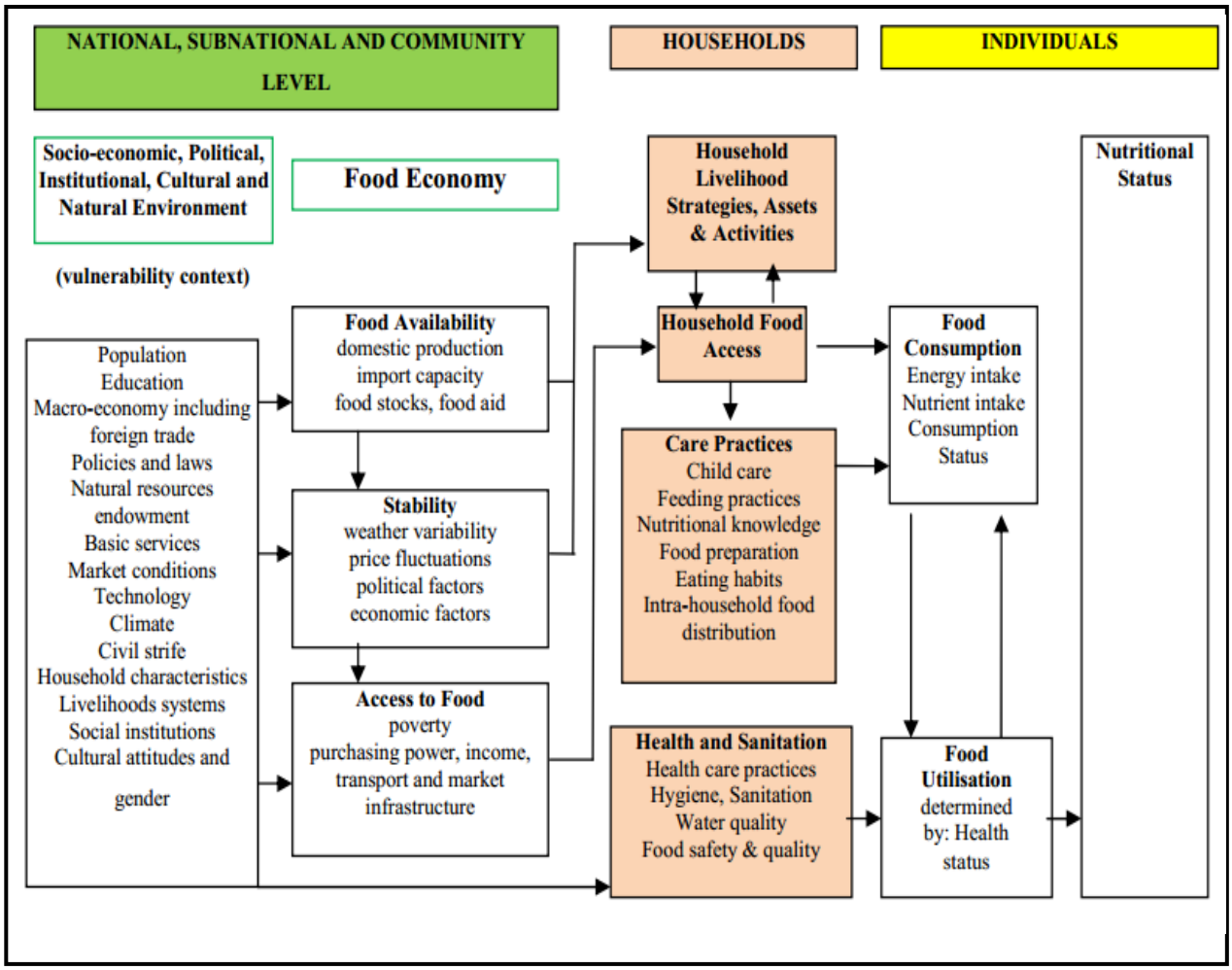


Figure 1.1: Food Insecurity and Vulnerability Information Management Systems Framework. Source: FAO, 2008a.

The diagram further illustrates that effective and efficient food utilization by the body is primarily dependent on a person's health status, which however is reliant on general sanitation and health conditions. The nutritional status component (concept) of the framework shows the interactions and relationships of the main issues that affect an individual's nutritional status (FAO, 2008a; 2008b). The nutritional outcome depends on two major sub factors: food consumption (food intake as regards nutrients and energy) and the biological utilization of food (determined by a person's health status).

The FAO-FIVIMS theoretical framework offers a comprehensive insight on the factors influencing vulnerability as well as drivers of current and future food security (dependent variable) in the study area. These factors as seen from Figure 1.1 include weather variability (including flooding), income, food stock, food aid, social institutions, gender and poverty level (which affects people ability to afford), and even availability of markets and transport facilities which serve as the independent variables. The easily accessible and measureable components of the theoretical framework have been operationalised in the conceptual framework.

1.7.2 Sustainable Livelihoods Approach (SLA) Framework

The sustainable livelihoods framework developed by the Department for International Development (DFID) in 1999 is a tool that aids the understanding of livelihoods, especially that of the poor. It presents the majors factors that affect the livelihoods of people, and their interactions. The SLA empowers the poor by treating them as decision-makers with their own personal sets of priorities, and not as victims.

"A livelihood comprises the capabilities, assets, and activities required for a means of living. It is deemed sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities, assets, and activities both now and in the future, while not undermining the natural resource base" (Serrat, 2017:21).

The SLA tries to show the way the vulnerable and poor live their lives and how institutions and policies can help alleviate poverty. Poverty and vulnerability are shown to be related in the framework.

Vulnerability is regarded as insecurity in households' well-being when changes occur in people's external environment (e.g. flooding). Vulnerability has two sides namely; external side of shocks (e.g. floods, conflict, storms, illnesses, droughts, diseases), seasonality (e.g.

food prices, and critical trends (e.g. governance, environmental, demographic, economic, and technological; and internal side of defenselessness induced by inability to cope (Serrat, 2017). Shocks (e.g. flood, conflict) are shown to directly destroy assets as "they can force people to abandon their home areas and dispose of assets (such as land) prematurely as part of coping strategies" (DFID, 1999:3). "Seasonal shifts in prices, employment opportunities and food availability are one of the greatest and most enduring sources of hardship for poor people in developing countries" (DFID, 1999:3). Some trends mentioned above can reduce vulnerability e.g. economic indicators can move in positive directions and new technologies may be very helpful to poor people.

The SLA framework throws light on how informed livelihoods strategies would mean more income, reduced vulnerability, increased well-being and improved food security. The livelihood assets that the poor ought to make choices and certain trade-offs about are embedded in their social, human, natural, financial and physical capital (Figure 1.2). The framework presents the livelihood assets pentagon from which multiple benefits are generated and how they can either increase or reduce vulnerability and poverty in addition to certain processes and structures with which the coping capacities of the people especially the poor can improve.

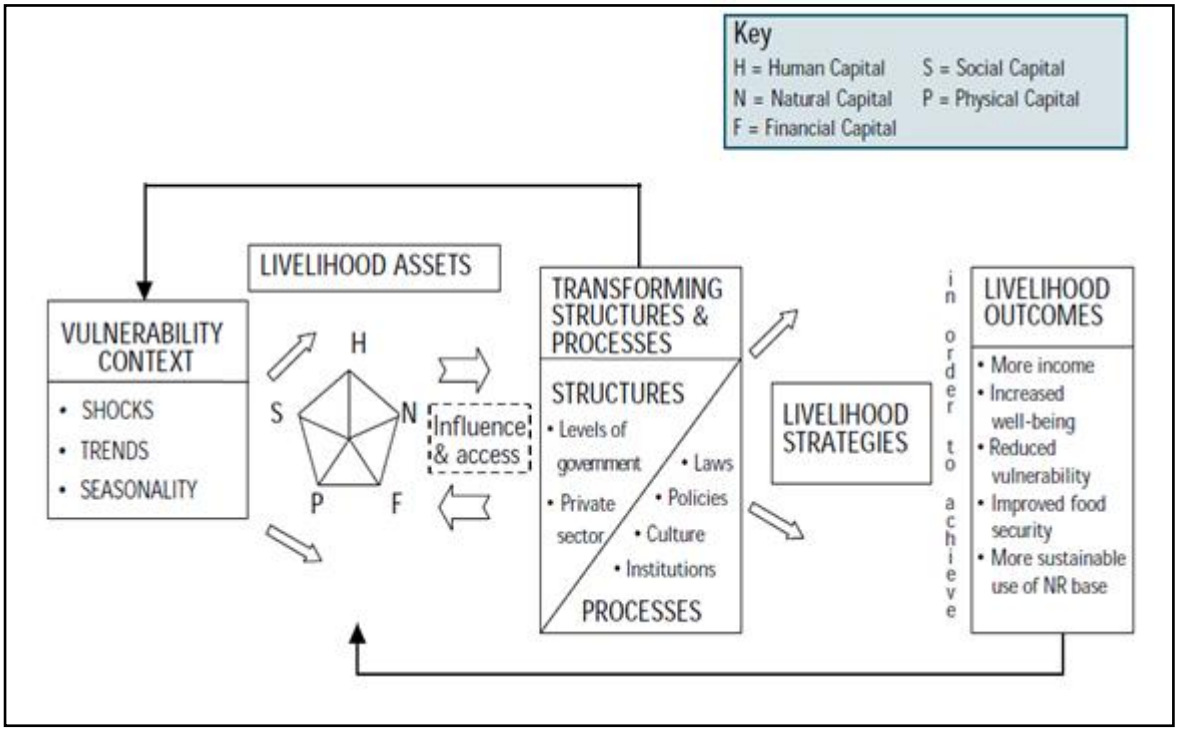


Figure 1.2: Sustainable Livelihoods Framework
Source: DFID, 1999; 2009

The SLA framework has been reviewed because it brings out the relationship amongst poverty, vulnerability, sustainable food security and livelihoods considered in this study.

1.7.3 Conceptual Framework

The conceptual framework shown in Figure 1.3 illustrates the relationship between flooding and food security drawn mostly from the Food and Agricultural Organization - Food Insecurity and Vulnerability Information Management Systems (FAO-FIVIMS) framework and the sustainable livelihoods framework as well as reviewed literature. The FAO-FIVIMS including the Sustainable Livelihoods framework helped in understanding the linkages among various food security dimensions and factors influencing them at various levels (Verduijn, 2005; FAO, 2008a; FAO, 2008b; FAO/NRCB, 2008). As shown in Figure 1.3, food security has four dimensions viz; food availability, accessibility, utilization and stability. A state of food security entails that households have sufficient food; have physical and economic access to the food they need and that food is efficiently utilized. But food accessibility, availability and utilization have to be ensured over time (stability). Stability stresses the significance of having to minimize the risk of the negative effects on the other three dimensions (FAO, 2008a). Conversely, food insecurity exists whenever there is a negative shift (e.g. caused by flooding) in any of these dimensions of food security which ushers in the concept of vulnerability.

"Vulnerability refers to the array of factors that place households at risk of becoming food insecure or being affected by flooding. The degree of vulnerability of households or groups of people is determined by their exposure to the risk factors and their ability to cope with" (IPCC, 2007:11) flooding and food insecurity as well as the degree to which they are affected (sensitivity). Vulnerability comprises adaptive capacity factors (e.g. income, education, access to information) which reduce vulnerability; exposure and sensitivity factors (flood frequency and severity, flood awareness, location) which increase vulnerability. Data on these factors were measured by means of indicators collected through questionnaire.

On the one hand, flooding as a phenomenon has a negative effect on food security through reducing crop harvest and farm income derived from crop sales; damaging assets (e.g. houses); destroying road and food and farm storage facilities; reducing labour demand; polluting streams which serve as the major source of water. On the other hand, adaptive capacity and coping strategies (e.g. income diversification) adopted by households help to enhance household food security in addition to cushioning the effects of flood-induced food

insecurity while food security determinants either enhance or reduce food security. In addition, sustainable food security is achieved when the four dimensions of food security and adaptation strategies are established or improved over time.

Food security is the dependent variable and its predictors are drawn from food availability, accessibility, utilization and stability variables and environmental factor (e.g. flooding) measured through the use of indicators (via questionnaire) shown in Table 1.1. The Binary Logistic regression model was used to show the relationship between food security and its determinants due to the dichotomous nature of the household food security status (food secure and food insecure households). The variables were mostly categorical and where ordinal scale of measurement was involved (e.g. level of education ranging from "no formal education" through having a primary school leaving certificate to having a University degree), data were transposed into two categories ("no formal education" and "educated") to show binary relationship. Flood vulnerability levels is also the dependent variable and the independent variables are the indicators shown in Table 1.1 and regression analysis was used to show the direction of influence of these variables on flood vulnerability.

Table 1.1 shows how the variables captured in Figure 1.3 were operationalized through the use of indicators collected through questionnaire and measurement while flood characteristics were measured using rainfall data and satellite imageries.

Table 1.1: Operationalization of variables

Variable	Indicator
Flood	Flood extent, frequency, seasonal variation, severity
Food availability	Sufficiency in own food production, food sources, access roads, crop storage facilities e.g. yam barn, food assistance from relatives, friends, neighbours, government
Food accessibility	Monthly income, meal frequency, off-farm income, poultry/livestock ownership, access to credit, money spent on food, diversification of income, access to markets, assets ownership
Food utilization	Adequate diet knowledge, dietary diversity, access to potable water
Stability	Irrigation practice, land ownership
Flood vulnerability	Age, marital status, sex, level of education, flood awareness, frequency of flooding, income diversification, income (on- and off-farm), social capital e.g. from group members, access to information, type of houses, past flood experience, receipt of relief materials/ food aid, land elevation, farm location, access to information, storage facility, canoe ownership, dependency ratio, remittance
Food insecurity vulnerability	Age, sex, marital status, household size, access to fertilizer, location of farm land, level of education, farm size, access to land, remittance, flooding, availability of storage facility, land ownership, sufficiency in own food production, off-farm income, social network, farm size, irrigation farming, income diversification
Adaptation strategies/policy measures	Off-farm income, poverty and hunger reduction initiatives, food security programmes, social network/association membership, fertilizer subsidy, availability of agricultural extension agents, free primary and secondary education, flood warning, Irrigation farming, access to credit, school feeding programme, assets ownership e.g. canoe

Source: Researcher, 2015

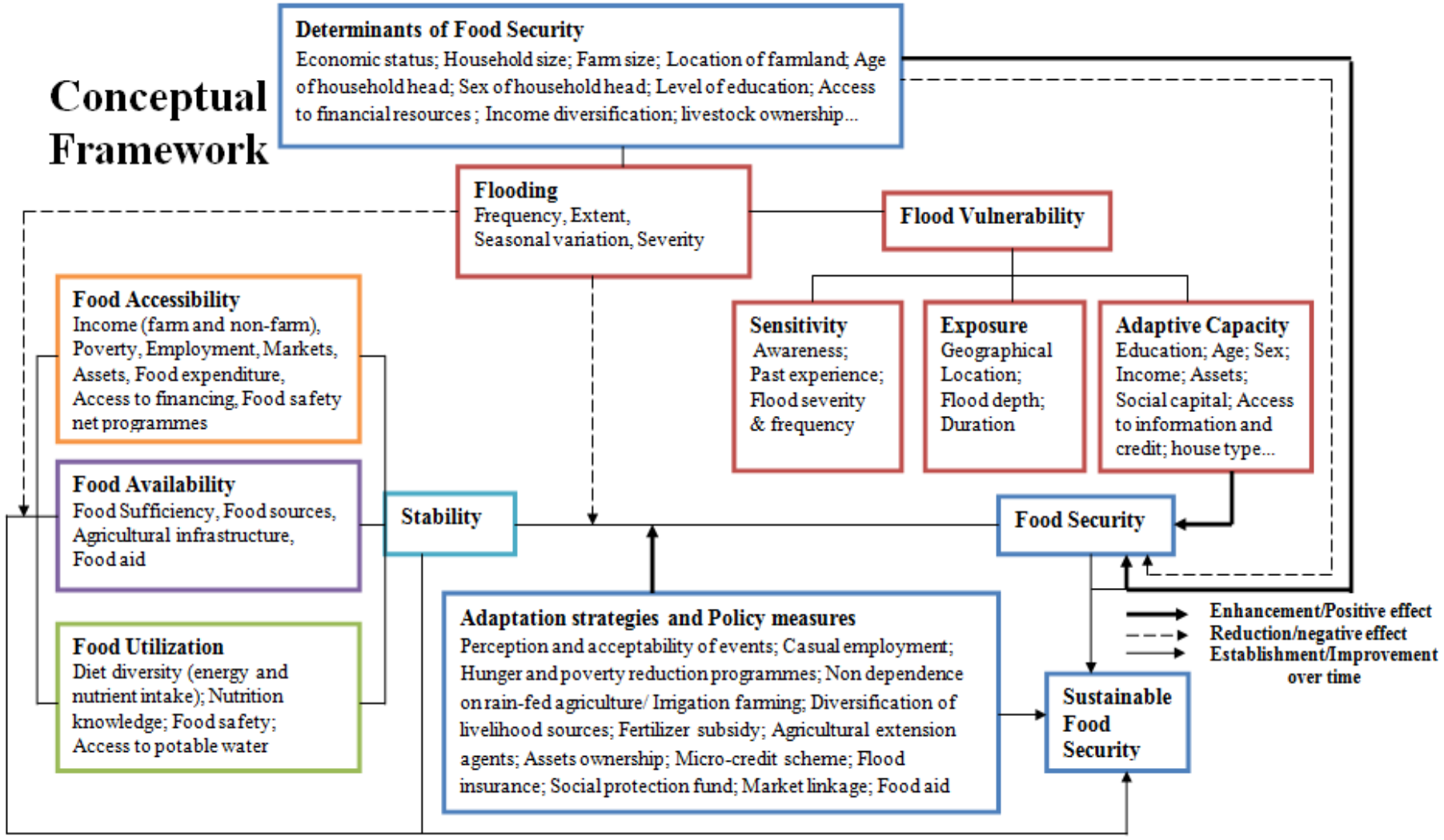


Figure 1.3: Flood, Vulnerability and Food security Framework.
Source: Researcher, 2015

1.8 Research Hypotheses

1. H_0: There is no significant difference in the vulnerability of households to flooding in the various agrarian communities.
2. H_0: There is no significant difference in the determinants of food security among households in the agrarian communities.
3. H_0: There is no significant relationship between flooding and food security of households in the agrarian communities.

1.9 The Study Area

This section is discussed under the following headings; location; climate; relief and drainage; soil and vegetation; geology and geomorphology; population; socio-economic activities; socio-political structure; and transport and road infrastructure.

1.9.1 Location

The study area, Southeastern Nigeria, comprises the five Igbo speaking States of Abia, Anambra, Ebonyi, Enugu and Imo. These States constitute one of the six geo-political zones in Nigeria. It is located between latitudes 4° 20′ to 7° 10′ north of the equator and longitudes 6° 35′ to 8° 25′ east of the Greenwich Meridian with a land size of about 28,983km^2. The region is bounded to the north by Benue and Kogi States, to the south by Rivers State, to the east by Cross River State and to the west by Delta State (Figure 1.4). Anambra and Imo States have been selected for this study, thus there were specific discussion on the two States. Anambra State is located between latitudes 5°40′ and 6°46′ north of the equator and longitudes 6°35′ and 7°21′ east of the Greenwich meridian. To the north, the State is bounded by Enugu and Kogi States, to the south it is bounded by Imo State, to the east it is bounded by Abia and Enugu States, and to the west it is bounded by River Niger and Delta State, with a spatial extent of about 4,816km^2. Imo State lies between latitude 5°10′N to 5°25′N and longitude 6°35′E to 7°23′E of the Greenwich meridian. Its total land area is about 5,183sqkm (National Population Commission, 2010). It is bounded on the east by Abia State, on the west by Rivers State, on the north by Anambra State and on the south by Abia and Rivers States.

1.9.2 Climate

Southeastern Nigeria lies within tropical wet-and-dry climate or Aw climate based on Koppen's climate classification. It usually experiences an average of eight months of rainfall and four months of dry season. The two major seasons experienced in this region are; the

rainy season (March to October) and the dry season (November to February). A temporary cessation of rain popularly known as 'August Break' separates the maximum rainfall regime from a minimum, and is experienced usually between the last two weeks of July and the second week of August, though, there might changes. A period of dry, cold and dusty wind known as Harmattan also occurs between November and February.

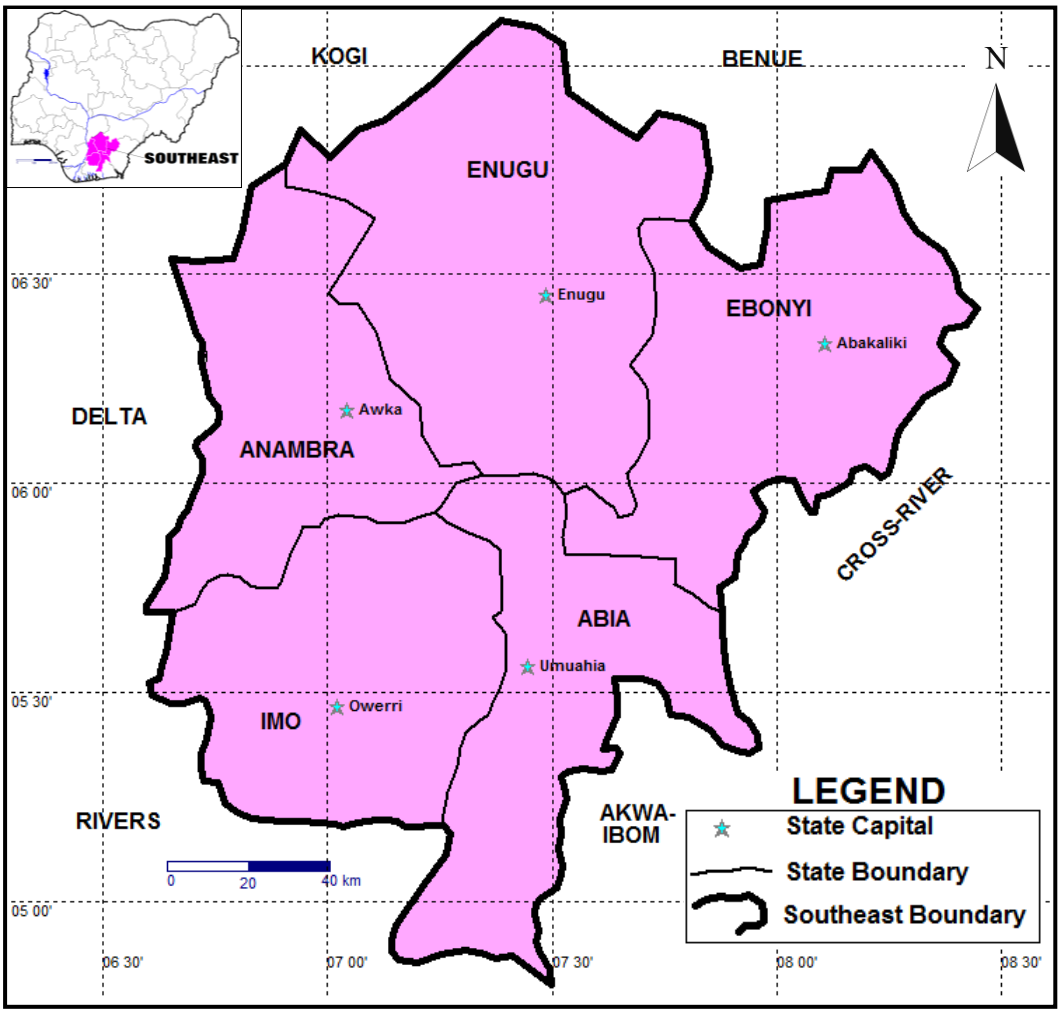


Figure 1.4: Map of the Study Area.
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2015

Heaviest rainfall usually occurs in July and September, and December records the driest month while the month of March records the hottest weather. Mean annual rainfall ranges from 1800mm to 2000mm. It experiences high temperatures all year round with an average value of 27°C while the average relative humidity ranges between 60-70% and 80-90% in January and July respectively (Monanu, 1975a; Monanu, 1975b; Anyadike, 2002; Akukwe, 2007; Duru, 2008). Floods in the south east are greatly influence by the rainfall pattern, and are usually experienced between July and October.

1.9.3 Relief and Drainage

The Southeastern region of Nigeria may be classified into two broad relief regions namely; lowlands and cuesta landscapes. The lowlands have heights of less than 400 meters and are made up of the Niger-Anambra lowlands in Anambra State and the undulating lowlands and coastal plains located along the Bende-Ameke-Umuahia axis of Imo and Abia States. The cuesta landscapes of above 350 meters high comprise the Nsukka-Okigwe cuesta and Awka-Orlu uplands (Ofomata, 2002a). The Nsukka-Okigwe cuesta is made up of the Enugu escarpments formed by the resistant sandstone in the lower coal measures and in the lower parts of the false bedded sandstone. The Awka-Orlu uplands are found around the Agulu, Nanka, Oko, Ekwulobia and Onitsha areas in Anambra State and Orlu area in Imo State. In terms of drainage, Anambra State is surrounded by rivers such as the River Niger, Omabala River, the Nkisi River, the Idemili River, Duo River, Mamu River, Ezu River and the Nwangele/Utumonye creek.

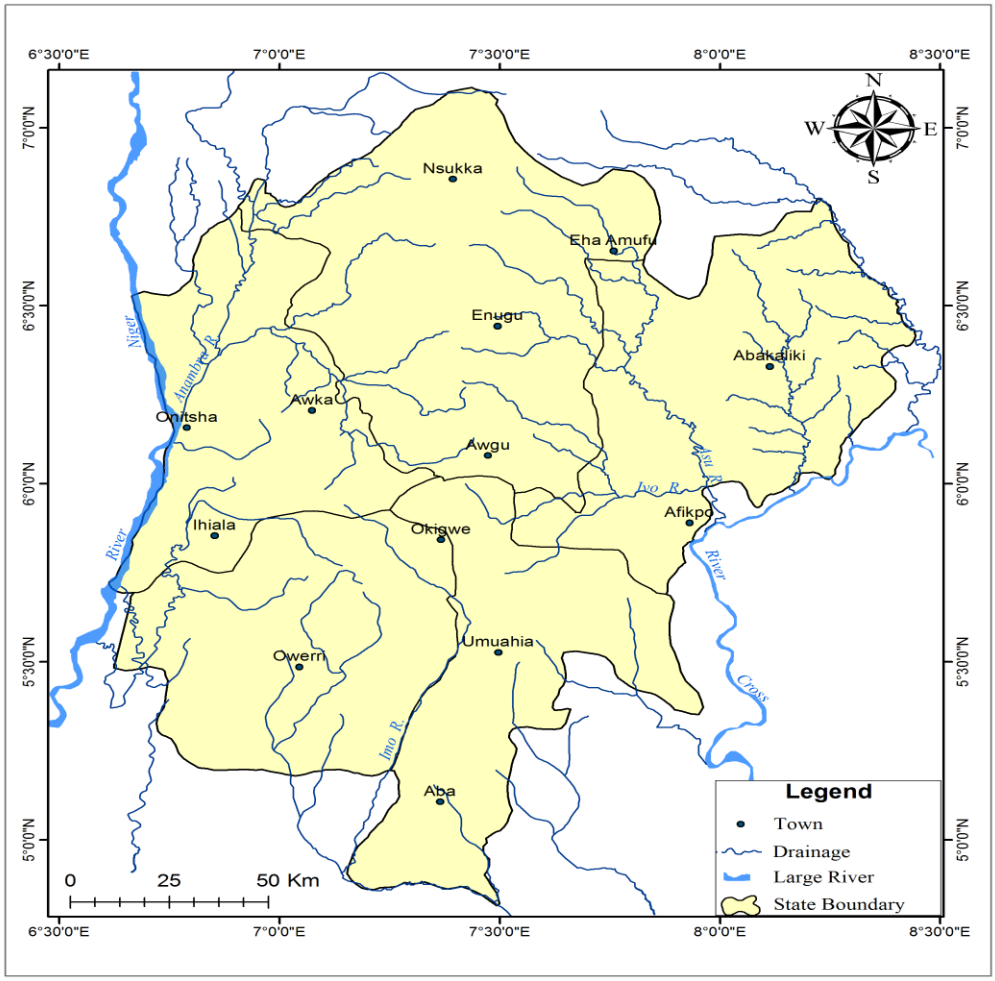


Figure 1.5: Drainage Map of the Study Area.
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2015

Imo State has few rivers with enormous interfluves that carry run-off in periods of heavy rains. The unique evenness of the terrain could be attributed to the uniformity of the rock structure and to the dearth of tectonic disturbances (Udo, 1981). The main streams draining the State are Imo, Otamiri, Njaba and Ulasi rivers, all of which have very few tributaries. With the exception of Imo River (which runs through the area underlain by the Imo Shales), other rivers in Imo State rise within the coastal plain sands.

All these rivers in the Southeastern region of Nigeria are tributaries of River Niger (Figure 1.5), and they sometimes overflow their banks to inundate adjacent communities especially due to excessive water supply from River Niger.

1.9.4 Soil and Vegetation

The soils of the area is composed mainly of iron rich tropical soils, which may be in the forms of loamy, clay, sandstones and sandy clays, and is further classified based on geological formation (Figure 1.6), landscape features and degree of profile development into lithosols, juvenile soils, ferralitic soils and hydromorphic soils (Onokala and Phil-Eze 2001; Umeji 2002, Ofomata, 2002b).

Her vegetation is mainly rainforest-savanna eco-tone. This vegetation zone comprises more than 60% grass with Hyparrhenia, Andropogon and Pennisetum purpureum as the predominant species (Phil-Eze 2001; Anyadike, 2002). The dominant plant species found in this area include; *Elaeis guineensis* (Oil palm tree), *milicia excelsa* (iroko tree), *Raphia vinifera* (Raphia palm), *Dacroydes edulis* (African pear), *Psidium guajava* (Guava), *Mangifera indica* (Mango), *Lophira alata, Gmelina arborea* (Gmelina tree), *Avicennia Africana*, coconuts, kola nuts, bitter kola nuts, bread fruit tree etc (Phil-Eze, 2001).

The region is predominantly agrarian and therefore much dependence on land resources, as a result of its dense population averaged to about 566 people/Km^2 (National Population Commission, 2010). This high population density is partly influenced by uncontrolled urbanization, which has brought about change in land-use and built-up environments as well as decrease in infiltration and percolation in parts of the region. The resultant effect is increased surface run-off which is generated faster than they are evacuated, thereby exacerbating flooding rates. In addition, the dependence on land has led to the overuse (due to annual farming of agricultural lands) of the land resources in the region (Anejionu, Nwilo and Ebinne, 2013).

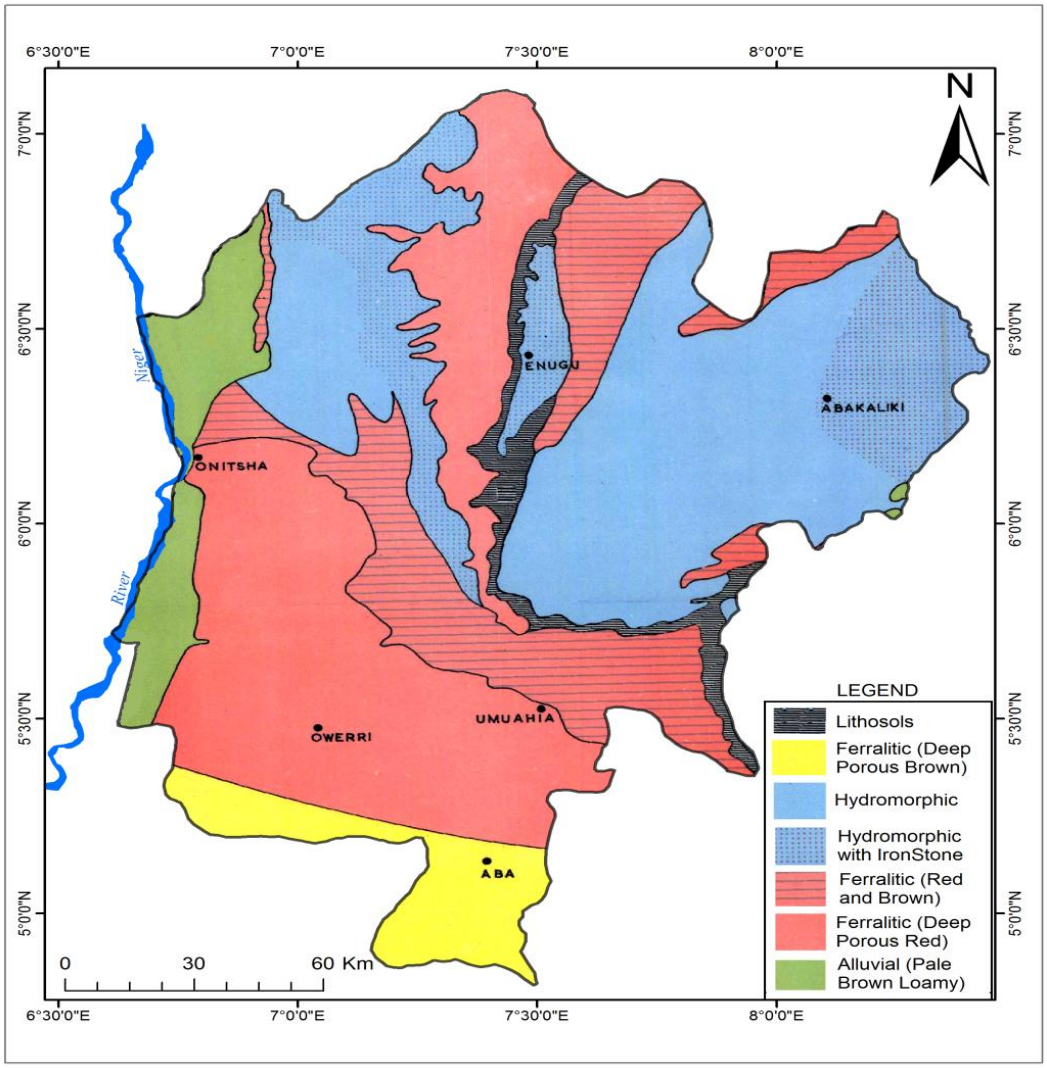


Figure 1.6: Soil Map of the Study Area.
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2015

1.9.5 Geology and Geomorphology

The landscape in Anambra State is largely the outcome of the interaction between the geologic substrates, climate-related processes, and man. The sandstones sometimes mixed with lateritic materials constitute the elevations and the watersheds that separate the river basins. The shale formation constitutes the Anambra River basin while the recent sands are found within the Niger flood plains in the northern tip of the Niger Delta, south of Onitsha (Ofomata, 2002a). The elevations are about 210metres above mean sea level along the Abatete-Enugwu Ukwu Akwa ridge, and separate the Anambra basin from the Idemili basin. The Anambra basin contains the Anambra West, Anambra East and Anambra Local Government Areas. Onitsha South local Government Area lies within the Niger flood plains especially around Fegge and the Bridge Head Industrial layout while Ogbaru Local

Government Area lies entirely within the Niger flood plains under laid by the Holocene sand deposits. The plains suffered most of the floods due to their relatively flat and low disposition with slope angles of 1º-3º. The floods occurred due to the increase in river level along the Niger following the excessive water supply from the Niger and the Benue.

1.9.6 Population

Anambra State and Imo State have a population of 4,177,828 (with 2,117,984 male and 2,059,844 female) and 3,927,563 (with 1,976,471 male and 1,951,092 female) persons respectively according to the 2006 population census figures. The population of the four selected Local Government Areas (LGAs) are Anambra East - 152,149 persons; Ogbaru – 223,317 persons; Oguta – 142,340 persons and Ohaji/Egbema – 182,891 persons (National Population Commission, 2010). In order to update the population figures at the LGA level, the equation below was applied;

$$P_2 = P_1 (1+r)^n \quad ...(1)$$

Where; P_2 is the projected population
P_1 is the known population (2006 in this case)
R is the rate of natural increase, 2.8% as noted by the United Nations, 2013.
n is the number of years between P_1 and P_2 (interval) and its 11 years in our case.

The population projections for the LGAs as calculated using equation 1 are shown in Table 1.2.

Table 1.2: Projected 2016 population for the study area

Local Government Area	2006 population (persons)	Projected 2016* population (persons)
Anambra East	152,149	205,401
Ogbaru	223,317	301,478
Oguta	142,340	192,159
Ohaji/Egbema	182,891	246,903

Source: *Researcher's computation, 2016; National Population Commission (2010).

1.9.7 Socio-economic Activities

Economically, the region is predominantly agrarian, with a substantial proportion of its work force engaged in farming, trading and services. In the urban areas, trading is the principal occupation, followed by services while in the rural areas, farming form the main economic activity. Aba (in Abia State), Nnewi and Onitsha (in Anambra State) form the major industrial hub in the region. Nnewi and Aba are famous for their handicrafts. Their major

economic contributions are palm oil and textiles alongside cosmetics, cement, pharmaceuticals and plastics.

There are several international markets found in the region e.g. the Onitsha Main Market which is the largest market in the region followed by the Ariaria International Market in Aba, Ngbuka motor spare parts market, Nkpo building market, Obosi electrical parts market etc. There are several daily popular markets like, Eke Onunwa in Owerri (demolished on 26/08/2017), Relief markets in Owerri and Onitsha, Ogbete market in Enugu among others. Despite the existence of daily markets, some towns in south east have markets that are periodic; people come to buy and sell on their market day, which usually has a four-day-cycle. There are four market days in the south east region viz; Eke, Orie, Afor and Nkwo. These periodical markets are found mostly in rural areas where most of the foods are grown, and this affect food security as the selling and buying of farm and non-farm produce are on a four-day-cycle. The region is rich in natural resources including crude oil, natural gas, zinc, lead, iroko, obeche, mahogany, rubber trees, oil palms and wood. The region has comparative advantage in the production of subsistence crops like yams, maize, potatoes, cashew, rice, plantains, and cassava which add a rich agricultural importance to the economy of Nigeria. The region could potentially offer food security to the nation, and generate export revenues if given adequate support.

Agriculture is mainly rain-fed in the region with many farmers involved in small-scale farming. They use crude farming implements like hoes, cutlasses and diggers among others while mechanised farming is practised by large-scale farmer who are very few. Shifting cultivation is practised in some parts where there are large expanses of land, though this practice is decreasing due to land scarcity. Rotational bush fallowing and crop rotation are also common practices. Rain-fed agriculture affects food security as some crops are seasonally available and are so expensive during off season.

There are several primary and secondary schools, as well as tertiary institution with some being run by the State governments, individuals and others by the Federal government. These tertiary institutions include; Imo State University, Owerri; Federal University of Technology, Owerri; University of Nigeria, Nsukka; Nnamdi Azikiwe University Awka; Abia State University, Uturu; Ebonyi State University; Anambra State University, Uli and Igbariam; Enugu State of Science and Technology; Oko Polythenic; Alvan Ikoku College of Education, Owerri etc.

Health centres and hospitals are found mostly in urban centres with sometimes none found in an entire town, though each of the Universities in the South east has a Teaching Hospital. Most Primary Health Care (PHC) centres are found in LGA headquarters which are usually not easily accessible to rural dwellers.

1.9.8 Socio-political structure

South easterners are generally patrilineal. There is the common practice of communal land ownership where kinsmen come together to share communal land amongst the male members each farming season, and whenever an adult kinsman wants to erect a building. This land tenure system has made land inaccessible to some people and has reduced the portion of land cultivated. Women do not own land in Igboland; they can only acquire/own land through marriage, leasehold or by buying. Farm/land leasing is also a common practice in the region. There is also individual ownership which is usually inherited, gifted or bought.

In most towns and villages, there are traditional rulers who pilot the affairs of their communities, where there is no traditional ruler, the town union president for instance, might be handed the mantle of leadership for his community.

In the study area (Igboland), a household is made up of a man, his wife and children, unmarried brothers and sisters, aged parents, and extended family. This social structure of household according to Afigbo (1992) is as a result of the agricultural system where these household members are obliged to help out in different activities. “Land holding is a reflection of the extended family structure where the adult males basically own the land and then lease it to their wives. The extended family is readily accepted, including large families in the traditional Igbo society, because it guarantees an increase agricultural labour force which is required for agricultural production” (Chukwuezi, 1999:12). Family members usually constitute the greatest part of agricultural labour, though hired labour is also employed.

1.9.9 Transport and Road Infrastructure

Air, rail, road and river transport means are available in the South east region of Nigeria. Air transport is not common as there are only two (2) airports situated in the region; 1 local (Sam Mbakwe Airport, Owerri and one international (Akanu Ibiam International Airport, Enugu). Rail transport that links the five (5) States to the rest of the country is minimally used and non popular because the railway passed through a very few towns, and there are a very few train

stations in the region. This has affected inter-regional trade. The most popular train stations in the south east are the Eha Amufu, Enugu and Aba train stations. River transport is mainly by canoes and speed boats and are evident only in the agricultural towns that are surrounded by rivers e.g. Oguta, Otuocha, Anam. The major mode of transport is road with a couple of inter-State roads linking the five States that make up the south east region as well as inter-regional roads linking them to other regions e.g. Onitsha-Owerri highway; Enugu-Port Harcourt express way; Onitsha-Awka-Nsukka road; Enugu-Nsukka-Makurdi-Lokoja highway. Intra-State roads linking LGAs together are also available. Onitsha, Aba, Enugu, Owerri and Abakiliki are major hubs for road transport in the region - a large number of transport companies operate buses and coaches that convey people and goods to different parts of the country daily.

Road infrastructure in the region is inadequate (in terms of number, accessibility and connectivity) and majority of the available roads are in poor state which is a major constraint to the development of agriculture and trade with the exception of Anambra State. Anambra State is the only State in the region that has improved tremendously in road network in recent years. The poor transport system within the region, affects movement of farm produce and increase transport cost e.g. in areas with non motorable roads, motorcycles are used to carry farm products from farm to market or other urban centres, thereby increasing food prices because a motorcyclist sometimes has to make 10-20 round-trips of what a vehicle (truck) could make once.

1.10. Organisation of Chapters

The thesis consists of five chapters. Chapter one is the introduction comprising the study's background, problem statement, objectives of the study, justification of the study, scope and limitations of the study, definition of concepts, theoretical/conceptual framework, research hypotheses, study area and organization of chapters.

Chapter two is the review of relevant literature on the effects of flooding on food security organized in five themes namely; causes and effects of flooding, vulnerability and adaptation to flooding, food security concept and measurements, determinants of food security, and climate change, flooding and food security.

Chapter three dealt with the research methodology involving the data sources, data collection methods as well as the tools/techniques employed in the data analysis.

Chapter four comprises the results and discussion. It dealt with a description of flood frequency, seasonal variations and severity as well as mapping the extent of flooding. Similarly, households' vulnerabilities to flooding and the different flood vulnerability levels, households' food security situations and their determinants, the effects of flooding on food security across households, the different adaptation and coping measures adopted by households to reduce the effects of flooding and food insecurity, and resilience of households were discussed in this chapter. Finally, chapter five consists of the summary of findings, conclusion and suggestions of measures to alleviate the effects of flooding as well as policy measures to enhance food security in the study area.

CHAPTER TWO

LITERATURE REVIEW

Thematic method has been adopted in discussing relevant literature in this study. The themes are; causes and effects of flooding; vulnerability and adaptation to flooding; food security concept and measurement; determinants of food security; climate change, flooding and food security.

2.1 Causes and effects of flooding

Flooding is one of the most common of all environmental hazards (Adewuyi and Olofin, 2014; Akukwe and Ogbodo, 2015). Flood is a natural phenomenon but human activities and interventions such as uncontrolled urbanization, impervious surfaces, blocked drainage facilities, improper use of flood plains, deforestation, coupled with increased population have increased the damages and losses caused by floods (Ologunorisa, 2004; Jeb and Aggarwal, 2008; Ogba and Utang, 2008; Balabanova and Vassilev, 2010; Ojigi et al., 2013; Akukwe and Ogbodo 2015). "Statistics have shown that floods in third-world countries usually cause many casualties and comparatively little damage, whereas floods in Europe and the USA cause enormous economic damage, but relatively small number of victims" (Klijn, 2009:5). However, it has not been established whether the increased adverse effects of floods in the last decades were caused by more intense and recurrent flooding, or by the increased vulnerability of flood plains, which are the preferred areas for economic development and settling (Klijn, 2009).

Flooding has been observed globally as one of nature's damaging phenomena (Adeoye et al., 2009; Aderogba, 2012; Wright, 2011; Duru and Chibo, 2014). Globally, the incidence of flooding has increased due to rise in sea level mostly in the coastal cities as well as changes in annual and seasonal rainfall as a result of climate change (IPCC, 2007; Syaukat, 2011) which has been manifested in increased pest outbreaks, reduced crop yields, rampant soil erosion and water logging (FAO, 2008b; Emaziye, et al., 2013).

Over the past century, the Central United States (CUS) has been beleaguered by a chain of large floods especially the incidences of 1993, 2008, 2011, 2013 and 2014 (Downton, Miller and Pielke; 2005; Xiao, Wan and Hewings, 2013). These flood events had taken a devastating societal consequences and economic toll on the CUS including decreased food production

and displacement of communities/people, contributing to economic losses reaching billions of dollars (Downton et al., 2005; Xiao et al., 2013; Mallakpour and Villarini, 2015).

Yin and Li (2001) noted that floods had become more frequent in the middle reaches of Yangtze River because of human activities (destruction of vegetation, land reclamation and siltation, construction of levees) in the river basin which had increased soil erosion of the upper reaches of the River, reduced the river's size and caused restricted flood discharge capacity.

Ninno et al. (2003) studied the floods in Bangladesh and they reported the floods to have affected food security of millions of households, and flooding, according to Muriadi and Wljaya (2013) has led to food insecurity in Indonesia. In West Bengal, heavy rainfall, melting snow, glacial outbursts, and dam break flows have been attributed as the main cause of inland flooding and the effects of flooding include; displacement of persons with associated poverty, loss of life and property, agricultural deficiency, disease outbreak, unemployment and starvation (Ismail and Mustaquim, 2013).

Many cities in Africa had been noted to face tremendous problems of severe flooding according to Douglas et al. (2008) which is caused by increased storm intensity and frequency related to climate change, and worsened by factors such as increased runoff from impermeable surfaces, blocked drainage systems, occupation of floodplains and inadequate waste management.

Furthermore, flooding in Nigeria has been due to natural (e.g. rainstorm/torrential or heavy rains, tidal waves and oceans storms usually along the coast), artificial (e.g. dam burst, burst water pipes, levees failure, silted up drainage, uncontrolled urbanisation) and topographic factors (Etuonovbe, 2011; Akukwe, 2014).

In various parts of Nigeria, flooding has killed people and forced thousands away from their homes; caused loss of life, animals and property; destroyed businesses, bridges, roads and other infrastructure; caused poverty through the degradation of agriculture land and disruption of services; polluted water resources and increased the risk of diseases (Jeb and Aggarwal, 2008; Ogba and Utang, 2008; Adeloye and Rustum, 2011; Etuonovbe, 2011; Olorunfemi, 2011), destroyed farm land and agricultural products resulting to poverty, hunger and starvation (Ejikeme et al., 2015) and according to Ajaero (2017), the 2012 flood in Nigeria affected the food security status of both female- and male-headed categories of

households.

Food insecurity among others had been identified as one of the effects of flooding in Nigeria (Ajaero, 2017), though little attempt has been made to comprehensively analyse it. However, this study analysed the effects of flooding on food security with emphasis on the spatial variations as regards households flood vulnerabilities.

2.2 Vulnerability and adaptation to flooding

The increasing body of literature on vulnerability and adaptation contains a perplexing combination of terms such as vulnerability, susceptibility, sensitivity, adaptation, resilience, risk, adaptive capacity, hazard, adaptation baseline among others (IPCC, 2001; Adger et al., 2002; Burton et al., 2002; Klein, 2004; Smit and Wandel, 2006; IPCC, 2007; Gbetibouo and Ringler, 2009; Malone and Engle, 2011; Balica, 2012). The term "vulnerability" is dynamic, scale-dependent, place-specific and multi-dimensional (Aandahi and O'Brien, 2001; Adger et al., 2004; Mayhura, Manyena and Collins, 2017) and tend to have contextual meanings. However, it has been noted that, it is important to only talk significantly about the vulnerability of an element at risk or a specified system exposed to a specific hazard (e.g. flood, drought...) or range of hazards, and this element or system may be an individual, business, household, population group, community, economic sector, region, country, or ecosystem (Brooks, 2003; Brooks et al., 2005).

It has been observed that scholars from the natural hazards discipline tend to centre on the concept of risk, while those from the social sciences and climate change discipline often choose to talk in vulnerability terms (Downing et al., 2001; Allen, 2003; Cutter, Mitchell and Scott, 2004 in Akukwe, 2012). "The concept of vulnerability has been viewed from different points by scientists, whereas social scientists tend to view vulnerability as a combination of socio-economic factors that influence the ability of people to cope with change or stress (Allen, 2003; Wisner et al, 2004), climate scientists often view vulnerability in terms of the probability of occurrence and impacts of weather and climate associated events (Nicholls, Hoozemans, Marchand, 1999; Vincent, 2004; Fussel and Klein, 2006; Yusuf and Francisco, 2009; Hinkel, 2011; Malone and Engle, 2011)" in Akukwe and Ogbodo (2015:1).

According to IPCC (2007:11), "vulnerability is defined as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes", from which this study adopted its definition of vulnerability. The

above definition conceptualizes vulnerability as a function of three factors: exposure, sensitivity and adaptive capacity and agreed by several scholars e.g. Klein (2004); Kasperson et al. (2005); Gbetibouo and Ringler (2009); Balica (2012) and IPCC (2012). In this study, vulnerability to flooding refers to a minimized state of the ability to cope with flooding as a result of biophysical and socio-economic factors.

Vulnerability assessment became relevant as it was seen as a tool to reducing damages and improving well being as it helps to answer these questions, 'What/who is vulnerable?', 'What is vulnerability?', and 'Vulnerable to what?' (Malone and Engle, 2011). In this regard, Cardona (2004) pointed out that since hazards cannot be controlled, efforts geared towards minimizing risk to a hazard can only be achieved by reducing the vulnerability of the exposed environments or communities to that hazard. Sinclair and Pengram (2003) specifically stated that the devastating effects of floods can be minimized if advanced warnings are available since the occurrence of floods cannot be prevented and Adger et al. (2004) noted that the vulnerability approach is a valuable tool use to assess people's needs in terms of improving their adaptation or ability to cope with existing threats. Adger (1999) noted "vulnerability" as the level of exposure of humans to extreme weather activities like drought, floods and earthquakes which threatens their very existence, and livelihood means through food production. Hence, any minor variation of the patterns of food production resulting from global warming could harm millions of people who depend on agricultural production, solely as their sources of livelihood (Yaro, 2013). In addition, Malone and Engle (2011) opined that vulnerability has emerged as a bridge between impacts on one side and the need for adaptive changes on the other.

Several studies have demonstrated vulnerability of individuals or community to flooding as a function of factors such as exposure of infrastructure and population, geographical location, institutional and political structures, coping and adaptive capacity as well as cultural and socio-economic conditions that distinguish the impacts on people and human system (Wisner et al., 2004; Barroca et al., 2006; Olorunfemi, 2010; Midgley, Davies and Chesterman, 2011; Cardona et al., 2012; Munyai, 2015; Munyai, 2017).

Adaptation on the other hand, refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). This shows adaptation as having an inverse

proportionality with vulnerability because adaptation measures or adaptive capacity limit vulnerability. For instance, adaptive capacity is the reason why people who are exposed to same degree of flooding, feel different degrees of impact(s). Thus, improving people's adaptive capacity is crucial in reducing their vulnerability to flood and this is dependent upon many factors. As noted by Maskrey (1999:85), "a community's capacity to absorb the impact of a hazard event and recover from it is determined by its geographical location, the resistance of its physical structures and infrastructures, its economic capacity, its levels of social cohesion and organisation, its cultural vision of disasters and many other factors." Similarly, studies on patterns of coping emphasise that people draw on number of informal sources of income and food, e.g. social networks, and there are existing variations in households' resources and the ability to convert these into food entitlements (Pottier 1988; Davies 1993; Swift 1993; Homewood, 1995 and Morrow, 1999).

In addition, individuals in a household vary in skills, knowledge, and in their socially and culturally determined rights to resources (e.g. monetary resources, water or forest resources, labour resources, agricultural production) according to age and gender (Anderson and Woodrow 1991; Nypan 1991; Dercon and Krishnan 1996; Cannon, 2002; Denton, 2002; Adger et al., 2004), and households differ in their capability to organize and manage resources and therefore ability to cope (Adger et al., 2004).

The interconnections between vulnerability and adaptation have been documented. In this light, Cardona et al. (2012) noted that, having an insight on the many-sided nature of vulnerability and exposure is a precondition for determining how weather and climate events influence disasters occurrence, and for designing and implementing efficient adaptation and disaster risk management strategies.

Studies on vulnerability and adaptation to climate risks and climate change, including floods, have been undertaken in various regions of the world (Bankoff, 2003; Dutta, Khatun and Herath, 2005; Metzger and Schroter, 2006; Thorton et al.,2006; Thieken, Kreibich and Merz, 2007; Ali 2007; Aragon-Durand, 2007; Gbetibouo and Ringler, 2009, Yusuf and Francisco, 2009; Heltberg and Bonch-Osmolovskiy, 2011; Midgley et al., 2011; Balica, 2012; Akukwe; 2012; Akukwe and Ogbodo, 2015; Ejikeme et al., 2015; Munyai , 2017). Vulnerability assessment is considered a core step towards successful disaster risk reduction as it helps to identify disaster (e.g. floods, earthquakes) hotspots as well as where targeted impact-

reduction strategies should be applied (Balica, 2012; Roy and Blaschke, 2015; Fernandez, Mourato and Moreira, 2016; Mayhura, Manyena and Collins, 2017). Correspondingly, Muriadi and Wljaya (2013) opined that the increasing magnitude and frequency of floods have made assessing people's vulnerability to flood pertinent, whether as a part of risk management system, or for policy support requirements. Studies on flood vulnerability have been carried out globally and have been reviewed nationally based on continents with examples from Asia, Europe, South America and Africa.

Nonetheless, Balica (2012) developed a flood vulnerability indices (FVI) by using a parametric approach through indicators (e.g. mortality rate for a region, storage capacity of a dam, GDP per capita) with FVI ranging from 0 to 1 indicating low and high flood vulnerability respectively between various spatial scales, and opined that the FVI would help to respond to flood disaster in the future.

In Asia, Bangladesh precisely, Roy and Blaschke (2015) worked on the spatial vulnerability assessment of floods in the coastal regions of Bangladesh using grid-based methodology (that is, GIS weighted overlay) of twelve (12) domains (characterized under two broad headings of sensitivity and coping capacity domains) and parameterized by forty-four (44) indicators. They noted that their developed explicit GIS-based methodology is useful for monitoring vulnerability and it can incorporate new indicators or components over time as well as being replicable in other countries. In addition, Park, Yang and Kim (2016) assessed social and economic vulnerability to natural disasters in Seoul, South Korea using indicator-based model and their results showed that vulnerabilities differ within same borough as well as noted that vulnerability assessment to disasters such as floods, earthquakes, landslides are important as it could help to prioritized disaster prevention projects in different areas.

In Europe, vulnerability assessments to floods have been carried out. For instance, in Portugal, Fernandez et al. (2016) applied a geographic information system-based multicriteria decision analysis (GIS-MCDA) to social vulnerability which assisted in assessing what and who is at risk, and where targeted impact-reduction strategies should be implemented. The social vulnerability was measured using population, socio-economics, buildings, and exposed elements and their relationships were presented according to a pessimistic scenario (maximum risk and without trade-off) with Oliveira do Douro, Mafamude, Vila Nova de

Gaia, and Avintes civil parishes recording high vulnerability in the inter civil parish analysis.

In South America, Novelo-Casanova and Rodríguez-Vangort (2015) assessed the flood risk of Motozintla, Mexico by adopting the structural, socioeconomic, organizational and global vulnerabilities. Their results showed that high level of flood risk to flooding was related to high structural vulnerability; poverty, lack of basic public services and proper social security services; no knowledge of existing Civil Protection Plan; and non-existent of disaster mitigation and response.

In South Africa, Munyai (2017) assessed community flood vulnerability and adaptation using exposure, susceptibility and resilience indicators and his results showed that flood vulnerability is determined by dwelling quality, poor or lack of drainage system, education levels, employment status, rainfall amount and topography in Greater Tzaneen Local Municipality, South Africa. Moreover, Mayhura et al. (2017) assessed the spatial variation of social vulnerability to flood hazards in Muzarabani district, Zimbabwe. They developed a social vulnerability index (SoVI) using the principal component analysis (PCA) technique and ArcMap10.2 geographic information systems (GIS) tool, and the results presented at the ward level to show their spatial variability. The SoVI scores were classified into five categories ranging from 1 (very low vulnerability) to 5 (highly vulnerable). The results showed that 69.0% of the wards in Muzarabani had a moderate to high level social vulnerability influenced by a set of institutional and socio-economic factors that varied across the wards.

In West Africa, Antwi et al. (2015) determined the level of communities' vulnerability to floods in Ghana, by developing an analytical tool based on complex interaction of human and natural indicators called Total Community Vulnerability Assessment Framework (TCVAF). They employed a rural participatory research approach in developing four vulnerability categories (engineering, socio-economic, political and ecological) using indicators that helped in the calculation of the total community vulnerability index for each community. Their results revealed that Baleufili community was the least vulnerable in terms of engineering, socio-economic and political vulnerability, but the most vulnerable, ecologically while Chietanga community was the least vulnerable ecologically but the most socio-economically vulnerable. They also showed that the state of each community's vulnerability to flood was a combined effect of the four vulnerability index categories which may act concurrently or independently.

In Nigeria, nevertheless, assessments have been carried out on vulnerability to flood using different approaches (Ologunorisa, 2004; Ologunorisa and Abawua, 2005; Ishaya, Ifatimehin, and Abaje, 2009; Adelekan, 2010; Ejikeme et al., 2015; Ogbonna et al., 2015; Okwu-Delunzu et al., 2017; Onuigbo et al., 2017). Ologunorisa (2004) used hydrological techniques to assess flood vulnerability in the Niger Delta zones while Ologunorisa and Abawua (2005) reviewed flood risk assessments and they found GIS techniques to hold a lot of promises as it is capable of integrating all the known techniques of predicting flood risk. The study approach of Ishaya et al. (2009) was mapping flood vulnerable areas in Gwagwalada Abuja with the use of 1991 & 2001 Landsat TM image while Adelekan (2010) study approach was on assessing the catastrophic Abeokuta flood that occurred in 2007 using the vulnerability characteristics of people.

In addition, Ejikeme et al. (2015) noted that flood vulnerability mapping is essential in flood risk management as it helps to identify areas vulnerable to flood disaster and they used remote sensing and GIS technologies to classifying Anambra State into areas of very high, high, moderate, low and no risk of inundations. Ogbonna et al. (2015) assessed flood vulnerability in Aba urban using GIS Technology and rainfall information and found 71.65% of Aba vulnerable to flood while 28.35% was not. Similarly, Okwu-Delunzu et al. (2017) worked on spatial assessment of flood vulnerability in Anambra East and environs using Remote Sensing (RS) and Geographic Information System (GIS). Their flood vulnerability assessment showed that 76.24% of the study area was liable to very high flood risk.

Finally, Onuigbo et al. (2017) used environmental factors such as slope, hydrology, land use/land cover, soil type, landform and drainage density to map flood vulnerability in Lokoja into four vulnerability areas namely; not vulnerable, less vulnerable, more vulnerable and most vulnerable areas. Their results revealed that not vulnerable areas accounted for 20.25%, less vulnerable areas accounted for 34.57%, more vulnerable areas accounted for 28.57% and the most vulnerable areas accounted for 16.61%.

However, the above studies assessed vulnerabilities using either physical or socioeconomic method which did not give a balanced analysis, but this study adopted the integrated method (involving both biophysical and socioeconomic factors) to analyse household vulnerability levels to flooding and mapped using GIS. The integrated approach had been used by some scholars and has indications of being holistic e.g. Deressa et al. (2008) and Tesso et al. (2012) used it to assess the vulnerability to climate change in Ethiopia; Opiyo (2014) used it to

assess vulnerability to climate change among Turkana pastoralists in North-western Kenya and Madu (2011) used it to assess the vulnerability of Nigerians rural households to climate change while Akukwe and Ogbodo (2015) adopted it to assess the vulnerability of households to flooding in Port Harcourt metropolis, Nigeria. The study took into cognizance the biophysical, socioeconomic and demographic dimensions in assessing the adaptive capacity of households in the communities as regards the multidimensional nature of vulnerability and adaptation as partly opined by Cardona (2004) and Brooks et al. (2005).

2.3 Food Security Concept and Measurement

The concept of food security has significantly advanced over time. The term first originated in the mid-1970s, when the World Food Conference (1974) expressed food security in food supply terms, thereby, assuring the availability and price stability of essential foodstuffs at the national and international levels. In the early 80's, the concept of "access" was included in the definition of food security (FAO, 2006). However, the generally accepted definition of food security, according to FAO (1996; 2008a:9) "exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". This definition encompasses four dimensions (viz; food availability, affordability, utilization and stability) which when not fulfilled leads to food insecurity. Yaro (2013) had noted food insecurity to be a long-standing developmental challenge for Africa which has been complicated due to its connectivity with the socio-economic, technological, political and environmental systems. He further identified unemployment, poverty, increase in food prices, lack of education, poor access to market climate and environment conditions as factors that have a direct relationship with food security

However, these four food security dimensions as opined by Ibok, Idiong et al. (2014) could be broadly grouped into two determining factors, namely; the demand side and supply side factors. Whereas the supply side factors determine food availability or food supply as well as the physical access to food at various levels, the demand side factors determines the economic access of individuals and households to the available food (Omonona and Agoi, 2007; FAO, 2008a; Ogundari, 2013).

On the one hand, food availability has to do with sufficient food being available and it "is determined by the physical quantities of food that are produced, stored, processed, distributed and exchanged" (FAO, 1996:4; 2008:9) while food accessibility is determined by factors such as household financial resources, market prices, socio-cultural as well as geopolitical factors as against the availability of food in the market (World Bank, 2008; Beyene and Muche, 2010; Tefera and Tefera, 2014). On the other hand, food utilization has been described as the food use and how essential nutrients are acquired from consumed food by a person person (FAO, 2008) and it is influenced by conditions such as nutrients loss during food processing, improper care and storage, inadequate sanitation and some cultural practices which prevent the consumption of nutritious food at the household level (Barret and Lentz, 2010; Akudugu and Alhassan, 2012; Tefera and Tefera, 2014 in Djangmah, 2016).

Furthermore, food stability deals with the phrase "at all times" in the food security definition by FAO (1996; 2008a) and it emphasizes the importance of having to minimize the risk of negative effects on the other three dimensions namely; food availability, food accessibility or food utilization over time. Stability has been noted to be affected by shocks (economic and climatic disasters) or cyclical events such as seasonal shortage which causes disruptions in food availability, accessibility or utilization (FAO 2006, FAO, 2008a; WFP, 2009).

There is a linkage among the four food security dimensions and any interruption in any of them leads to food insecurity, for instance, when food supply is completely or overtly influenced by factors such as climatic events (e.g. drought, flood) and/or natural disasters (e.g. earthquake, tornado), food availability is affected (FAO, 2006; FAO, 2008a; Barret and Lentz, 2010; Akudugu and Alhassan, 2012 in Djangmah, 2016). Thus, this study which looks at flooding effects on food security is imperative.

Globally, scholars have adopted different methods to measure household food security status using various indicators. These indicators include; food consumption score/dietary diversity score, per capita expenditure on food, per capita food consumption (such as protein, per capita nutrient intakes of calorie, and fat), share of dietary intake, anthropometry measures, food insecurity access scale (self-report/assessment) and coping strategy index among others (Ogundari, 2017). These indicators are usually in the form of questions and according to Castell et al. (2015), the food insecurity questionnaires usually employ a series of retrospective questions that detect the level of concern and the inadequate access to, variety

and/or quantity of food, which often reflect three different domains of food insecurity namely; uncertainty or anxiety; insufficient quality and insufficient quantity. However, an attempted had been made to categorise research works based on the indicators used.

The Household Food Insecurity Access Scale (HFIAS) is a food insecurity scale consisting of a set of nine questions, developed by the USAID's Fanta Project. This scale makes use of scores attached to responses e.g. 0, 1, 2 and 3 attached to "never, rarely, sometimes and often" responses respectively, where a cumulative higher score represents greater food insecurity. Four categories of households namely; food secure, mildly food insecure, moderately food insecure and severely food insecure households are arrived when this measurement method is used (Coates, Swindale and Bilinsky, 2007).

In South Africa, Battersby (2011) assessed household food insecurity levels in Cape Town using HFIAS, and their study revealed that 80% of households were either moderately or severely food insecure. Similarly, Sekhampu (2017) used the HFIAS in Kwakwatsi, Free State province of South Africa, and found 51.1% households to be food insecure while 48.8% were either mildly, moderately or severely food insecure.

Correspondingly, Knueppel, Demment and Kaiser (2009) categorized households in rural Tanzania using HFIAS method and their results revealed that 20.7 % of the households were food secure, 8.4 % were mildly food insecure, 22.8 % were moderately food insecure and 48.1 % were severely food insecure and the reason for the large proportion of food insecure households were attributed to two underlying factors viz; insufficient food intake and insufficient food quality. Farzana et al. (2017) also adopted the HFIAS to classify households in Bangladesh into food secure, mildly food insecure, moderately food insecure and severely food insecure and further categorized the coping strategies adopted with respect to the households' food security levels.

The Food Consumption Score (FCS) developed by WFP (2008), is commonly used as a proxy indicator for determining utilization dimension of food security as well as access to food. "It is a weighted score based on dietary diversity, food frequency and the nutritional importance of food groups consumed with a reference period of seven days" (WFP, 2008:1). The FCS of a household is calculated by multiplying the frequency of foods consumed in the last seven days with the standardized weighting of each food group, thereby classifying households into three namely; poor (with FCS of $\leq$21); borderline (with FCS of 21.5 to 35)

and acceptable (with FCS of >35). Ndakaza et al. (2016) used the FCS approach to classify households in Rwanda into food secure (comprising households with “acceptable” FCS) and food insecure (consisting of households with “poor” and “borderline” FCS) and their results showed that 70.9% and 29.1% households were respectively food secure and food insecure. However, the FCS approach is not without challenges. An observed problem with this method is its consideration of the frequency of food groups eaten without taking cognizance of the quantity eaten within the reference period.

On the other hand, Ibrahim et al. (2009) assessed the state of food security among urban households in the Federal Capital Territory of Nigeria using the food security score scale developed by Freedom from Hunger (FFH), their results show that 70% of the respondents were food secure while 30% were not food secure in their study area.

The per capita food expenditure measures food security on the basis of money spent on food monthly, against the household size. “A food secure household is thus, a household whose per capita monthly food expenditure fall above or is equal to two-third of the mean per capita food expenditure while a food insecure household is that whose per capita food expenditure falls below two-third of the mean monthly per capita food expenditure” (Omonona and Agoi, 2007:402). Omonona and Agoi (2007) analyzed the food security situation among urban households in Lagos State, Nigeria using food security incidences from per capita food expenditure, and found out that food insecurity increases with increase in household size and ages of household heads, and decreases with higher level of education.

Similarly, Adepoju and Olawuyi (2012) applied the per capita food expenditure method to measure food security indices among farmers in Oyo State, Nigeria and found about 69% to be food insecure. Ibok, Bassey, et al. (2014) also applied this method to assess the status of food security of urban households involved in farming in Cross River State of Nigeria, and their results revealed that 52.5% of the households were food secure whereas 47.5% were food insecure. One of the disadvantages of this method of measuring food (in)security is its emphasis on amount of money spent and household size with no account on the food composition and amount of food consumed.

Nevertheless, Ojogho (2010); Asogwa and Umeh (2012); Olagunju et al. (2012) and Yusuf et al. (2015) applied the cost-of-calorie method proposed by Greer and Thorbecke (1986) to determine food security in Edo State and Benue State of Nigeria respectively. The method

derived a threshold value that was close to the minimum calorie requirement for human survival which served as the minimum level, described as the "food insecurity line" and people who fell below this calorie level were classified as "food insecure" in the study area.

Similarly, Welderufael (2014) used the Foster-Greer-Thorbecke (FGT) method proposed by Foster et al. (1984) to examine the extent of household's vulnerability to food insecurity in urban and rural areas of Amhara regional state of Ethiopia, where about 48% households were revealed to be food insecure (i.e. they fell below the recommended caloric requirement of 2200 kcal/Adult Equivalent/day) and these food insecure households were mostly found in the rural areas. In addition, cost-of-calorie method had been applied by Babatunde et al. (2007) who found 64% of the households in Kwara State of Nigeria to be food insecure because they were below the recommended daily requirement of 2260 kcal while Mitiku, Fufa and Tadese (2012) found 36% households to be food insecure in Shahemene district of Oromia region, Ethiopia using the FGT method. Furthermore, the FGT method had also been used by Tefera and Tefera (2014) and Dawit and Zeray (2017) in Ethiopia; Orewa and Iyanbe (2010) in Nigeria among others. The limitation of this method is that it employs the per capita calorie supply technique which means larger household size with adults will usually be close to the minimum level or below it.

The Household Food Security Survey Module (HFSSM), developed by the United States Department of Agriculture (USDA) classifies households using a constructed linear food security scale. It measures the degree of food insecurity/hunger experienced by households in terms of a single numerical value which ranges between 0 and 10 (Bickel et al., 2000). Like the HFIAS, it employs responses to a set of 14-18 questions regarding households' food needs with "never true" coded as 0 while "sometimes true" and "often true" coded as 1.

In the United States of America, Coleman-Jensen, Rabbitt, Gregory and Singh (2015) assessed the household food security of Americans using the United States Department of Agriculture (USDA) approach, and their results show that 85.7% and 86% Americans were food secure in 2013 and 2014 respectively. In addition, Sanusi et al. (2006) measured the household food security status in Lagos and Ibadan using the USDA approach and found over 70% to be food insecure. Fakayode et al. (2009) also examined the food security situations of farm households in Ekiti State, Nigeria using the USDA approach. They found out that only 12.2%, 43.6%, 35.9% and 8.3% of the respondents were food secure, food insecure without

hunger, moderately food insecure with hunger and severely food insecure with hunger respectively. Similarly, Ibok, Idiong, et al. (2014) used the USDA approach to examine the food insecurity status among urban farm households in Cross River State, Nigeria and their results showed that while 12.44% of urban farmers were food secure, 55.76%, 25.35% and 6.45% were food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger correspondingly. An observed disadvantage of this method is the proxy answers given by parents/guardians on behalf of other members of the family, though it has more advantages such as concentrating on virtually all the dimensions of food security compared to other methods.

However, researchers are beginning to adopt more than one measurement method to assess food security at household level as regards its complexity. For instance, Goshu (2016) in his PhD work measured the food security status of households in Gubalato district, Ethiopia using a combination of the HFIAS, FGT, Food Consumption Score (FCS) and Coping Strategies Index (CSI) methods. His HFIAS findings showed that 48.26%, 30%, 16.09% and 5.65% households were food secure, mildly food insecure, moderately food insecure and extremely food insecure respectively. The FGT findings indicated 53.9% of the households to be food secure, 17.8 % mildly food insecure and 28.3% severely food insecure using 2,100 Kcal per adult equivalent per day as a threshold. Moreover, his FCS results revealed that about 50%, 33% and 17% of the households had acceptable FCS (greater than 35), borderline FCS (between 21 and 35) and poor FCS (below 21) respectively while his CSI results categorized about 37% as moderately/severely food insecure, 30% as mildly food insecure and 33% as food secure households in his study area. The variation in the food security status of households using various methods is because these methods have got some limitations too.

Furthermore, to take care of some of these limitations, indicators harmonization has been attempted. Ogundari (2017) incorporated the food utilization and accessibility aspects of food security definition in assessing food security in an attempt to capture the multidimensional nature of food security. He harmonized two food security indicators namely; dietary diversity score (DDS) and food expenditure to categorize households into four different levels of food security states in Nigeria namely; completely food insecure households as revealed by both indicators, transitory food insecure households (two types) each based either on food expenditure or DDS indicators, and completely food secure households as revealed by both indicators. His results revealed that about 60% and 66% of

the households were food secure based on DDS and food expenditure indicators, respectively whereas only about 42% of the households were eventually food secure when the two indicators were harmonized.

In the face of the extant literature on food security indicators, it is still devoid of an agreement on the main indicators that are needed to adequately measure and monitor household food security situations both at the micro- and macro-levels around the world (Carletto, Zezza and Banergec, 2013 in Ogundari, 2017), as it is known that these indicators only centres on one dimension at a time. This is supported by the findings of Bashir and Schilizzi (2013) on the determinants of rural household food security in Africa and Asia, which proposed a conceptual model as regards the three widely known components of food security of food accessibility, availability and utilisation, who found food availability to be the most studied component, followed by food accessibility, while food utilisation has been the most ignored component in both continents. To fill the gap of studying a single aspect of food security, the USDA approach was adopted for a comprehensive household food security assessment while other indicators have been used to assess other food security dimensions.

The USDA approach has been shown to be a robust approach for assessing food security status at household level since it includes virtually all of the food security dimensions and could be used to show the percentages of households that are food secure and food insecure with/without hunger. For this reason, it was adopted in this research to assess food security status. However, in order to incorporate the multidimensionality of food security, this study adopted food composition scores to analyse the utilization dimension; per capita monthly food expenditure to analyse the accessibility dimension; sufficiency in own food production to analyse the availability dimension and irrigation agricultural practice to determine the stability dimension since the sampled households are largely agrarian.

2.4 Determinants of food security

The determinants of food security vary across countries and regions around the globe and have been examined by different scholars using mostly regression models. Demographic and socio-economic factors have been extensively demonstrated as the determinants of food security globally. These factors include; sex and age of household heads, level of education and marital status of household head, income (including off-farm income), wealth index (e.g. livestock ownership), household size and dependency ratio, land holding (farm size);

sufficiency in own food production among others as revealed below.

In Indonesia, Wiranthi, Suwarsinah and Adhi (2014) applied the ordered regression to examine the determinants of household food security in the Eastern and Western regions and they found age and level of education of household's head, head of household occupation in non-agricultural sector, increase in expenditure equivalent, female household head, small household size, and location of household in urban areas as increasing the likelihood of a household being food secure.

In Mexico, Magaña-Lemus, Ishdorj and Rosson (2013) applied the ordered probit model to study the determinants of household food security and they found that households with less-educated and younger household heads, had a higher probability of being food insecure. Their results also revealed that, the vulnerability to food insecurity was higher in households with disabled family members; households headed by a single, widow or divorced mother; rural households; households with kids; households with strong indigenous background; non-agricultural households and low income families.

In South Africa, Sekhampu (2017) employed the logistic regression analysis to ascertain household food security and demographics in Kwakwatsi township, and his results demonstrated household size, the gender and marital status of the household head to be negatively associated with food security whereas household income and the age of the household head were positively associated with food security.

Studies that have employed multiple logistic regressions in East Africa include; Mitiku et al. (2012) whose findings revealed, cultivated land size, family size, total farm income, livestock ownership and off-farm income of households as the significant determinants of household food security status in Shashemene District, Ethiopia. In the same vein, Tefera and Tefera (2014) applied the logit regression model to determine the direction and strength of factors that influence food security in Mareko District, Guraghe Zone of Southern Ethiopia, and age of household head, size of credit received, size of cultivated land, household size, level of education, off-farm income per adult equivalent, use of improved seed, number of contact with development agents, and size of livestock owned were revealed as the significant factors.

Moreover, Welderufael (2014) applied the binary logistic model to examine the determinants of food insecurity in Amhara Regional State of Ethiopia and revealed sex and age of the

household heads, consumption expenditure, family size, employment status, farm inputs, farm size, livestock ownerships and shocks such as illness and drought as the determinants of household food insecurity. Similarly, Goshu (2016) employed logit regression analysis which revealed dependency ratio, household size, education level of household head, number of livestock, agricultural technology, access to protected water, access to credit, distance to the market, benefit received from Production Safety Net Programmes (PSNP) and crop diversification index as the significant determinants of food security in Gubalafto District of Amhara Regional State, Ethiopia.

In Rwanda, Habyarimana (2015) used Probit model to examine determinants of food insecurity in rural households of Rwanda where household size, livestock ownership, monthly food expenditure, household asset index and membership to agricultural cooperative were among significant factors that explained rural household food insecurity levels in Rwanda. Additionally, Ndakaza et al. (2016) used probit regression to model the factors influencing food security in Rwanda and their results revealed sex and level of education of household head as well as farm size, access to near market, livestock ownership and climatic adaptation among others as significant determinants of household food security.

In Kenya, Oluoko-Odingo (2006) used the stepwise multiple regression to show the relationship between food security determined by food crop production and some socio-economic factors. She found a negative relationship between land cultivated the previous year and household food crop production with a positive relationship existing between farm size and household labour and household food crop production. Mungai (2014) used the probit regression to assess food security determinants amongst households in Lugari and Makueni Sub-counties of Kenya and three factors namely; household income, land size per capita and education level of household head were found to have significant positive effect on household food security while household size were negatively and significantly correlated with food security.

In West Africa, regression models have been employed to examine the significant food security determinants as well. For instance, Aidoo et al. (2013) assessed food security determinants among rural households in Sekyere-Afram Plains District, Ghana using the logistic regression model where marital status and household size had a significant negative effect on food security, and credit access, farm size and off-farm income were found to

significantly influence household food security positively.

In the same vein, Djangmah (2016) studied comparative analysis of food security status across farming households in Eastern and Northern regions of Ghana using logistic regression. Her results revealed that monthly household income, off-farm activities, total quantity of own farm production and dependency ratio positively and significantly influenced households' food security while household size and the number of years spent in education negatively and significantly affected food security in the two regions.

Moreover, Zakari et al. (2014) examined the factors influencing household food security in Niger, West Africa, using logistic regression to determine the relationship between household daily rations and factors influencing food security. Their findings revealed that, the sex of the head of household, access to market, labour supply, diseases and pests, poverty, flooding, food aid and the distance away from the main road are significant factors influencing the odds ratio of a household having appropriate daily rations. This is supported by the works of Adepoju and Olawuyi (2012) and Asogwa and Umeh (2012), who used tobit regression model and concluded that increase in household size has a positive correlation with food insecurity among rural households in Oyo State and Benue State of Nigeria respectively.

In Nigeria, Arene and Anyaeji (2010) used logistic regression and they found income and age of household head as important determinants of food security. Ojogho (2010) used the multiple binomial logit regression model to examine the determinants of food insecurity among arable farmers in Edo State of Nigeria and his results show that sex of the household head, level of education and output level of households are negatively significant while household size and dependency ratio are positively significant as the factors that influence food insecurity.

Similarly, the logistic regression was used by Ahmed and Dotti (2014) and Ibok, Bassey, et al. (2014) to examine the determinants of food security among medium income households in Maiduguri Metropolis and to investigate food security determinants among urban food crop farming households in Cross River State, Nigeria respectively. They found years of age of farmers, formal education, farming as main occupation, farming experience, output of food crops produce, income from farm and household size to be the major determinants of food security status of the households.

On the contrary, Adepoju and Olawuyi (2012) found educational status not to be a significant

factor in determining the food security status, though their study agrees that an increase in income increases the food security status of farmers while a unit increase in age of farmers led to a unit decrease in their probability of being food secure. However, Ogundari (2017) found household size, income and level of education, sex of household heads and ages of family members as significant determinants of household food security using multinomial regression model in Nigeria.

In south eastern Nigeria, Ajaero (2017) used binary logistic regression models to estimate the socio-economic predictors of food security for male-headed households (MHHs) and female-headed households (FHHs) before and after floods in Anambra State, and his results revealed larger household sizes, higher incomes and marital status as the significant determinants of food security for both FHHs and MHHs after the 2012 flood. Other scholars that had employed regression model to analyse the socio-economic and demographic determinants of food security in Nigeria include; Omotesho et al. (2006); Olagunju et al. (2012); Adepoju and Adejare (2013); Obayelu (2013); Henri-Ukoha et al. (2013); Yusuf et al. (2015).

Most empirical studies have employed regression models especially the logistic regression model to examine the relationship between food security and its determinants. The logistic regression is a non parametric statistic tool that has proved to be a powerful tool in showing the direction, strength and extent (in terms of odd ratios) of the relationship between various food security levels and their determinants, hence the reason for using this statistical tool. As a non parametric tool, most of the assumptions (e.g. linearity, homoscedasticity and being normally distributed) considered under parametric regression (Ordinary Least Squares) are inconsequential as they are taken care of in the logistic regression model. Therefore, binary logistic regression model was adopted to assess the relationship between food security and other determining factors because the strength of the effects could be measured using this technique as evident in the reviewed works, and because of the binary nature of the nominal variable being assessed (food security/food insecurity).

Nonetheless, the extensive discussion of the demographic and socio-economic determinants of food security without in-depth studies on the influence of external disturbances such as flooding in agrarian and flood vulnerable communities facilitated this study, which considered flooding as one of the determinants of food security.

2.5 Climate change, Flooding and Food security

Several studies have been carried out on climate change and food security. These studies have predicted climate change to cause some shifts in food security in the future. Due to the prediction that climate change will increase the intensity of flooding in some regions, there is need to review some studies related to climate change and food security. It has been noted that the global mean temperature has increased by 0.74 °C in the last 100 years, and is expected to rise to between 1.1 and 6.4 °C by the end of the twenty-first century, depending on projected scenarios (IPCC, 2007), which could lead to extreme climate variability and weather-related events like flooding (Syaukat, 2011). Evidence shows that more intense and recurrent weather events (heat and cold waves, floods, droughts, heavy storms), rising irregularities in seasonal rainfall patterns and rising sea levels (including flooding) are already having direct impacts not only on food production, but also on incidence of food distribution infrastructure, food emergencies, livelihood assets and human health in both urban and rural areas (FAO, 2008b; Emaziye, Okoh and Ike, 2013).

Climate change is not the sole most significant driver of food insecurity but predominantly an important determinant of food system performance at the farm end of production-linked income due the overall dependent of food system performance on climate today than it did 200 years ago, especially in locations where the primary source of income and food is still dependent on rain-fed agriculture (FAO 2008b). Similarly, Hanhra and Qureshi (2010) opined that climate change may affect food security and agriculture by shifting the temporal and spatial rainfall distribution and the availability of water, capital, land, terrestrial resources and the biodiversity by exacerbating uncertainties throughout the food chain; from farm to fork and yield to trade dynamics and eventually affecting the ability to feed nine billion people by 2050.

Nevertheless, the increased frequency and intensity of storms, flooding and drought had altered hydrological cycles and precipitation variation which have implications for food availability in the future (Syaukat, 2011). Warner, Schattman and Hatch (2017) noted that the forecast using climate change models of increasingly intense and frequent floods for New England (Unites States) are already being felt mostly by farming communities that have been experiencing the associated negative consequences such as inundation, erosion, natural habitat destruction, and property damage, which invariably affect food security.

Ludi et al. (2007) modelled the impacts of climate change on agricultural production and established that over the next century, there would be negative effects on crop yields, especially in developing countries where people are already at risk. In addition, FAO (2008b) acknowledges that these changes in agricultural production patterns would affect food security in two ways; by affecting food supply at both local and global levels; and by affecting livelihoods and ability to access food. In the same vein, Schlenker and Roberts (2009) projected temperature effects on crops in the United States, and Muller et al. (2011) projected temperature effects on crops in Africa, and both concluded that climate change would have negative impacts on crop yields. They did these projections by basing the effects on temperature trends and an expected increase in the possibility of extremes during the growing season.

Furthermore, in relating the impact of Climate Change to food Production and food security, Syaukat (2011) used climate data of 36 years (1971 to 2006) and with aid of a simulation, he emphasized that Indonesia agricultural production is more sensitive to temperature increase rather than rainfall decrease. His research also showed that the combination of rainfall and temperature would have significant impact on Indonesia's food balance by 2050 with an estimated deficit of 90 million tons of husked rice by 2050. Moreover, Emaziye et al. (2013) focused on the linkage between climate change and food security of rural households in Cross River State, Nigeria by applying the food security index equation used by Hoddinott (2001) and Feleke, Kilmer and Gladwin (2003). They established that Cross River State was moderately food insecure with food security having statistically significant relationship with the climate change factors, with 67.07% losses of annual income.

Floods have been described as the natural disasters with most consequences on agriculture; hampering food security especially in developing countries (Pacetti et al., 2017) where people are predominantly dependent on agriculture. To prove this, Pacetti, et al. (2017) used remote sensing data combined with water footprint databases and agricultural statistics to assess the effects of flood events on food supply (food availability) with reference to the extreme floods events in Pakistan (2010) and Bangladesh (2007) as case studies. They evaluated flood damages on agricultural areas by estimating crop losses and converting it into lost calories and water footprint as complementary indicators, and their results depicted a flood-induced reduction of food supply between 8% and 5% in Pakistan and Bangladesh respectively.

On the other hand, Ramakrishna et al. (2014) examined the impact of flood on food security and livelihoods of Internally Displaced Person (IDP) households using binary logit model. They concluded that floods have a negative impact on food security by reducing the wage income and purchasing power, resulting in food shortages among households in Khammam region of India. In the same vein, Zakari et al. (2014) also concluded that floods have adverse and significant effect on household food security in Niger Republic using logit model and Oluoko-Odingo (2006) found a negative correlation between flooding and household food crop production in Nyando district of Kenya.

In Nigeria, flooding had been noted to affect crop production and invariably food security. In this light, Sidi (2012) carried out a research on the impact of the 2012 floods on agriculture and food security in Nigeria using GIS and his results show that flooding affected a substantial percentage of areas that produce the three main tuber food crops (sweet potatoes, cassava and yam) in Nigeria. He noted that 17.2% of sweet potato production areas; 21.6% of cassava production areas and 27.9% of yam production areas were affected.

Furthermore, Ajaero (2017) demonstrated the impact of flood on food security of male-headed and female-headed flood-induced migrant households in Anambra State by determining the before- and after- the 2012 flood food security status of the two categories of households and his results showed flood to have affected food security, since the 89% of the FHHs reported to have been food secure before the flood reduced to 22% after the flood while the 84% of MHHs that were food secure decreased to 34%.

However, based on the available literature, the impact of climate change on food security is well documented while the effect of floods on food security is still sparse. If climate change has an adverse effect on food security as Syaukat (2011) and Emaziye et al. (2013) argued, then flooding which arises from extreme weather events as one of the manifestations of climate variability is also expected to affect food security. Since Ramakrishna et al. (2014) and Zakari et al. (2014) found out that floods have positive impact on household food insecurity in Khammam (India) and Niger respectively, there is need to investigate the effects of flooding on food security in other flood vulnerable areas. Therefore, the main thrust of this research was to examine the extent to which flooding could affect food security in the agrarian communities which are vulnerable to flooding in south eastern region of Nigeria. Additionally, the multiple logistic regression was adopted to show the relationship between flooding and household food security alongside other socio-economic and demographic

factors since the latter is a nominal variable with two values (food secure and food insecure households). Moreover, the ordinal logistic regression was used to show the relationship between flooding and food security. The study is pertinent because there is paucity of scientific literature showing the interaction between floods and food security in the south eastern region of Nigeria.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The research methodology was discussed under the following; reconnaissance survey, field sampling techniques, data sources, data collection and data analysis.

3.2 Reconnaissance Survey

The researcher embarked on reconnaissance visits to the study communities to sensitize the pertinent community stakeholders on the purpose and the usefulness of the study. The outcome of the reconnaissance visits were used in modifying the research instruments where needed, and to identify the target population.

3.3 Field Sampling Techniques

The study was carried out in two (2) Nigerian Southeastern States namely; Imo and Anambra States which are the most vulnerable States to flooding as they were the only two States affected in the region by the 2012 floods termed the most devastating floods in Nigeria (UN-OCHA, 2012). Only two Local Government Areas (LGAs) viz; Ohaji/Egbema and Oguta LGAs were affected in Imo State by the 2012 floods. Therefore, for equal and unbiased representation of the two States, two (flood vulnerable and easily accessible) LGAs namely; Ogbaru and Anambra east LGAs were purposively selected in Anambra State. These four LGAs viz; Ohaji/Egbema and Oguta LGAs (in Imo State); Ogbaru and Anambra east LGAs (in Anambra State) were sampled because they consist of agrarian communities that are very vulnerable to floods; that are situated not too far from the River Niger (the largest River in Nigeria) and were among the worst affected by the devastating 2012 floods in Nigeria as well as being accessible. The sample size was determined using Yamane (1967) and Israel (1992) equation with 400 persons being the sampling size for any population between 100,000 and more persons, at +/-5% level of precision. It is given as;

$n = N/[1+N(e^2)]$...(2)

where;

n – is the sample size

N- is the population of Anambra East, Ogbaru, Oguta and Ohaji/Egbema LGAs

e – is the level of precision/sampling error i.e. 0.05.

n = 400 households

A multi-stage purposive sampling technique was employed to establish the sampling frame. In each of the LGA, two (2) communities (one being the LGA headquarters) was purposively selected based on the criteria used in selecting the LGAs, giving a total of four (4) communities for each State and eight (8) communities for the two (2) States.
Stratified sampling method was used to determine the number of households sampled in each LGA (Table 3.1 and Figure 3.1) on the basis of the population figures given in section 1.9.6, with respect to the sample size of 400 households calculated above.
Random sampling method was employed in the administration of the questionnaire.

3.4 Data sources

The data sources are grouped into two viz; primary and secondary sources.

The primary data was obtained from questionnaires (household survey, Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). These primary data include answers to the various questions on household income, coping strategies adopted, causes and effects of flooding, food security situations and their determinants, severity of flooding, level of education, nutrition knowledge among others.

The secondary data are rainfall (1974-2013) data collected from the Nigerian Meteorological agency, Lagos (NIMET); Moderate-resolution imaging Spectroradiometer (MODIS) (October, 2012) and Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM) imageries collected from the United States Geological Survey (USGS) were used to identify flooded locations and estimate areas affected in the study area with ArcGIS 10.2 and QGIS 2.0.1.

3.5 Data collection

Mixed data collection methods which are; Questionnaire Surveys, Focus Group Discussions (FDGs) and key informant interviews (KIIs) were employed in the research.

The Questionnaire Survey consists of two categories; one was used to elicit information from heads of households (Appendix 1) while the other was used to conduct FDGs and KIIs (Appendix 2). The questionnaires were validated by experts from Departments of Agricultural Economics, Agricultural Extension, Geography and Environmental studies. From the questionnaire, the socioeconomic characteristics of households; flood characteristics; the vulnerability of households to floods and insecurity; the effects of the

flood on food security; sources of livelihoods of farmers; adaptive capacities to flood-induced food insecurity among others in the study area were ascertained. Because the research was mainly questionnaire-based, data was collected mostly in dry season, which is usually off-farming season to enable farmers participate.

In addition, a total of eight (8) Key Informant Interviews (KIIs) were conducted (one (1) in each community) from a list of key stakeholders such as lecturers (2), traditional rulers (3), Town Union leaders (1), Youth presidents (1), leaders of faith-based groups (1). Moreover, one (1) Focus Group Discussions (FGDs) comprising twenty to thirty (20-30) male and female (active farmers) was conducted in each of the eight (8) communities (Table 3.1). Research Assistants (RAs) and Community Laison Officers (CLOs) were employed to assist in field data collection. The CLOs comprised eight (8) knowledgeable persons from each community, who know the terrain and understand the culture of the their communities. Six (6) RAs (experienced field RAs and graduates), who understand the language and culture of the agrarian communities were chosen. These six (6) RAs comprised three (3) male and three (3) female. The RAs were trained on how to carry out interviews, administer questionnaire, record responses as well as capture personal observations.

Cameras were utilized in capturing some important photographs especially during the rainy season when flooding was experienced.

Table 3.1: Sample size of the study

State	**Local Government Area (LGA)**	**Sampling size**	**Community / Household sampled**	**Focus Group Discussion**	**Key Informant Interview**
Anambra	Anambra East	(205,401 / 945,941) x 400 = 87	2 communities (44 for one community and 43 for the other) = 44+ 43 households	2 (1 for each community)	2 (1 for each community)
	Ogbaru	(301,478 / 945,941) x 400 = 128	2 communities (64 for each community) = 2 x 64 households	2 (1 for each community)	2 (1 for each community)
Imo	Oguta	(192,159 / 945,941) x 400 = 81	2 communities (41 for one community and 40 for the other) = 41+ 40 households	2 (1 for each community)	2 (1 for each community)
	Ohaji/Egbema	(246,903 / 945,941) x 400 = 104	2 communities (52 for each community) = 2 x 52 households	2 (1 for each community)	2 (1 for each community)
Total		400	400	8	8

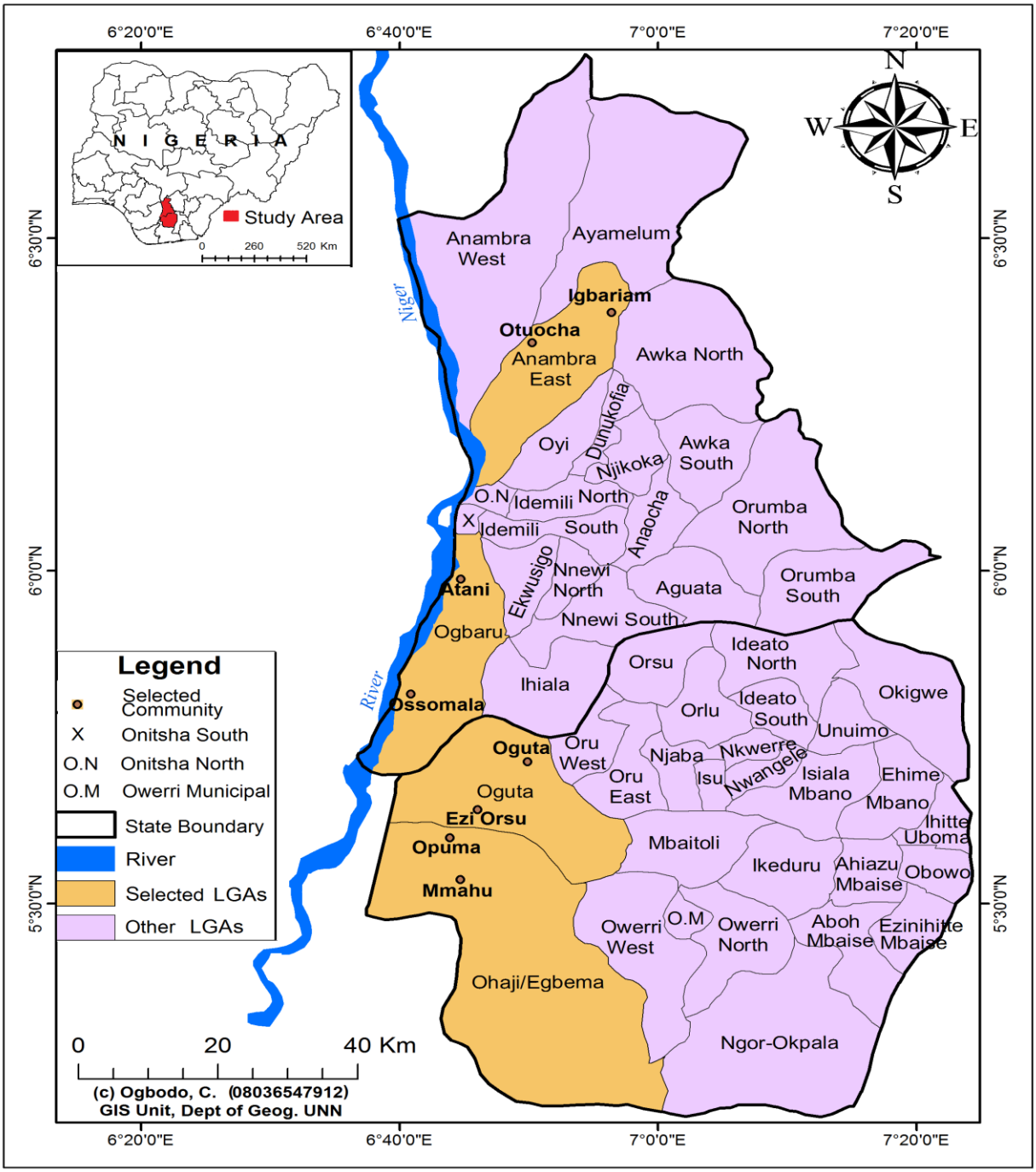


Figure 3.1: Map of the study area showing the sampled LGAs/Communities.
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka, 2016

3.6 Data analysis

3.6.1 Flood Trend and Extent Analyses

Trend analysis and flood extent mapping were carried out to achieve part of objective one of the study. Rainfall data for a forty-year period (1974-2013) were subjected to trend analysis

to show if there is variability in rainfall patterns over the study. The respondents' perception of flood occurrences collected through questionnaire was matched with rainfall data to show if flood events follow rainfall patterns. Flood extent was analysed using Moderate-resolution imaging Spectroradiometer (MODIS) and Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM). ArcGIS mapping software was used to generate maps showing the extent and depth of flooding and flood vulnerability in the communities that make up the study area.

3.6.1.1 The Flood Extent Mapping Procedure

Digital image processing of earth remote sensing data and GIS geoprocessing techniques were employed to determine the 2012 flood extent in the study area, and the processes executed using ArcGIS ArcMap software. The 2012 flood extent was analysed because 100% of the participants agreed to have experienced extreme floods in 2012, and 2012 has been termed the worst flood year in Nigeria for over 40 years where 33 out of the 36 States that make up the country were affected (UN-OCHA, 2012).

The Moderate-resolution imaging Spectroradiometer (MODIS) Aqua 8-day composite satellite image (MYD09Q1.A2012281.h18v08.006) captured in October, 2012 spanning the flood period, was acquired for the study area, via the USGS EarthExplorer portal. Similarly, the Shuttle Radar Topographical Mission (SRTM) v3 3-arcsec Digital Elevation Model (DEM) dataset for the area was acquired.

For ease of identification of inundated surface from the MODIS image, the 534 band combination (a false colour composite) at default 500m spatial resolution was used, because the true colour composite would not allow for ease of identification or visual contrast between bare surface and flood water.

The MODIS image, the SRTM DEM, and the ArcMap pixel inspector, were used to identify the maximum elevation inundated by the 2012 flood water in the study area as 35m.

Whereas, the satellite image provided a visual of the extent of the flood event, and visual clarity was impaired slightly by cloud cover. The study area largely being a plain, the DEM intuitively helped to obtain a more complete picture of the event, when subjected alongside the MODIS image, to a conditional reclass algorithm implemented in ArcMap, effectively dealing with the cloud cover, and thus producing a visual of the flood extent.

The algorithm follows that: If LC is [X]pixel and DEM is LT.EQ [Y]pixel, then Output [X]pixel as [F]pixel else, [X]pixel is [N]pixel.

Where: LC is the MODIS image derived Land Cover Raster, categorized into Flood, Cloud, and Others.

[X] pixel is cloud pixel
[Y] pixel is maximum elevation under inundation
[F] pixel is Flood pixel
[N] pixel is Not Flooded
LT.EQ means Less Than or Equal To

From the output of the conditional reclass, the corresponding pixels of the DEM were extracted, and classified into flood depths below 10metres and those above.
The area of land inundated in each LGA was also computed via the spatial analyst toolbox.

3.6.2 Simple percentage

Descriptive statistics was used to illustrate the socioeconomic characteristics of respondents, flood characteristics, causes and effects of flooding, food sources and food security situations, effects of flooding on food security, determinants of food security, adaptation and coping strategies adopted, recovery length of respondents, household assets and amenities, effect of floods on economic diversification, income earning opportunities and welfare, food safety nets, remittance, past flood experience among others in the study area.

3.6.3 Flood Vulnerability Index Calculation and Principal Component Analysis (PCA)

The flood vulnerability index for each household was calculated using thirty-six (36) socio-economic and environmental variables and the selection of these variables were drawn from literature and observations. The construction of such indices is faced by many challenges which include; the choice of the right indicators, weights attached and directions of relationships with vulnerability. To overcome the challenge of weight, Principal components analysis (PCA) was employed. PCA is a technique for extracting from a set of variables those few orthogonal linear combinations of variables that most successfully capture the common information (Anyadike, 2009). PCA was used because it is frequently used in research that is based on constructing indices for which there are no well-defined weights (Deressa et al., 2008). The direction of relationship in vulnerability indicators (their sign) was adopted from the procedure followed by Deressa et al. (2008); Madu (2011); Tesso et al. (2012) and Opiyo

(2014), who attached a positive value to adaptive capacity and a negative value to both sensitivity and exposure indicators to create vulnerability indices. The justification for attaching negative signs to sensitivity and exposure indicators is because areas that are highly exposed to damaging climate are more sensitive to damages, holding adaptive capacity constant.

In addition, the adaptive capacity variables were assigned a positive sign because "it is assumed that people with higher adaptive capacity are less sensitive to damages from climate change, keeping the level of exposure constant" (Deressa et al., 2008:11).

Due to unavailability of certain data, indicators based on some simple assumptions were mostly used for calculating the vulnerability indices (Table 3.2). "Indicators were adopted to assess the exposure, sensitivity and coping/adaptive capacity of the households based on the definition of vulnerability given by IPCC (2007; 2012)" (Akukwe and Ogbodo, 2015:6) where vulnerability is seen as the net effect of adaptive capacity, sensitivity and exposure. Vulnerability is thus given as;

$$Vulnerability = (adaptive\ capacity) - (sensitivity + exposure) \quad ...(3)$$

The equation above is expanded as;

$$VI = (wA_1 + wA_2 + \dots wA_n) - (wB_1 + wB_2 \dots wB_n + wC_1 + wC_2 + \dots wC_n) \quad ... (4)$$

"Where ;

VI is vulnerability index
w are weights of the first principal component scores
$A_1 - A_n$ are adaptive capacity variables
$B_1 - B_n$ are sensitivity variables
$C_1 - C_n$ are exposure variables"

The linear combination of variables with maximum variance using PCA is usually found on the first principal component (Anyadike, 2009; Yang, 2015). Thus, the first principal component (w) that captures the largest amount of information common to all the variables served as weights, w used in the computation of the household vulnerability analysis. The normalized values for all the adaptive, sensitivity and exposure variables were used. For example, normalized values for the first adaptive capacity variable across the households were calculated as follows,

$$A_1 = (A1 - A*1)/s*1 \quad ...(5)$$

Where; A*1 is the mean of variable A1 across households and *s**1 is its standard deviation. The same goes for all other variables starting from $A_1 - A_n$ through $B_1 - B_n$ to C_1 - C_n.
It is assumed that, higher net value (computed vulnerability index) indicates lesser vulnerability and vice versa, because when adaptive capacity of the household exceeds that of its sensitivity and exposure, the household becomes relatively less vulnerable to flooding and its effects.

Flood vulnerability assessment is crucial in determining the vulnerable person(s) and why they are vulnerable. The idea was adopted from IPCC (2007; 2012) where vulnerability is considered as the net effect of adaptive capacity (socio-economic) and sensitivity/exposure (biophysical) factors. "The integrated assessment approach and the indicator method that combines both biophysical and socio-economic factors" (Akukwe and Ogbodo, 2015:4) to create household vulnerability indices were adopted in this study. A plausible construction of the relationship between vulnerability and the indicators is attempted in Table 3.2.
The thirty-six (36) indicators used in the flood vulnerability analysis were selected based on possibly measurable variables drawn from literature, and definition of adaptive capacity, sensitivity and exposure.

"Adaptive capacity indicators were chosen based on those factors; socio-economic/physical factors that influence the ability of people to adjust to flooding; to moderate its potential/actual damages; to take advantage of opportunities arising from it; or to cope with the consequences (adapted from IPCC, 2007; 2012)" (Akukwe and Ogbodo, 2015:6). Twenty-nine (29) adaptive capacity indicators were used viz; sex, age, marital status, literacy rate, level of education, income diversification, off-farm income, monthly income, dependency ratio, type of housing unit, pre-flood awareness, group membership, land ownership, food production sufficiency, livestock ownership, village poultry/farm ownership, farm size, availability of storage facility, fertilizer use, fertilizer subsidy, irrigation practice, food/aid receipt, early warning information access, phone ownership, radio/TV ownership, canoe ownership, access to improved water sources, remittance and credit access.

"Sensitivity is the degree to which a system is affected either adversely or beneficially, by climate variability e.g. frequency of flooding (adapted from IPCC, 2007; 2012)" (in Akukwe and Ogbodo, 2015:6). Three (3) sensitivity indicators were adopted viz; flood frequency, past (1 year) flood experience, and severity of flood experienced.

Exposure as seen in this study is "the nature and degree to which a system is or people are exposed to significant flooding (adapted from IPCC, 2007; 2012)" (in Akukwe and Ogbodo, 2015:6). Four (4) exposure indicators were used viz; flood experience (house and farm), farm location (floodable farm), and depth of flood.

3.6.4 Cluster and Spatial Analyses

Hierarchical cluster analysis was run on the vulnerability indices to group the households and communities according to similarity in their degree of vulnerability using Average linkage method into three relative flood vulnerability indices (FVI) namely; less, moderate and high vulnerability levels.

ArcMap toolbox in ArcGIS 10.2 software was used to map the spatial pattern (spatial variation) of the different vulnerability levels across the Local Government Areas (that comprise the communities) and States and reasons for the variations were explained.

The spatial analysis of flood vulnerability would have been mapped at the community level but due to unavailability of administrative map at the community level, the spatial pattern of communities' flood vulnerability was not produced.

Table 3.2: Vulnerability, Units of Measurement and their relationship to vulnerability

Determinant of vulnerability	Vulnerability indicators	Description of each indicator	Unit of measurement (proxy)	Relationship between indicator and vulnerability
ADAPTIVE CAPACITY	Wealth	Monthly income	% of total population who earn above N15,000 monthly	The higher the % of total population who earn more than N15,000 monthly, with diversified and off-farm incomes, who received assistance, who are group members, who own a canoe, land, livestock and village poultry, who are literate, who have access to technology, who received some institutional support, who have less than 5 dependants, who live in block houses and who have pre-flood awareness, the lesser the vulnerability
		Income diversification	% of population with different sources of livelihood	
		Off-farm income	% of population who do not solely depend on farm income	
		Receipt of assistance/relief	% of population who received assistance	
		Membership in a group	% of total population who belong to a group	
		Ownership of canoe, land, livestock and village poultry	% of population who own a canoe, land, livestock and village poultry	
		Remittance	% of population who receive financial assistance	
		Access to credit facility	% of population who are credit worthy	
	Literacy rate	Read and write competence	% of population who can read and write	
	Technology	Ownership of radio/TV/ Phone	% of population who have access to radio/TV/phone	
		Access to potable water facilities (drinking water)	% of population with access to clean water	
		Use of fertilizer	% of population who use fertilizer	
		Irrigation	% of population that practise irrigation farming	
	Household size	Dependency ratio	% of population with less than 5 children	

	Storage availability	Storage facility	% of population who have where to store harvested crops	
		Food production sufficiency	% of population that produce enough for their households	
	Institutional	Fertilizer subsidy	% of population who agrees that government subsidized fertilizer	
		Early warning	% of population who heard about the flood before it happened	
	Quality of building structure	Block/zinc/wooden	% of population who live in block houses	
	Flood perception	Awareness of flood	% of total population with pre-flood awareness	
SENSITIVITY	Flood characteristics	Frequency of flood	How often flood events occur in the zones	The higher the frequency, the more the vulnerability.
		Severity of Flood	Magnitude of the flood impacts	The more the magnitude, the more the vulnerability
	Flood experiences	Past flood experience	% of total population who had experienced flood in the last 6 months or 1 year	The higher the % of the population, who had experienced flood, the more the vulnerability
EXPOSURE	Farm location	Farms located in floodplains	% of farms located in the floodplains	The higher the number of farms located in the floodplains, the higher the vulnerability.
	Depth/height of flood	Height of flood	The depth of flood water using the ankle, knee and waist	The higher the height of the flood water, the more the vulnerability.

Source: adapted from Deressa et al., 2008; Akukwe and Ogbodo, 2015

3.6.5 Regression Analysis and Analysis of Variance (ANOVA) for flood vulnerability

The factors influencing household flood vulnerability and their direction (positive or negative) of influence were analysed using the linear regression analysis because it was the most suitable model regarding the proposed relationship between flood vulnerability and these factors (see Table 3.2), though, the flood vulnerability levels were ordered *viz*; less vulnerable, moderately vulnerable and highly vulnerable.

The relationship between household vulnerability (Y) and its determinants (X) were examined using multiple linear regression model. The vulnerability level (Y) was the dependent variable while independent variables were the factors influencing vulnerability as shown below;

$$Y = b_0 + b_1x_1 + b_2x_2 + \ldots b_{36}x_{36} \ldots (6)$$

Where; Y is the household vulnerability level

b_0 is the constant that scales the equation

b_1 to b_{36} are the coefficients that determine the direction and extent to which the (x) factors influence household vulnerability (Y)

x_1 to x_{36} are the determinants of household vulnerability, which are in this study;

farm location (floodable farm), Access to credit, Marital status, Canoe ownership, flood experienced in farmland, Food/Aid receipt, fertilizer subsidy, remittance, poultry farm ownership, affected by flood in the last one (1) year, early warning, flood frequency, phone ownership, livestock ownership, Radio/TV ownership, pre-flood awareness, access to potable water, dependency ratio, flood experienced in area of residence, irrigation practice, diversified income, flood severity, literacy rate, group membership, storage facility availability, type of dwelling unit, fertilizer use, sufficient own food production, sex, age, farm size, flood depth, monthly income, private land ownership, level of education, off-farm income.

Data on ordinal scale of measurement e.g. flood severity, level of education were transposed before the regression analysis were run

The one-way analysis of variance (ANOVA) statistic was used to show variations in the determinants of households' vulnerability as well as variations between female-headed and male-headed households while the Snedecor's variance ratio test or Snedecor's F test was used to test for their significance (test the hypothesis).

3.6.6 Food Security Assessment

The Food Security Index (FSI) equation given below was used to assess the food accessibility dimension of food security as defined by FAO (1996). The FSI according to (Omonona and Agoi, 2007:402) is given as follows:

"FSI = $\frac{\text{Per capita monthly food expenditure for the } i^{th} \text{ household}}{\text{2/3 mean per capita monthly food expenditure of all households}}$ …(7)"

Where FSI =General Food security index
FSI $\geq$1 =Food secure i^{th} household
FSI <1 =Food insecure i^{th} household

"A food secure household is any household whose per capita monthly food expenditure is equal to or more than 2/3 of the mean per capita monthly food expenditure of all households. Conversely, a food insecure household is any household whose per capita monthly food expenditure is less than 2/3 of the mean per capita monthly food expenditure of all households" (Omonona and Agoi, 2007:402). Subsequently, the headcount ratio was used to determine proportion of food secure/insecure households in the study area.

The headcount ratio (HR) according to Ibok, Bassey, Atairet and Obot (2014) is given as follows;

$$HR = Q/W \quad ...(8)$$

Where Q = number of food secure/insecure households
W = number of households used for the study.

"The Food Consumption Score was used to assess the food utilization dimension of food security. The FCS is a composite score based on dietary diversity, food frequency, and the relative nutritional importance of different food groups; it also serves as a proxy for current food security" (WFP, 2008:1). For example, each food item is put into a category, and each category is weighted based on relative nutritional value where sugar and oil each is given a weight of 0.5; vegetables and fruit both a weight of 1; cereals and tubers are given a weight of 2; pulses a weight of 3 while meat, milk and fish are given a weight of 4. The standard thresholds for each food consumption group are presented in Table 3.3.

3.6.6.1 FCS Calculation Steps

i. "Group food items in the specified food groups
ii. Get consumption frequencies (number of days food items is eaten) within the same group

iii. Multiply the frequency value of each food group by its weight
iv. Sum the weighted food group scores to obtain FCS
v. Determine the households food consumption status based on the following thresholds:

0-21: Poor, 21.5-35: Borderline, >35: Acceptable" (see WFP, 2008:3).

Table 3.3: Food consumption score thresholds

Food consumption group	Standard threshold
Poor food consumption	0–21
Borderline food consumption	21.5–35
Acceptable food consumption	≥ 35.5

Source: World Food Program (2008)

The Household Food Security Survey Module (HFSSM), developed by the United States Department of Agriculture (USDA) which categorizes households using a constructed food security scale was adopted for assessing the food security status of households. This scale is a linear scale (Table 3.4) which measures the degree of food insecurity/ hunger experienced by households in terms of a single numerical value, and ranges between 0 and 10 (Bickel et al., 2000). "The categorical form of the measure is appropriate for comparing prevalence of food insecurity and hunger across subpopulations or regions, and is often the more convenient form for reporting food security monitoring data and for preliminary or exploratory research into the nature, causes, and consequences of food insecurity and hunger" (Bickel et al., 2000:32).

In addition, because the scale actually measures the severity of food insecurity, the condition of being fully food secure representing the absence of the measured condition, is assigned 0 while the most severe condition signifying the presence of all the available indicators, is assigned a value close to ten.

The household responses to the structured survey questions determine the household's score/position on household food insecurity/hunger scale.

The Household Food Security Survey Module uses the Rasch model to compute the scale scores/values which was performed using the Ministep (Winsteps) Rasch, student version.

This HFSSM method was chosen because the structured questions cover most of the dimensions as contained in the definition of food security used in this study.

Table 3.4: Standard values for assessing household food (in)security status/level

Scale Score Standard 0-10 Metric	Food Security Status/Level
0*- 2.32	Food secure
2.33 - 4.56	Food insecure without hunger
4.57 – 6.53	Food insecure with hunger (moderate/less severe)
6.55 – 10.09	Food insecure with hunger (severe/more severe)

Source: Bickel et al., 2000

* means households that affirm no items are deemed to be food secure and are assigned a scale score of zero.

3.6.6.2 Coding Survey Responses for the Food Security Scale

Responses to a set of eighteen (18) questions regarding households' food needs as shown in Figure 3.2 were used to determine where a household falls on the food security continuum. Analysing households' food security status on the food security scale required firstly, coding responses to each question as either "affirmative" or "negative" that is either "yes" or "no". The questions had three response categories viz; "often true", "sometimes true" and "never true". "Often true" and "sometimes true" were coded as "1" because they were considered affirmative responses while "never true" was coded as "0" because it showed the condition never occurred during flood events. Secondly, the households food security status scores were computed using the Rasch analysis and these scores were further categorized into four namely; food secure, food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger (Figure 3.3) on the basis of the calculated values positions on the food security scale. Households with "food secure" status have scores between 0 and 2.32 on the food security scale while "food insecure without hunger" households are located between 2.33 to 4.56 on the scale. The "moderately food insecure with hunger" households have scores from 4.57 to 6.53 on the scale whereas households with the "severely food insecure with hunger" status falls between 6.54 and 10 on the food security scale. The Rasch analysis was performed with Ministep (Winsteps) Rasch, student/evaluation version.

Question	Responses Often true	Sometimes true	Never true
•Do you always have enough food to eat? •Do you always have the kinds of food you want? •Do you worry if your food stock will run out before you get another to eat? •Do you have enough resources to acquire enough food? •Could you afford to eat balanced meals? •Do you supplement your children's feed with low cost foods? •Can you afford to feed your children balance meals? •Were your children not eating enough, because you couldn't afford enough food? •Do adults in your household skip meal or cut the size of their usual meals? •Do you eat less than what you feel, you should? •Were you ever hungry, but didn't eat? •Did you lose weight, because there wasn't enough food to eat? •Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? •How often did this happen? •Did you ever cut the size of your children's meal because there wasn't enough money for food? •Did any of the children ever skip meals, because there wasn't enough food to eat? •Did any of the children ever not eat for a whole day? •Were the children ever hungry but you just couldn't afford more food?			

Figure 3.2: Structured survey questions on household food security

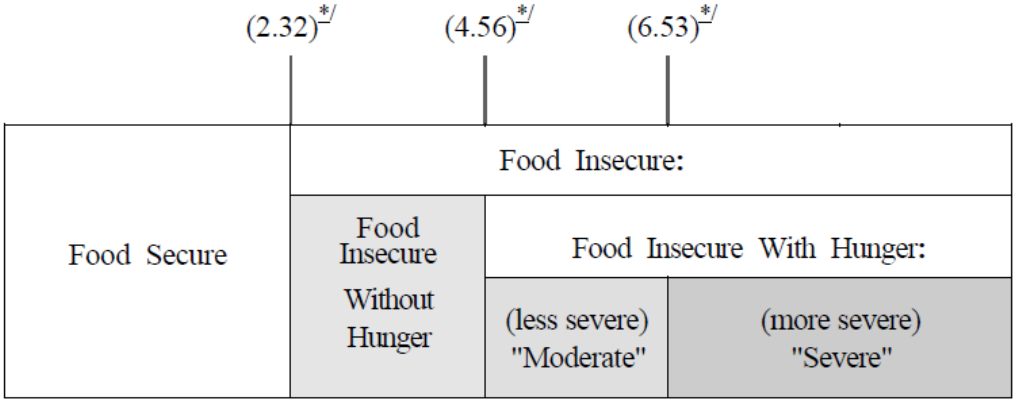


Figure 3.3: Household food security status - categorical measure
Source: Bickel et al., 2000:31
*/ located at midpoint between the two adjacent household scale values.

3.6.6.3 Rasch Analysis

To ensure that the Food Security Indices (FSI) range from 0 to 10 and to remove negative values that occurred in the output tables using the USCALE=1 and UIMEAN=0 in the

original computation, a new USCALE and UIMEAN were calculated using the minimum and maximum values, and the range ("User-friendly rescaling: zero point and unit, 2018"). This ensures that the lowest reportable person measure is 0 and the highest is 10. Therefore, the new USCALE and UIMEAN were computed as;

USCALE= (wanted range) / (current range) = 10 / 7.83 = 1.28

UIMEAN= (wanted low) - (current low * USCALE) = 0 - (-4.06 * 1.28) = 5.20

The above computations were done using the values below;

"current low" person measure = -4.06 (calculated original minimum value)

"current high" person measure = 3.77 (calculated original maximum value)

"current range" = "current high" - "current low" = 3.77 - -4.06 = 7.83

"wanted low" person measure = 0; "wanted high" person measure = 10

"wanted range" = "wanted high" - "wanted low" = 10 - 0 = 10

Thus, final required values for the computations were:

USCALE = 1.28; UIMEAN = 5.20; UDECIM = 2 to show two decimal places in report

3.6.7 Multiple Regression Analysis between food security and its determinants

Table 3.5 shows the *a priori* expectations of the relationship between X and Y variables and the selected indicators were drawn from literature such as Arene and Anyaeji (2010); Bashir et al. (2012); Aidoo et al. (2013); Ramakrishna et al. (2014); Welderufael (2014); Zakari et al. (2014); Djangmah (2016); Goshu, 2016; Ajaero, 2017; Dawit and Zeray, 2017 among others. Based on the household food security status (Y), the multiple binary logistic regression was used to assess households' food security determinants (X) because of the dichotomous nature of the dependent variable (food secure/food insecure). It was used to show the relationship between household food security status (dependent) variable and its explanatory (independent) variables as shown below;

$$[Y/(1-Y)] = b_0 + b_1x_1 + b_2x_2 + \ldots b_{25}x_{25} \quad \ldots(9)$$

Where; $[Y/(1-Y)]$: likelihood that household is food secure/insecure

b_0 is the constant that scales the equation

b_1 to b_{25} are the coefficients that determine the direction and extent to which the (x) factors affect food security status (Y)

x_1 to x_{25} are the factors that influence food security i.e. sex of household head, age,

marital status, literacy rate, level of education, diversified income, off-farm income, monthly income, dependency ratio, group membership, private land ownership, sufficient own food production, livestock ownership, poultry farm ownership, distance to farm, distance to market, storage facility availability, fertilizer use, irrigation, food/aid receipt, nutrition knowledge, farm size, financial support, access to credit, flood experience.

Households in the study area were classified into four food (in)security levels viz; food secure, food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger. However, for the purpose of demonstrating the relationship between food security and its determinants using binary logistic regression model, the households were transposed into two categories namely; food secure and food insecure (comprising food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger) households. These households were further disaggregated into four again for better explanation of the factors influencing food security in the study area.

The Odds ratio (OR) was used to show the degree of association between X and Y variables. It is simply the exponential function of the regression coefficient ($e^{b1\text{-}b25}$) associated with a one-unit increase in the exposure (Szumilas, 2010).

Unlike the linear regression, the logit model does not make assumptions regarding linearity, normality and homoscedasticity. This implies that the logit model can handle any type of data and does not require a linear relationship between the independent variables and the dependent variable which is binary (food secure/food insecure), hence non-linear. However, the error term and independent variables do not need to be normally distributed and the homogeneity of variance around the regression line for all values of the predictor variable is equally not needed (Goshu, 2016).

3.6.7.1 Hypotheses Testing

The one-way analysis of variance (ANOVA) statistic was used to show if there are variations in the determinants of food security among households, and variations between female-headed and male-headed households while the Snedecor's F test was used to test for their significance.

Table 3.5: Hypothesize relationship between food security and factors influencing it

Determinants of food security (Variable)	Code	*A priori* expectation (Expected relationship between determinants and food security)
Sex of household head (X_1)	(Male=1; Female=0)	Positive
Age of household head (X_2)	(in Years)	Negative
Marital status (X_3)	Single=1; Married= 2; Divorced=3; Separated=4; Widowed=5	Neutral
Literacy rate (X_4)	(Yes=1; No=0)	Positive
Level of education (X_5)	No formal education=1; Primary school=2; secondary school=3; OND/NCE=4; B.Sc/B.A=5; M.Sc/M.A=6; PhD=7	Positive
Diversified income (X_6)	(Yes=1; No=0)	Positive
Off-farm income (X_7)	(Yes=1; No=0)	Positive
Monthly income (X_8)	<15,000= 1; 15,001-30,000=2; 30,001-45,000=3; 45,001-60,000=4; 60,001-75,000=5; 75,001-90,000=6; Above 90,000=7	Positive
Dependency ratio (X_9)	(>5=1; <5=0)	Negative
Group membership (X_{10})	(Yes=1; No=0)	Positive
Private land ownership (X_{11})	(Yes=1; No=0)	Positive
Sufficiency in own food production (X_{12})	(Yes=1; No=0)	Positive
Livestock ownership (X_{13})	(Yes=1; No=0)	Positive
Village/Agric. poultry ownership (X_{14})	(Yes=1; No=0)	Positive
Distance to farm (X_{15})	(>1hr=1; <1hr=0)	Negative
Distance to market (X_{16})	(>1hr=1; <1hr=0)	Negative
Storage facility availability (X_{17})	(Yes=1; No=0)	Positive
Fertilizer use (X_{18})	(Yes=1; No=0)	Positive
Irrigation practice (X_{19})	(Yes=1; No=0)	Positive
Food/Aid receipt (X_{20})	(Yes=1; No=0)	Positive
Nutrition knowledge (X_{21})	(Yes=1; No=0)	Positive
Farm size (X_{22})	(in acres)	Positive
Financial support (X_{23})	(Yes=1; No=0)	Positive
Credit access (X_{24})	(Yes=1; No=0)	Positive
Flood Experience (X_{25})	(Yes=1; No=0)	Negative

Source: Researcher, 2017

3.6.8 Ordinal Logistic Regression Analysis

The simple ordinal logistic regression analysis was used to assess effect of flooding on households' food security. The ordinal logistic regression analysis was preferred because of the ordered nature of the households as analysed by the food security status viz; food secure, food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger. Like the binary logit regression, the ordinal logistic regression does not make assumptions regarding linearity, normality and homoscedasticity.

The households were assigned codes ranging from 0 to 3 depending on their food security level which is a function of their scores on the food security scale. Food secure households were assigned 0, 1 was assigned to households with the status "food insecure without hunger", 2 was assigned to households termed "moderately food insecure with hunger" and severely food insecure with hunger households were assigned 3. These codes, 0 to 3 formed the codes for the dependent variable, Y, food security. The predicting variable, X, was flooding coded as 1 for "Yes" and 2 for "No".

The number of coefficients reported for categorical predictors in ordinal regression models with intercepts is usually less than one the number of categories of the variable. For instance, we had four categories for the dependent variable (Food Security = 0,1,2,3), only three coefficients for food security = 0,1,2 were displayed. For the predictor variable, we had two categories, but, only the coefficient for the "yes" responses with the value of 1 was displayed. The last category is usually the reference category, hence the coefficient of 0 for the second category (reference category) of the predictor variable in which our interest lies.

The ordinal regression model is given as;

$$[Y/(1-Y)] = a_j + bX \quad ...(10)$$

$_j$ goes from 1 to the number of categories (4) minus 1

Where; $[Y/(1-Y)]$: likelihood that a household is food secure/insecure

a is the constant

b is the coefficient

X is flooding

The ‘t’ test was employed to show if flooding is a significant factor influencing food insecurity while the odds ratio (OR) was used to show the degree of association between flooding and various levels of food security.

3.6.9 Mean score and Principal Component Analysis (PCA)

Mean scores were used to show if both positive and negative effects (on a likert scale) of flooding on food security were significant or not. A reliability test was first run with an expected Cronbach alpha value of ≥0.7 before running the mean score. A mean score of ≥3.0 was assumed significant since it was on a five-point scale.

PCA was run on the negative effects of flooding on food security to summarize the major aspects of food security that flooding affect negatively. PCA does data reduction by combining a large number of indicators into fewer similar groups, each group defining the underlying dimension in the contributing variables forming the group (Anyadike 2009). The components of the PCA were extracted using the varimax rotation method with significant loadings of +/-0.60. Eigen values are simply the coefficients attached to eigenvectors ranked in descending order of their eigen values to arrive at the principal components in order of significance. This implies that they are the measure of the data’s covariance (“A beginner’s guide to eigenvectors, PCA, covariance and entropy”, 2018).

3.6.10 Wealth Classes

Wealth classes were constructed using monthly income. First, the mean of each income group/level was calculated. Then, the minimum income value, the computed 1st, 2nd and 3rd quartiles, and the maximum income value were used to construct the five wealth classes (Table 3.6).

Table 3.6: Wealth classes computed from monthly income

Wealth Class	Monthly Income (in Naira)
Poorest	*15,000
Poorer	≥30,000
Middle	≥52,000
Wealthier	≥75,000
Wealthiest	≥90,000

* means ≤ and ≥

3.6.11 Poverty line determination

According to the World Bank (2015b), a poverty line sets a limit for minimum income. Individuals who fall below the line do not have enough money to meet their basic needs of food, clothing and shelter. The poverty line for the study area was determined using the World Bank general benchmark of <1.9USD daily for developing countries. As of the time the pilot survey of the research was carried out, the official exchange rate for US Dollar and Naira was $1= ₦263. Thus, $1.9 per day = ₦500 per day. Therefore, any household with a monthly income of <₦15,000 (derived from 500 daily x 30 days) was considered poor.

All the analyses were run using Statistical Package for Social Sciences (SPSS) version 21 and Microsoft Excel were used to produce some graphs.

3.6.12 Households' Assets and Amenities Measurements

Household assets were analysed using ownership of household items like car, refrigerator, generator, phone, furniture, television, canoe, motorcycle, fan, bicycle, radio, wheel barrow and others (e.g. sewing machine, clothes iron). Some items (e.g. wheel barrow, bicycle) were included in the list of assets because they are basic necessities in farming communities; canoe is an asset in the riverine communities. Household amenities analysed in the study were access to electricity and good drinking water, sanitary facilities, good housing, adequate waste disposal, access to roads and hospitals.

3.7 Ethical issues

The researcher notified and obtained the consent of the traditional rulers of each sampled community prior to the reconnaissance and final surveys. The cultural norms of the communities were obeyed during the field work. In addition, the consent of the respondents as well as the administration of questionnaire at their convenience was strictly followed. Anonymity and confidentiality of respondents were strictly adhered to in administering questionnaire and data collection.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter consists of the presentation and discussion of research findings. The results were mostly questionnaire-based and 400 copies of questionnaire were administered on respondents with 100% retrieval.

4.2 Demographic and Socio-economic Characteristics of Respondents

There are variations in the demographic and socio-economic characteristics of households across the communities in the study area. These variations in terms of their sex, age, occupation, level of education, economic status, access to technology, potable water access and other farm-related characteristics are shown in Tables 4.1 to 4.12 as well as in Figures 4.1to 4.11.

4.2.1 Sex, Age and Marital status

The sex, age and marital status of heads of households as well as years spent in each community by household heads are shown in Table 4.1. The study comprised 56.2% males as heads of households and 43.8% females as heads of households. In terms of age (in years), slightly more than a quarter (25.8%) of the household heads were between 40 and 49 years and 25% were between 60 and 69 years of age.

The analysis also revealed that 73% of the heads of household were between 40 years and above while 27% were between 20 and 39 years of age. In addition, majority (64.5%) of the heads of households were married while only 7.8% reported to have never been married (single).

However, 19.8% respondents indicated to have lost their spouses and women constitute a greater number (74.7%) i.e. (59 out of 79) of these people with the “widowed” status (figure 4.1), hence the reason they are solely farmers since 63.1% (out of the total of those with no formal education in the study area) were women (figure 4.2).

As regards number of years stayed in the community, a large of proportion (47.6%) reported to have spent between 30 to 49 years in their communities while 11.2% of household heads had spent between 60 and 69 years. Only 2% indicated to have stayed <10 years in their communities (Table 4.1) and this is an indication that majority of the households heads had

long years of farming experience since majority of them were farmers.

Table 4.1:Social and economic characteristics of respondents

Characteristic	Component	Frequency	Percent (%)
Sex	Male	225	56.2
	Female	175	43.8
	Total	400	100
Age	20-29Years	25	6.3
	30-39Years	83	20.7
	40-49Years	103	25.8
	50-59Years	84	21
	60-69Years	100	25
	70 Years & above	5	1.2
	Total	400	100
Marital status	Single	31	7.8
	Married	258	64.5
	Divorced	5	1.3
	Separated	27	6.7
	Widowed	79	19.8
	Total	400	100
Years stayed in community	Less than 10 Years	8	2
	10- 19Years	38	9.5
	20-29Years	60	15
	30-39Years	99	24.8
	40-49Years	91	22.8
	50-59Years	59	14.7
	60-69Years	45	11.2
	Total	400	100

Source: Researcher's computation, 2017

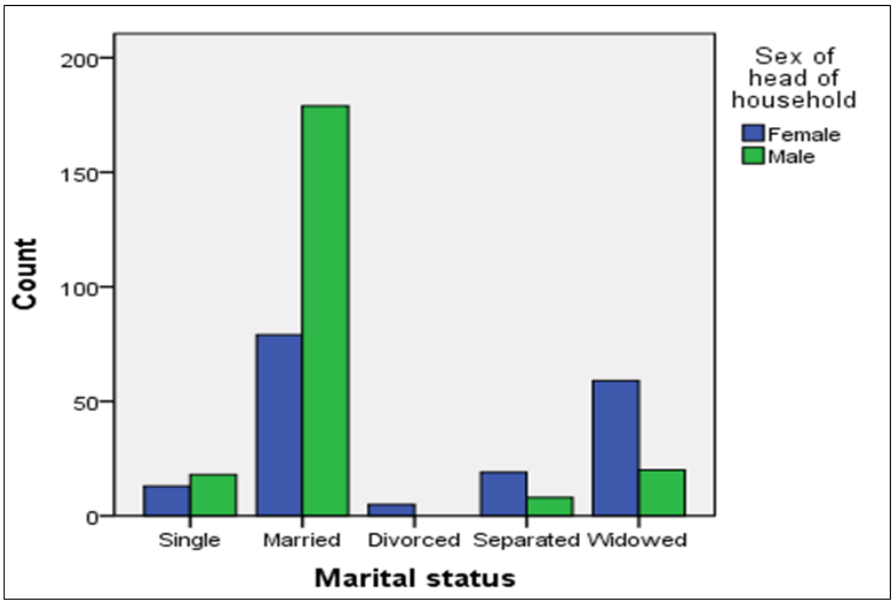


Figure 4.1: Distribution of marital status by sex of household heads

4.2.2 Literacy of household heads and spouses

Table 4.2 shows that about a quarter of the heads of households were uneducated (25.8%) with just 21.1% having been to a higher institution. Majority (53.5%) of the respondents have either Primary (First School Leaving Certificate (FSLC) or Secondary education (Senior Secondary Certificate Examination (SSCE). The table also reveals that 20.3% of the heads of households had attended one tertiary institution or the other, thereby obtaining either NCE/OND/B.Sc or their equivalent and only three (3) household heads indicated to have a Masters degree.

Table 4.2: Educational Qualifications of Household heads and their spouses

Characteristics	Variable	Frequency	Percent (%)
Educational qualification of heads of households	Non formal	103	25.8
	FSLC	115	28.7
	SSCE	98	24.5
	NCE/OND	64	16
	B.Sc or equivalent	17	4.3
	M.Sc or equivalent	3	0.7
	Total	400	100
Educational qualifications of spouses of household heads	Non formal	48	12
	FSLC	89	22.2
	SSCE	100	25
	NCE/OND	20	5
	B.Sc or equivalent	5	1.3
	NA	138	34.5

Source: Researcher's computation, 2017

The primary occupation of the respondents is a function of the distribution of their educational qualifications. There was a widened gender disparity gap in level of education (figure 4.2). A cross tabulation between gender and educational qualification represented in figure 4.2, shows that women were the least formally educated, constituting 63.1% (i.e. 65 out of 103) of the 25.8% of people who have never attended school and none of the women has a University degree or anything higher, though some of them have a Diploma certificate (NCE/OND).

The variation in the educational qualification of spouses of heads of household are also shown in the table 4.2, and 25% of them have attended Secondary schools while 6.3% of them have attended a tertiary institution. 22.2% and 12% of them had a primary education and no formal education respectively. The 34.5% whose spouses' educational background

was not available/applicable (NA) were those who were single, widowed, divorced and separated.

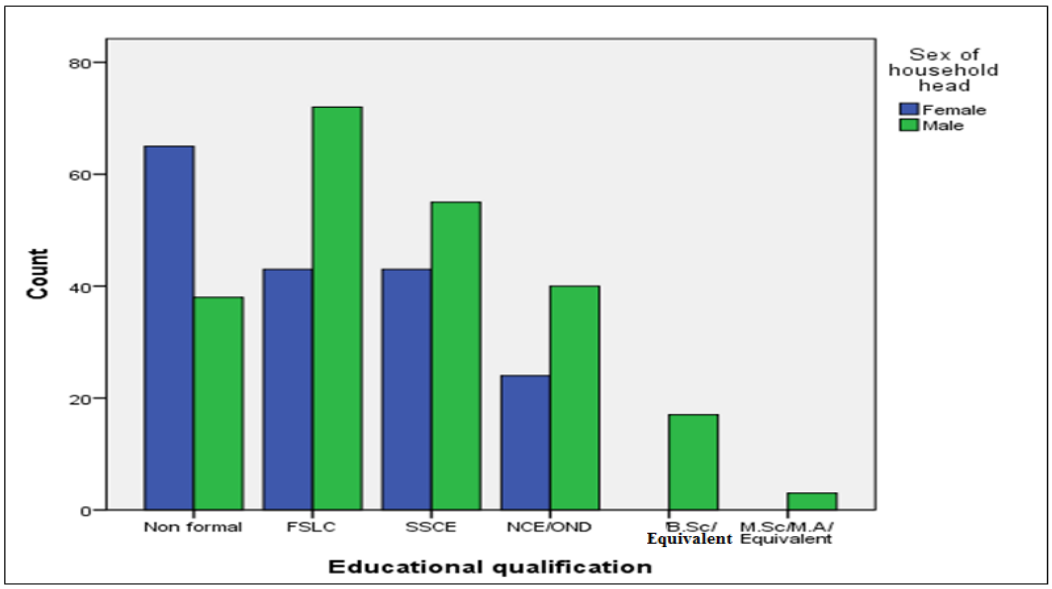


Figure 4.2: Distribution of educational qualification by sex of heads of households

4.2.3 Income

Income has been argued to have positive correlation with food security and resilience. Low income earners have also been said to be more vulnerable to flooding (Chan and Parker, 1996; Ribot, 1996; Kates, 2000; Emma et al., 2009) and food insecurity (Omonona et al., 2007; Battersby, 2011; Henri-Ukoha et al., 2013; Zakari et al., 2014 and Mutinda, 2015). Stringer et al. (2009) argued that though households' vulnerability and exposure to risks associated with climate change knows no social boundary; the poorer households are mostly at risk of adverse impacts of climate variability and change.

There was an obvious divide in income distribution among households in south eastern, Nigeria. An analysis of the monthly income of households in the study area (Table 4.3) shows that over a third (36%) of them earn between fifteen thousand to thirty thousand (₦15000-30000) Naira (30 USD) monthly. About a quarter (23.8%) fell below the poverty line (those who earn <₦15000 or <30 USD monthly) and over two third (70%) of them in this category were women. Only 9.3% of the population earn between sixty thousand to ninety thousand (N60000 – 90000) and above Naira (120 to 180 and above USD) monthly.

There was disparity between the monthly income of female-headed households (FHHs) and male-headed households (MHHs) with 37.7% of FHHs falling below the poverty line as against 12.4% of MHHs in the entire sampled households (Figure 4.3).

Consequently, FHHs constituted the largest proportion (70.2% i.e. 66 out of 94 of households) classified as "poor" because they earned <₦15,000 or $30 monthly. The observed gender disparity in income distribution in favour of MHHs (Figure 4.3), was partly the reason that FHHs were the most vulnerable to flooding and flood-induced food insecurity in the study area.

Table 4.3: Monthly Income distribution of Households (n=400)

Income	Percent (%)	Cumulative Percent
<15,000	23.8	23.8
15,001-30,000	36.0	59.8
30,001-45,000	22.5	82.3
45,001-60,000	8.5	90.8
60,001-75,000	6.0	96.8
75,001-90,000	1.0	97.8
90,001 and above	2.3	100.0
Total	100.0	

Source: Researcher's computation, 2017

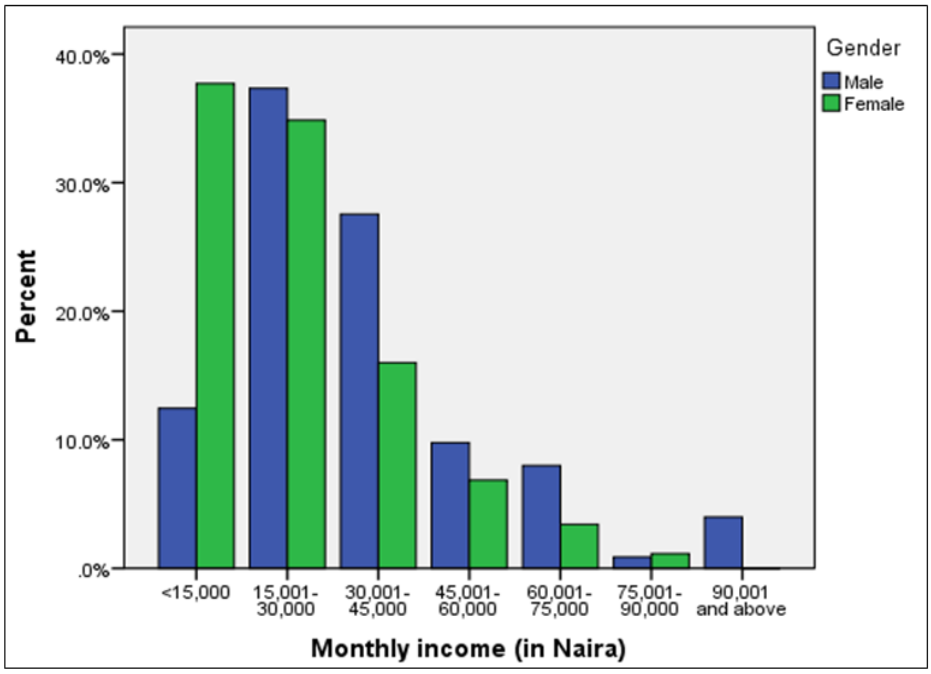


Figure 4.3: Distribution of monthly income by sex of household heads

4.2.4 Results of Wealth classes

Households were further classified based on their monthly income (in Naira) into five wealth classes viz; the wealthiest, wealthier, middle, poorer and poorest classes as discussed in the methodology. A large proportion (59.7%) of households falls under the poorest wealth class while only 2.3% and 14.5% fall under the wealthiest and middle classes, correspondingly (Table 4.4).

The wealthier and wealthiest classes (high income earners) depend on other non agricultural sources of income (e.g. civil services, trading/business) while the poorer and poorest classes depend on mostly agricultural activities as their sources of income. This sole dependence of the poorer and poorest classes on agricultural (climate-related) income made them the most vulnerable to flood-induced food insecurity because of reduced crop harvest and crop sales.

Table 4.4: Percentage Distribution of Wealth Classes (n = 400)

Wealth Class	Monthly income (in Naira)	Percent (%)
Poorest	*15,000	59.7
Poorer	≥30,000	22.5
Middle	≥52,000	14.5
Wealthier	≥75,000	1.0
Wealthiest	≥90,000	2.3
Total		100.0

Source: Researcher's computation, 2017

*means < and ≥

4.2.5 Analysis of Households' Assets and Amenities

A high percentage of households had phones, wheel barrows, bicycles, radio and about a third had canoes and motorcycles used mainly as a means of transportation, and about a quarter had television. A small proportion had cars, clothes iron, sewing machines, refrigerators, furniture, generator, and fans (Table 4.5).

The household assets were further cross tabulated against the wealth classes to know which classes had the greatest assets (Table 4.6). It was noted that, though few respondents were car owners, majority of those car owners were respondents in the wealthiest class (66.7%) wealthier class (50%). On the other hand, only 0.8% of those in the poorest class owned a car and 6.7% in the poorer class owned a car while 6.9% in the middle class owned a car. Similarly, 100% of respondents in the wealthier and wealthiest classes possessed furniture while only 5% in the poorest classes had furniture. 20% and 29.3% of people in the poorer

and middle classes respectively had furniture in their houses.

Table 4.5: Distribution of household items (n = 400)

Asset	Yes (Percent %)	No (Percent %)
Car	5	95
Refrigerator	11	89
Generator	18.3	81.7
Phone	94.3	5.7
Furniture	15	85
Television	25.7	74.3
Canoe	39.3	60.7
Bank savings	21.5	78.5
Motorcycle	33.3	66.7
Fan	19.7	80.3
Bicycle	62.5	37.5
Wheel barrow	92.3	7.7
Radio	56.3	43.7
Others	7.3	92.7
Access to credit	9.3	90.7

Source: Researcher's computation, 2017

In terms of motorcycle, more than 55% of members in the poorer, middle, wealthier and wealthiest classes owned a motorcycle whereas only 14.2% in the poorest class owned a motorcycle (Table 4.6).

Due to power (electricity) problem in Nigeria, generator is a very important asset to both the poor and the rich. All respondents in the wealthier class had a generator whereas 88.9% of those in the wealthiest class had a generator and only 3.3% of those in the poorest class owned a generator, despite the fact that a substantive percentage (68.6%) of them did not have access to electricity (Table 4.6). Those in the middle and poorer classes that owned a generator were 29.3% and 40%, correspondingly.

During times of crises like flooding, bank savings, access to credit and canoe ownership play crucial role, but, only 6.3% of the population in the poorest class had a bank savings while 88.9% in the wealthiest class had bank savings. In terms of access to credit, the wealth class with the greatest access was the poorer class (22.2%), followed by those in the middle class (20.7%). Those with the least access were in the wealthier class (0%), followed by those in the poorest class (1.7%) while the percentage with access to credit in the wealthiest class was only 11.1%. The importance of canoe ownership is evident in its distribution across the wealth classes as 31% of the households in the poorest class have got a canoe while 40% in

the poorer class has got one. A half of households in the wealthier class owned a canoe whereas more than half and about two third of households respectively owned a canoe in the wealthiest and middle classes. The implications of household assets and access to amenities are seen in the vulnerability to flooding and food insecurity discussed in subsequent sections.

Table 4.6: Percentage Distribution of Household Assets within wealth classes

Asset	Frequency	Wealth classes (in Percent %)				
		*15,000 (Poorest)	≥30,000 (Poorer)	≥52,000 (Middle)	≥75,000 (Wealthier)	> 90,000 (Wealthiest)
Car	Yes	0.8	6.7	6.9	50.0	66.7
	No	99.2	93.3	93.1	50.0	33.3
Refrigerator	Yes	1.3	13.3	31.0	100.0	77.8
	No	98.7	86.7	69.0	0.0	22.2
Generator	Yes	3.3	40.0	29.3	100.0	88.9
	No	96.7	60.0	70.7	0.0	11.1
Phone	Yes	90.4	100.0	100.0	100.0	100.0
	No	9.6	0.0	0.0	0.0	0.0
Furniture	Yes	5.0	20.0	29.3	100.0	100.0
	No	95.0	80.0	70.7	0.0	0.0
Television	Yes	6.3	48.9	55.2	100.0	88.9
	No	93.7	51.1	44.8	0.0	11.1
Canoe	Yes	31.4	40.0	67.2	50.0	55.6
	No	68.6	60.0	32.8	50.0	44.4
Bank savings	Yes	6.3	34.4	48.3	100.0	88.9
	No	93.7	65.6	51.7	0.0	11.1
Motorcycle	Yes	14.2	56.7	67.2	100.0	55.6
	No	85.8	43.3	32.8	0.0	44.4
Fan	Yes	9.6	28.9	34.5	75.0	77.8
	No	90.4	71.1	65.5	25.0	22.2
Bicycle	Yes	64.0	61.1	65.5	0.0	44.4
	No	36.0	38.9	34.5	100.0	55.6
Wheel barrow	Yes	92.5	88.9	94.8	100.0	100.0
	No	7.5	11.1	5.2	0.0	0.0
Radio	Yes	46.4	80.0	63.8	100.0	11.1
	No	53.6	20.0	36.2	0.0	88.9
Others	Yes	0.0	4.4	29.3	100.0	44.4
	No	100.0	95.6	70.7	0.0	55.6
Access to credit	Yes	1.7	22.2	20.7	0.0	11.1
	No	98.3	77.8	79.3	100.0	88.9
Amenity						
Electricity	Yes	31.4	57.8	74.1	100.0	100.0
	No	68.6	42.2	25.9	0.0	0.0

Source: Author's computation, 2017 *means < and ≥

Household amenities like access to electricity and good drinking water, sanitary facilities, good housing, adequate waste disposal, access to roads and hospitals were also analysed.

In the entire sampled population in the south eastern region of Nigeria, 45.8% had access to electricity (Table 4.7). Within this 45.8% people with access to electricity, only 31.4%, 57.8% and 74.1% of those in the poorest, poorer and middle classes had this access, respectively, whereas all the people in the wealthier and wealthiest classes had access to electricity (Table 4.6).

Drinking water sources are mostly streams with about 50% not having access to improved drinking water usually from water projects in the communities pumped manually (Plate 4.1). 52.9% of the population did not have access to decent toilets while 47.1% had, and a substantive percentage did not have proper means of waste disposal.

Table 4.7: Distribution of household amenities (n = 400)

Amenity	Frequency (Percent %)	
	Yes	No
Electricity	183 (45.8)	217 (54.2)
Sanitary facility	213 (53.3)	187 (46.7)
Water cistern only	55 (13.8)	345 (86.2)
Pit only	133 (33.3)	267 (66.7)
Pit & water cistern	29 (13.8)	371 (86.2)
Source of drinking water		
Rain harvest	165 (41.3)	235 (58.7)
Pond	5 (1.3)	395 (98.7)
Tank supply	77 (19.3)	323 (80.7)
Own dug well	1 (0.3)	399 (99.7)
Public dug well	146 (36.5)	254 (63.5)
Stream	345 (86.3)	55 (13.7)
Public tap	11 (2.7)	389 (97.3)
Compound borehole	45 (11.3)	355 (88.7)
Community borehole	21 (5.3)	379 (94.7)
Sachet ('pure') water	287 (71.7)	113 (28.3)
Waste disposal method		
River	106 (26.5)	294 (73.5)
Open dumping	187 (46.7)	213 (53.3)
Burning	384 (96.0)	16 (4.0)
Pit dumping	24 (6.0)	376 (94.0)
Burying	110 (27.5)	290 (72.5)
Official collection site	78 (19.5)	322 (80.5)

Source: Author's computation, 2017 (Figures in parentheses are the % values of valid frequencies)

Distribution of other household amenities is shown in table 4.7. About a fifth (20%) had access to water cistern sanitary facility while 40.5% had access to pit toilets. It was observed that majority of the households without sanitary facility used rivers and bushes as their toilets and the effects of this is felt more during flooding events.

The most used waste management method is burning reported by 96% households and followed by open dumping and river dumping practised by 46.7% and 26.5% households. The lower usage of official waste collection sites by households is because of the rural nature of most of the sampled communities, the 91.5% that disposed of their wastes in these sites were mainly in the LGAs headquarters. Pit dumping and burying were also practised as waste disposal methods by 6.0% and 27.5% households in the study area.

The active practice of "open dumping" waste disposal method, and the fewer percentage of households having access to improved sanitary facilities and potable drinking water might have some negative health impacts on households in the study area.

Plate 4.1: Manual pump water source (A is in Anambra State while B is in Imo State)

4.2.5.1 Household dwelling units

The observed housing types in the study were; block with zinc roof, block with thatch roof, zinc with zinc roof, mud with zinc roof, wood with zinc roof, mud with thatch roof and wood with thatch roof. A high percentage of the people live in houses made of block with zinc roof while a negligible number of them live in wood with thatch roof houses (Table 4.8).

Table 4.8: Percentage Distribution of Housing Type (n = 400)

Housing type	Percent
Block with zinc roof	70.0
Zinc with zinc roof	4.0
Mud with zinc roof	16.0
Wood with zinc roof	2.5
Mud with thatch roof	6.0
Wood with thatch roof	1.5
Total	100.0

Source: Researcher's computation, 2017

4.2.6 Household characteristics

4.2.6.1 Household Size and Dependency

The mean household size and number of dependants per household in the study area is approximately five (5) members (5.14 and 5.01 respectively) (Table 4.9), though, the age distribution of the household members was not examined.

The Spearman's correlation analysis shows that there is a significant positive relationship (0.88) between number of children and number of dependants in the sampled households (Appendix 3). The number of dependants was mostly used in the analyses as it determines the actual number of persons dependent on the heads of households.

As evident in Table 4.10, there is high percentage of dependants per household with 48.8% households having between 5 and 6 dependants (mean number of dependants). This high number of dependants per household has been noted to be a contributing (exposing) factor to high food insecurity levels of some households (Omonona et al., 2007; Asogwa and Umeh, 2012; Ibok, Bassey et al., 2014) especially where the head of a household is the only income earner and others depend on him/her for survival .

Table 4.9: Household size/dependants relationship (n = 400)

Household size	Percent (%)	Cumulative Percent
Number of children by household		
0	2.8	2.8
1	2.0	4.8
2	5.5	10.3
3	7.5	17.8
4	18.3	36.0
5	21.5	57.5
6	16.5	74.0
7	13.8	87.8
8	8.8	96.5
9	2.5	99.0
10	1.0	100.0
Total	100.0	
Mean	5.14	
Households' dependants number		
1	1.3	1.3
2	5.8	7.0
3	7.5	14.5
4	21.3	35.8
5	25.3	61.0
6	23.5	84.5
7	11.0	95.5
8	4.5	100.0
Total	100.0	
Mean	5.01	

Source: Researcher's computation, 2017

Table 4.10: Distribution of Number of Dependants

No. of Dependant	Frequency	Percent (%)
1 – 2	33	7.0
3 – 4	128	28.7
5 – 6	197	48.8
7 – 8	40	15.5
Total	400	100.0

Source: Researcher's computation, 2017

The maximum and minimum number of dependants in the study area was eight (8) and one (1) respectively, and the poorest have the highest number of dependants in all categories with 55.6% of them having at least eight (8) dependants (Figure 4.4). The wealthier and wealthiest classes had a maximum and minimum of five (5) and four (4) dependants respectively.

It was found that, "the higher the number of dependants of a household with respective lower income of the household head", the higher the level of food insecurity. This simply means

that, poorer agrarian households with higher number of dependants were highly vulnerable to food insecurity in times of flooding which had associated hike in food prices in the study area.

Figure 4.4: Household dependency by Wealth Classes

In addition, there was a positive correlation between educational level and income (0.426) as well as a weak negative correlation (-.164) between educational level and number of dependants which were both significant ($p < .01$) (Appendices 4 and 5). The implication is that higher income earners in the study area had higher educational degrees and those with higher educational degrees had fewer dependants, thereby making the poorer households more vulnerable to food insecurity as well as less resilient.

4.2.6.2 Livelihood sources

The major livelihood sources were reliant on agriculture (92% -farming) due to the study area being largely agrarian as shown in Table 4.11. Other sources of livelihoods include trading/business, hunting, civil service and others as shown in Figure 4.5 where fishing was reported as the major secondary occupation of the respondents while 13.7% respondents were farmers whose households depended solely on farming activities for survival while 10.5% engage in other agricultural activities (e.g. fruits/chicken/goats sale and basket weaving).

Table 4.11: Primary occupation of respondents (n = 400)

Primary income source	Percent (%)
Farming	92.0
Fishing	.8
Trading/Business	.8
Civil servant	6.5
Total	100.0

Source: Researcher's computation, 2017

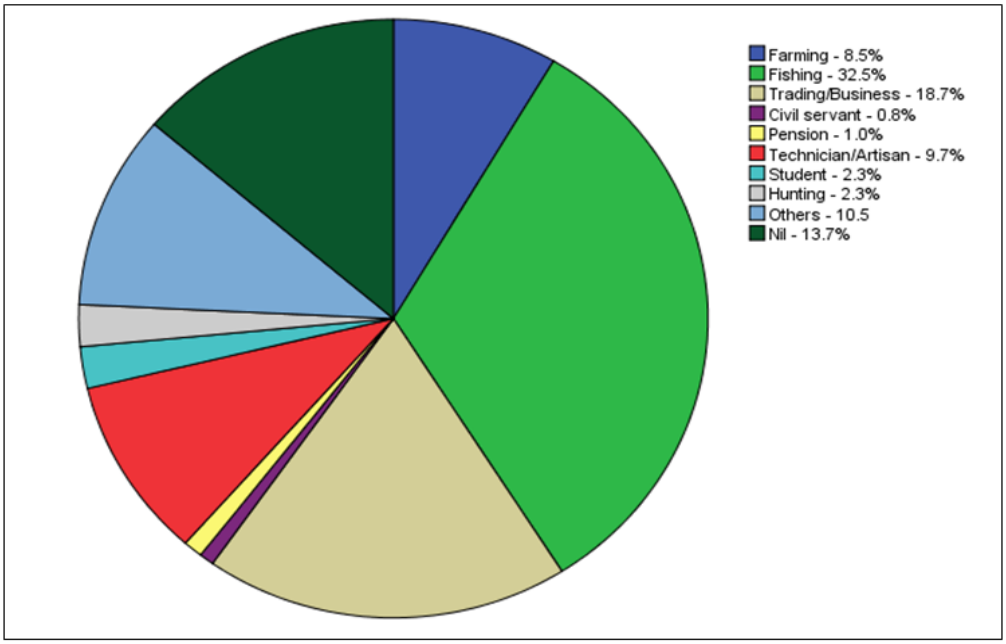


Figure 4.5: Distribution of secondary sources of livelihood of the respondents

4.2.7 Household farm-related characteristics

Some households' farm-related characteristics analysed in the study area are shown in Table 4.12.

Income diversification is indispensable as it signifies multiple income sources that reinforce livelihoods in time of shocks and about 85% households were found to have diversified their income, but within agricultural activities and this had some negative effects on the households in times of flooding which grounded their sources of livelihoods.

Off-farm income was earned by 77% households mainly from civil services, technician & artisan works, carpentry and masonry. This off-farm income was found to have helped these households in times of flooding and food insecurity. The analysis also illustrated that 41.3% owned a private land (acquired majorly through inheritance (Figure 4.7) while 58.7% did not.

About a quarter of the sampled households kept livestock for commercial and consumption purposes and 30.3% of them had a village poultry or agricultural poultry which served as income and protein sources.

Additionally, the knowledge of nutrition was analysed to determine the food utilization aspect of food security which suggested if the household heads had an idea of an "adequate diet". More than a half (54.3%) had the knowledge of food combination in the right proportions and this was partly the reason why the study area recorded a high percentage of acceptable food consumption score (FCS) as seen subsequently.

Table 4.12: Household farm-related characteristics (n = 400)

Component	Frequency (Percent %)	
	Yes	No
Diversified income	339 (84.8)	61 (15.2)
Off-farm income	308 (77.0)	92 (23.0)
Private land ownership	165 (41.3)	235 (58.7)
Livestock ownership	99 (24.8)	301 (75.2)
Village/Agric. poultry ownership	121 (30.3)	279 (69.7)
Nutrition knowledge	217 (54.3)	183 (45.7)
Distance to farm (>60 minutes)	295 (73.8)	105 (26.2)
Distance to market (>60 minutes)	157 (39.3)	243 (60.7)
Storage facility availability	142 (35.5)	258 (64.5)
Use of tractor	40 (10.0)	360 (90.0)
Use of fertilizer	176 (40.0)	224 (56.0)
Fertilizer subsidy	72 (18.0)	328 (82.0)
Food/aid receipt	96 (24.0)	304 (76.0)

Source: Researcher's computation, 2017

The study also revealed that 73.8% households walked for more than an hour (60 minutes) to their farms while 39.3% walked for more than 60 minutes to various markets where they sold their farm produce. Long walking distances to farm and market influence the quantities of crops harvested and sold at a given point in time.

There was an observed divide in the distribution of storage facilities as only 35.5% households had available storage facilities. Non availability of storage facilities was one of the factors that affected agricultural productivity in the study area. It made majority of the households to harvest and sell at the same time when supply was high, thereby crashing the prices of their farm produce. In the same vein, crop failure as a result of flooding was also revealed to have been exacerbated by the non availability of storage facilities. Households usually stored their harvested farm produce in yam/maize barns; cassava were stored in the

ground (shallow pits) in uplands; peeled cassava were preserved in rivers for a period of about 6 months (especially in Oguta); rice were stored in rice mills; houses also served as stores.

Only 10% heads of households employed the services of tractors which have been revealed in literature to reduce number of days spent on farms during land preparation, planting and harvest periods (especially for rice farming). The low percentage of tractor usage is an indication of non affordability as well as most of them being small-scale farmers as revealed by their average land holdings/farm sizes. Moreover, it was as a result of small number of rice farmers.

The use of fertilizer was practised by 40% households and this small percentage of fertilizer usage could be linked to low fertilizer subsidy as only 18% households indicated to have got fertilizers at a subsidized rate. Fertilizer usage is essential in the study area as the non accessibility to land by a good number of households induced the continuous cultivation on pieces of land with an aftermath of reduced soil fertility.

With regards to food/aid receipt, only 24% households reported to have had some assistance in terms of food or other relief materials, and they all indicated that the help was received after the devastating 2012 floods. This implies that they all received assistance as flood victims, meaning 76% households were abandoned during the last extreme flood since all households were affected in 2012 in the study area.

4.2.8 Other farm-related characteristics

4.2.8.1 Farm size/land holding

The average land holding of households in the study area is approximately 1.0 acre and as shown in Figure 4.6, 55.2% of the holdings ranged from 0.5 to 1.0 acre in size representing the largest proportion. More than a third (36.8%) of them cultivated on farm size between 1.1 to 1.5 acres of land while less than 1% cultivated on 2.1-2.5 acres of farmland. The pictorial illustration of the farm size/land holding indicate that majority of the sampled households consisted of small-scale farmers.

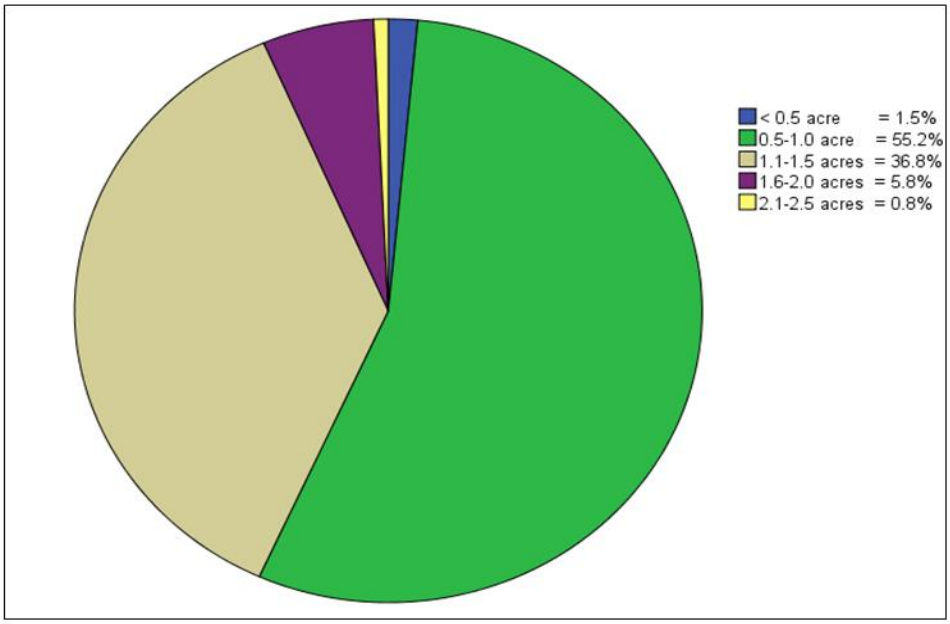


Figure 4.6: Household farm sizes in acre

4.2.8.2 Land acquisition methods

Access to land was found to be a major problem especially for FHHs who relied mostly on communal farmland for cultivation. Majority of the households (75.3%) cultivated on communal pieces of land on annual basis because these lands were not paid for. Inheritance of land mostly by men from their fathers was another important method of land acquisition in the study area, and 36.3% households acquired land through this means (Figure 4.7).

Leasehold where people paid for using land for a period of time was practised by 26% households while 11.8% practised sharedcropping where either the proceeds from the farm or harvested crops were shared between the land owner and the farmer or between farmers who cultivated on the same pieces of land. Only 12.5% either purchased or were gifted the land they had access to in the study area.

The land acquisition methods influenced the size of farm cultivated on by the households because only 41.3% of the sampled households indicated ownership of land (Table 4.12).
The total percentage of the various land acquisition methods add up to more than 100% because it was a multi-choice question where some persons had more than one method of acquiring land.

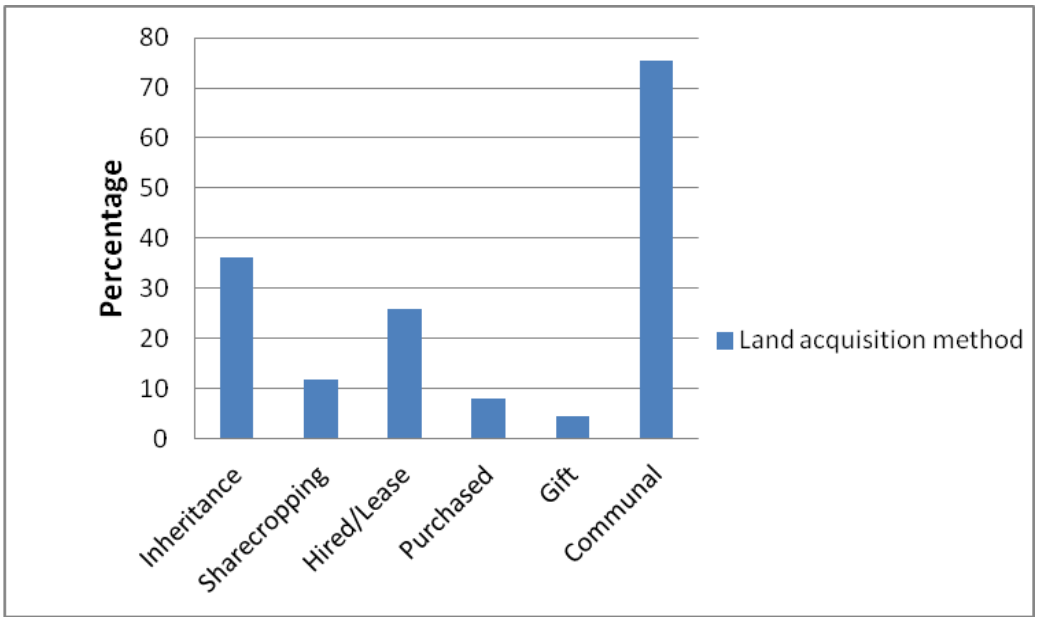


Figure 4.7: Land acquisition methods

4.2.8.3 Crops produced by households

The study area is known for its comparative advantage in the production of yam, cassava, maize and potatoes (staples in Nigeria) which is evident in the chart below. The variety of crops produced by households is shown in Figure 4.8. The chart shows that all the households (100%) produced cassava and maize with 89% producing 'ugu' (one of the most favourite vegetables in Nigeria). The reason for the <60% of households producing yam was partly due to the 2012 flood that affected their farmland and affected their incomes drastically, thereby causing them not to be able to purchase yam seedlings (which according to most of the respondents were costly). About 11% of the households produced rice and above 65% of them produced cocoyam and potatoes each. The reason given by some of the farmers for producing mostly potatoes was because potatoes is a vegetative plant and its cultivation is not capital-intensive. Okra, tomatoes, pepper, egusi and plantains are other crops produced in the study area and the percentage of households that produced them are illustrated in Figure 4.8. The crops that fall under the "others" category of produced crops are palm fruits, pineapple and cocoa and were produced by 10.5% households.

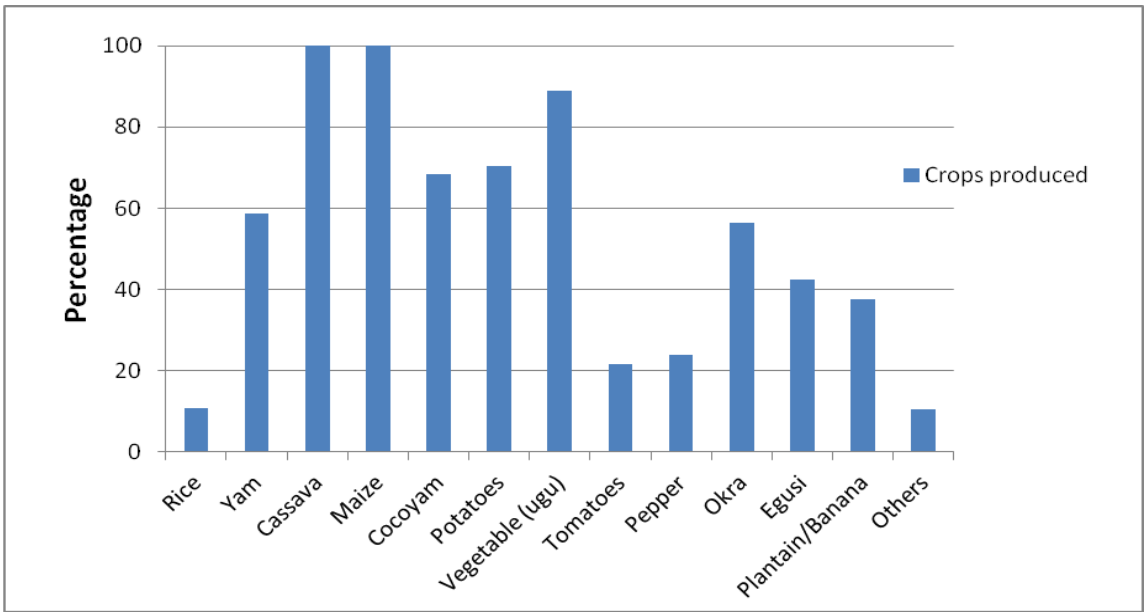


Figure 4.8: Variety of crops produced by households in the study area

4.2.8.4 Farm Location

Figure 4.9 shows that majority of the farmers has their farmland in both upland and lowland area and above 50% of them have their farms located in the flood plains. The implication of the representative distribution of farmland on the three different locations is that most of the farmers cultivated on scattered pieces of land. Cultivating in floodplains was one of the reasons the farmers were vulnerable to flooding and its effects.

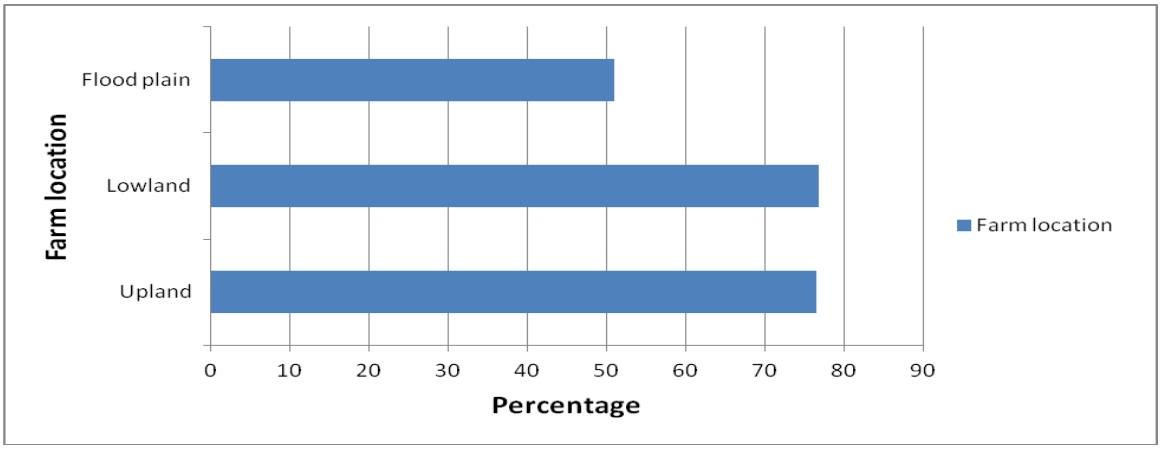


Figure 4.9: Distribution of farm locations

4.2.8.5 Transportation means

Seven (7) means were reported by households as ways of tarnsporting their farm produce from their farms to various places (e.g. market, house or river bank for further transporting to their final destinations (figure 4.10). Carrying farm produce in wheel barrows (98.8%),

motorcycle (80.5%), on human heads (74%) and bicycles (70%) were practised the most because most of the roads to farms were tracks and were not accessible enough to be plied by vehicles. Using canoes as means of transportation was reported by 70.8% households mostly in the riverine communitites e.g. Oguta and Otuocha where canoe is a major asset. The minimal use of vehicles and tricycles as means of transporting farm produce as shown in Figure 4.10 is because of the cost involved, and as only a negligible percentage of the sampled household owned a car.

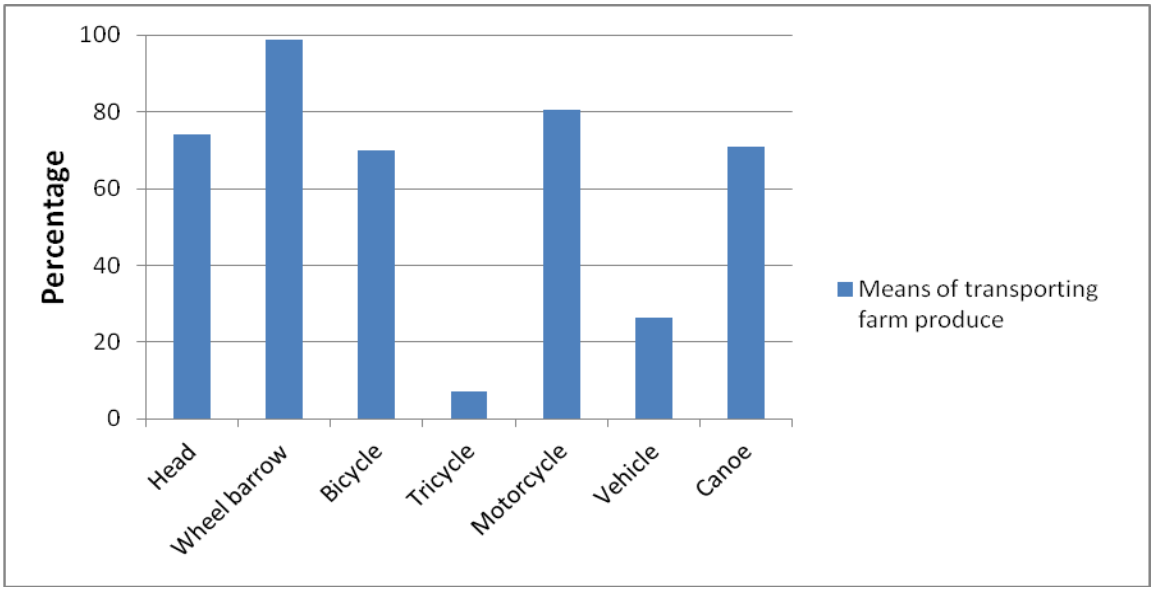


Figure 4.10: Transportaion means distribution

4.2.8.6 Seed sources

Farmers in the study area sourced their seed for planting from four (4) means viz; market, friend, relatives, stocked seeds. Majority of the households as illustrated in Figure 4.11 sourced their seed from the market (97.8%) followed by stocked seeds (87.8%) from previous harvest. The reportedly high sourcing of seeds from the market was linked to crop failures in some years of disasters (e.g. flooding, pests and diseases) that ravaged farms causing low productivity and thereby, lesser stocked seeds.

Surprisingly, 12.2% reported not to have used the stocked seeds from previous harvest. Households that reported not to have used their stocked seeds were observed to fall in the category of those whose own food production were not sufficient, so they had to augment by buying from the market. Only about one third (33.5%) sourced their seeds from friends who were reported to be fellow farmers and 6.5% sourced from their family/relatives.

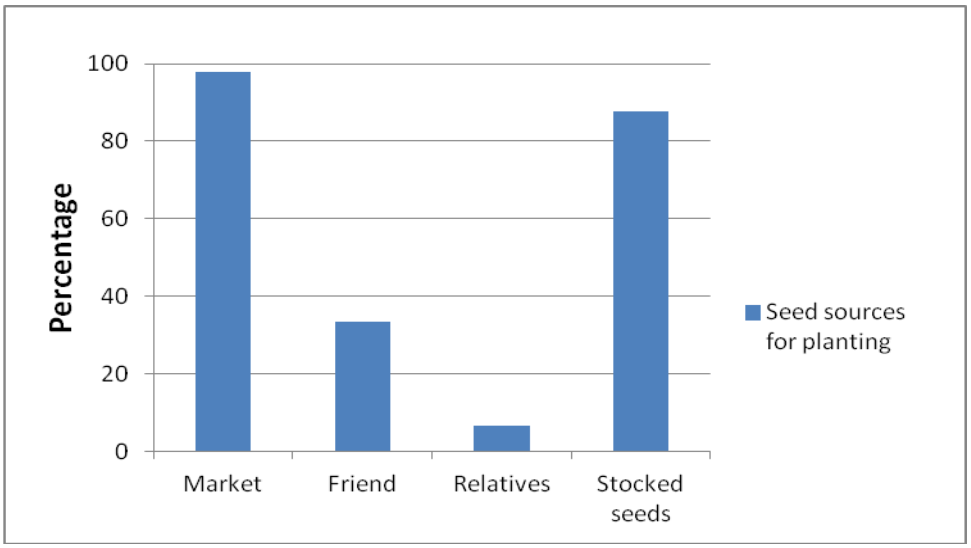


Figure 4.11: Distribution of seed sources

4.3 The Nature of flood

Flooding has been avowed to be one of the devastating environmental problems faced by some communities and its characteristics in terms of extent, frequency, severity and depth were examined to ascertain the area of inundation, the magnitude of damage as linked to how frequently floods occurred in the study area. In similitude, the causes and effects of flooding were examined in this section.

The flood characteristics in the study area are shown in Table 4.13. The Table reveals that most household (69%) suffered severe degree of flood damage which is linked to the frequency of flooding, as a gargantuan percentage (91.2%) of households experienced flood events most times in the rainy season in the study area. In addition, there was an even distribution in the proportion of households affected as all the households (100%) indicated to have been affected by flooding.

An analysis of the year(s) households were most affected by flooding, shows that all sampled households (100%) were affected in 2012, 9.8% in 2013, 34% in 2014, 22.5% in 2015 and 48.5% in 2016. It could be inferred from the percentage of households affected that devastating flooding occur on a two-year basis with that of 2012 being the worst in the last five years within the period under study. However, 2012 has been noted to be the most extreme flood year in the last five as evident in Table 4.13 and which is in line with the findings of UN-OCHA (2012) and FEWS NET (2012; 2013).

River flooding resulting from rivers overflowing their banks, and exacerbated by factors such

as; increased rainfall, farming on floodplains and inadequate drainage facilities is the major type of flooding experienced in the study. The flood water that affected houses were indicated by majority (51.7%) to be about 2-4m deep while 5.8% indicated that it was >4m deep. In addition, 23.5% of households indicated that the flood water within houses was <1m deep while 19% mentioned it was between 1-2m deep (Table 4.13). The depth of flood water within these housing units shows how vulnerable the households are to flooding. Conclusively, flooding in the study area is caused mostly by excess discharge from rivers and mostly severe in terms of damages as well as highly frequent as it occurred in most times of the rainy season.

Table 4.13: Nature of flood in South eastern, Nigeria

Nature of flood	Component	Frequency	Percent (%)
Severity of flood	Mild	13	3.3
	Moderate	111	27.7
	Severe	276	69.0
Flood frequency	Rarely	4	1.0
	Occasionally	10	2.5
	Whenever it rains	21	5.3
	Most times in the rainy season	365	91.2
Flood depth (house)	<1m	94	23.5
	1-2m	76	19.0
	>2m	107	26.7
	>3m	100	25.0
	>4m	18	4.5
	>5m	5	1.3
Flood type	Flash flood Yes	277	69.2
	No	123	30.8
	River flood Yes	400	100
	No	0	0.0
Affected by flood	Yes	400	100
	No	0	0.0
Year affected by flood	2012	400	100
	2013	39	9.8
	2014	136	34.0
	2015	90	22.5
	2016	194	48.5
Extreme flood year	2012	400	100
	2013	0	0.0
	2014	5	1.3
	2015	9	2.3
	2016	18	4.5

Source: Researcher's computation, 2017

4.3.1 Flood Extent Mapping

4.3.1.1 Elevation

The map shows that the elevation of the study area falls within 1-150m high with the selected communities (Atani, Ossomala, Otuocha, Igbariam, Oguta, Ezi-Orsu, Mmahu and Opuoma) falling within 1-50m high, hence the reason for their vulnerability to flooding (Figure 4.12).

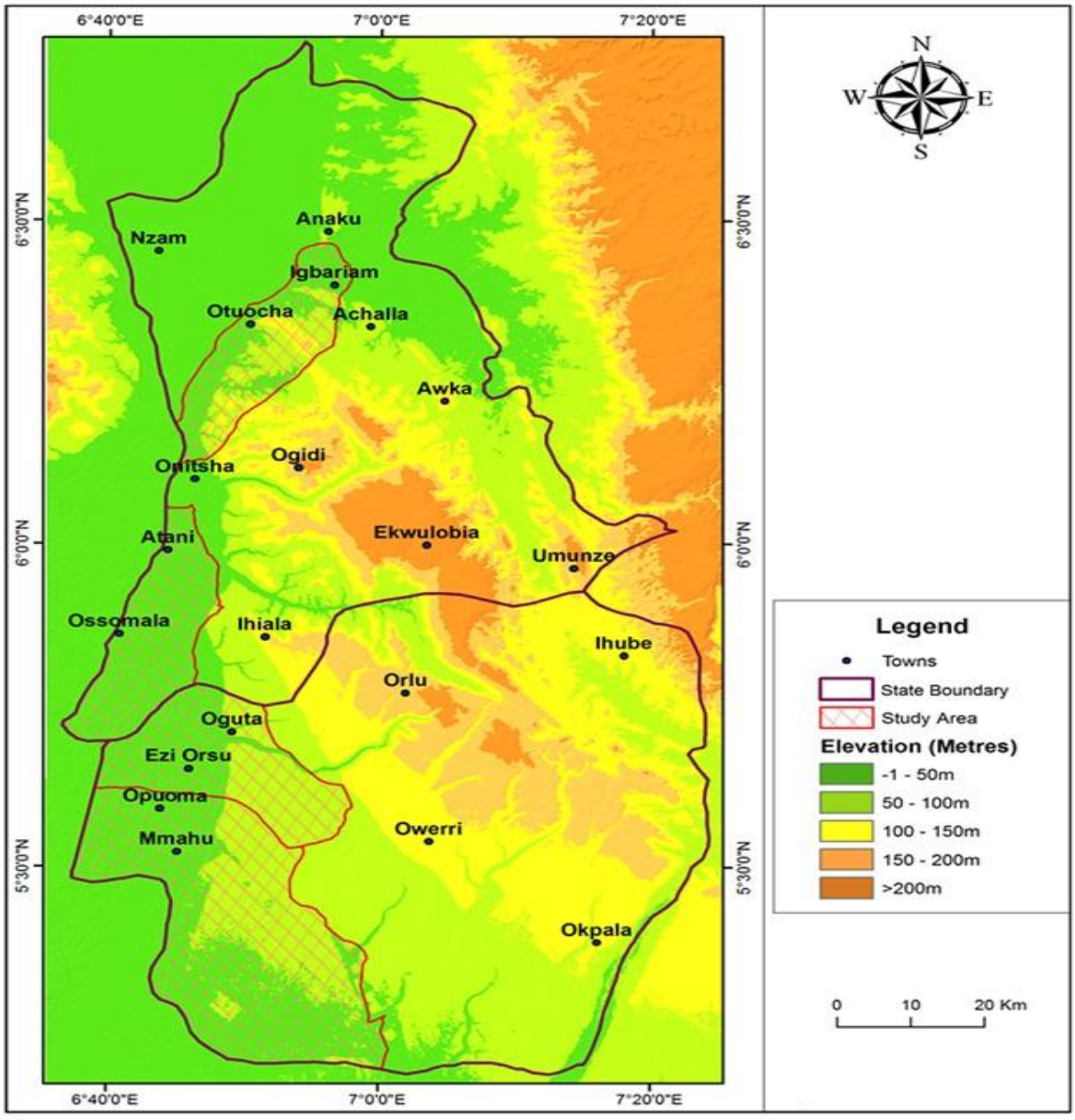


Figure 4.12: Map showing elevation of the study area
Source: Cartography Lab., Department of Geography, University of Nigeria, Nsukka

4.3.1.2 Flood Extent

Flood extent was analysed to illustrate the area inundated during extreme flood event and the

risk related to flood-induced losses was inferred from the flood extent map. Flood analysis from the MODIS and SRTM DEM images show that the maximum elevation inundated in the study area was 35m above sea level, thus any area with an elevation below the 35m threshold was inundated.

The map (Figure 4.13) shows that areas lower in elevation (1-50m) are more flood-prone and they experienced floods as deep as 10m and above extending to more parts e.g. Atani and Ossomala. River flooding was the major flooding experienced and this was caused mostly by the overflowing of the banks of Duo River, Mamu River, Ezu River, Nkisi River, Anambra River and River Niger. This agrees with the findings of Okwu-Delunzu et al. (2017) who noted areas lower in elevation in Anambra East LGA were prone to flooding as a result of concentration of run-off in these areas from areas of higher elevations. Figure 4.13 illustrates that most parts of the study area recorded floods as deep as 10m. Atani, Ossomala, Mmahu and Opuoma communities were highly submerged with a recorded flood depth of above 10m. A large proportion of Ezi-Orsu and Oguta communities were partly submerged with a recorded flood depth of between 1-10m while a small proportion of Otuocha and Igbariam communities were submerged with flood water as deep as above 10m. Majority of the farmlands in the study area was submerged which resulted in household food insecurity as concurred by the findings of FEWS NET (2012; 2013).

With respect to the area affected by flood, Anambra East LGA recorded the smallest proportion of 158.004 km^2 followed by Oguta, Ohaji/Egbema and Ogbaru LGAs with an inundated area of 241.982 km^2, 305.706 km^2 and 391.789 km^2 respectively (Figure 4.14). The implication is not only on the area affected but also on the proportion of the entire LGA affected. Table 4.14 shows that the Ogbaru LGA would have suffered severe effects of flooding, followed by Oguta, Anambra East and Ohaji/Egbema LGAs in a decreasing order with percentage inundated area of 98.5%, 50.6%, 41.7% and 26.6% respectively. The flood extent was majorly a function of the elevation of the communities and LGAs e.g. the 1.5% areas not flooded in Ogbaru LGA were between 100-150m above sea level and the entire inundated area in all the LGAs were mainly plains between 1-50m above sea level. The flood extent and depth could be linked to the availability and sizes of rivers that drained these areas because the major cause of flooding in the study has been adduced to rivers overflowing their banks.

Table 4.14: Percentage Inundated Area

Local Government Area (LGA)	LGA size (km^2)	LGA Inundated Area (km^2)	Percentage Inundated Area (%)
Anambra East	378.95	158.004	41.7
Ogbaru	397.61	391.789	98.5
Oguta	478.24	241.982	50.6
Ohaji/Egbema	1147.51	305.706	26.6

Source: Researcher's computation, 2017

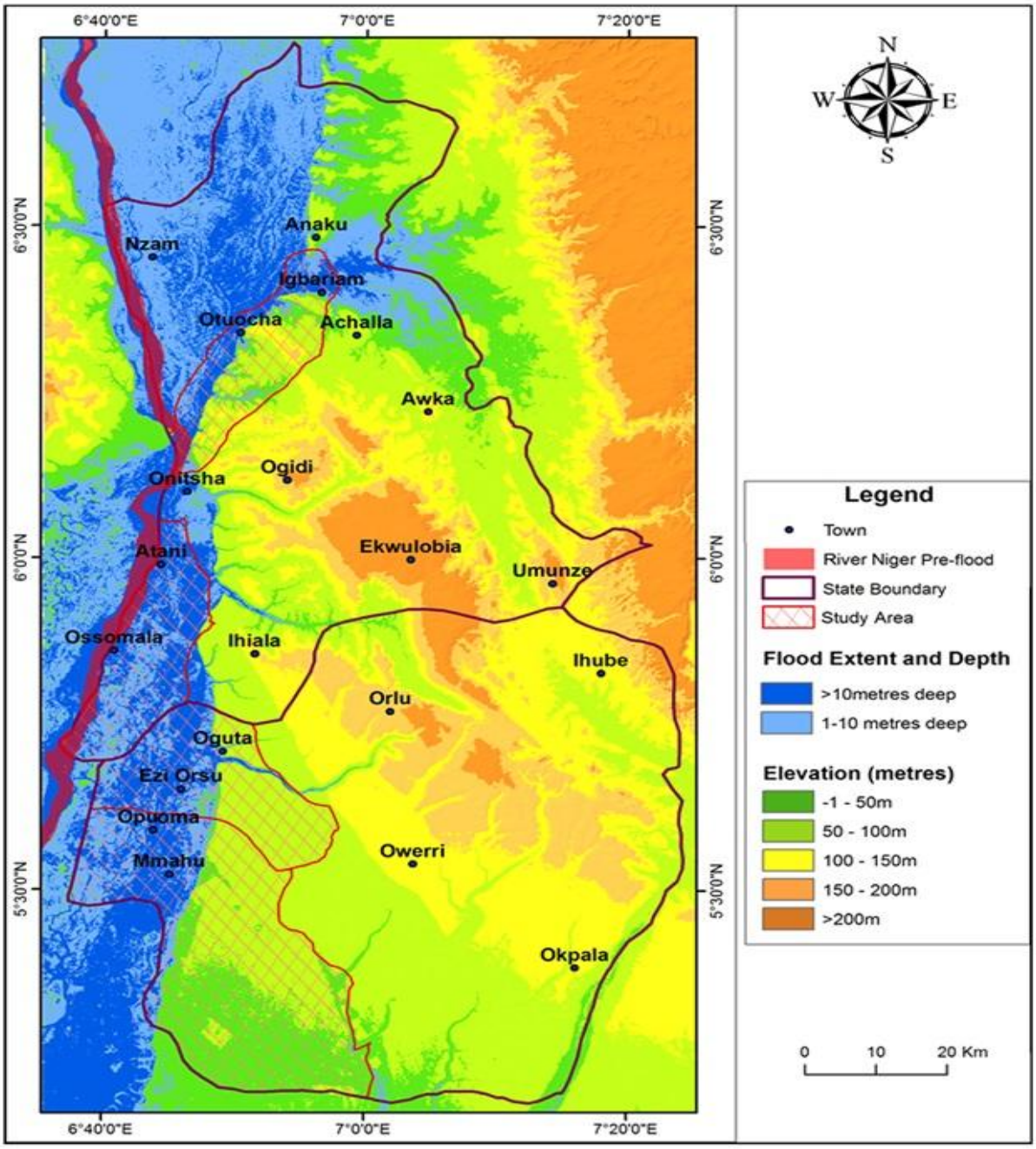


Figure 4.13: Flood Extent and Depth map

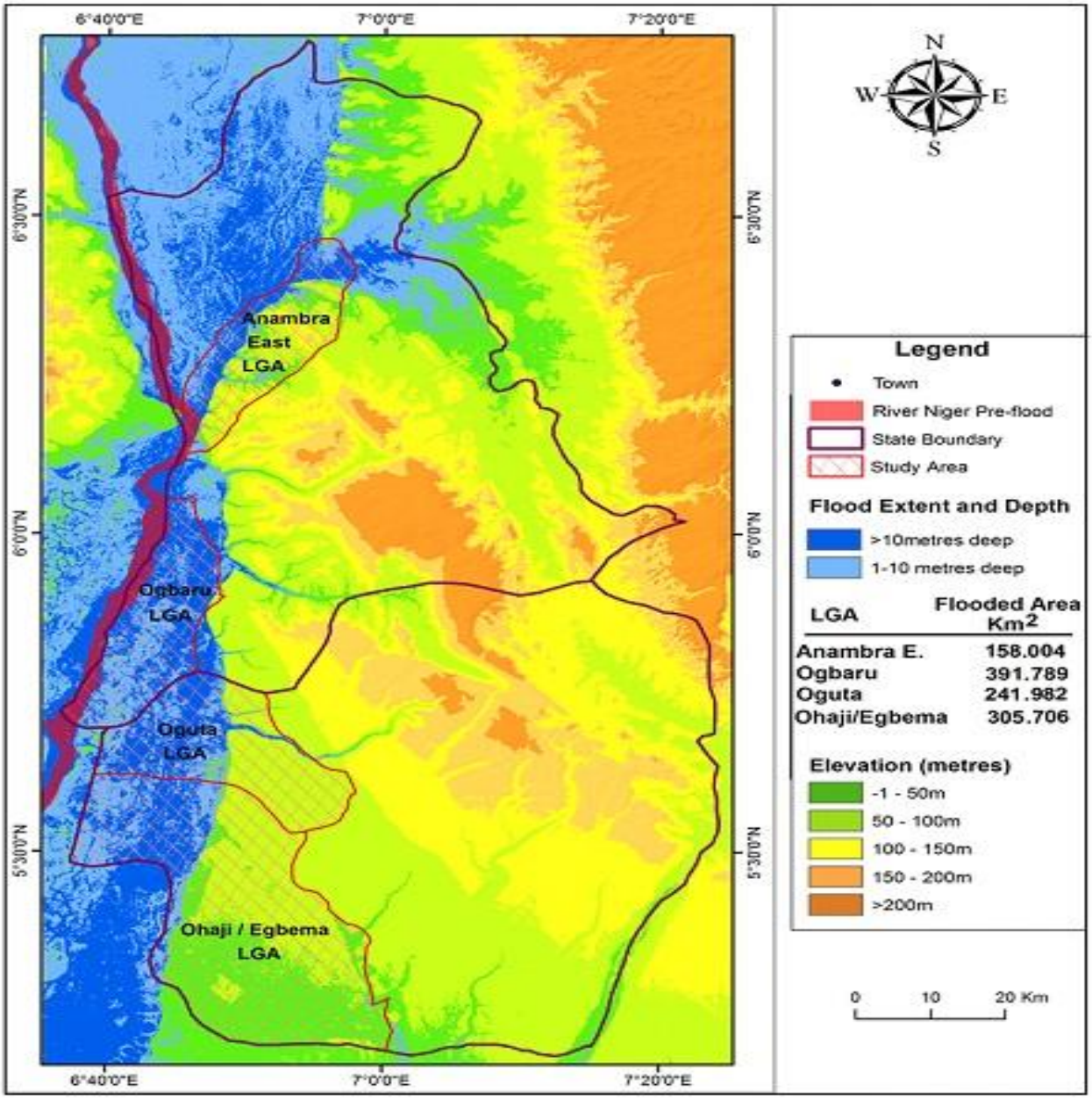


Figure 4.14: Map showing inundated Area at LGA level
Source: GIS Lab., Department of Geography, University of Nigeria, Nsukka

4.3.2 Seasonal variations in flood occurrence in Southeast, Nigeria

4.3.2.1 Flood Experience

Table 4.15 shows that 98.7% of the population accounted for people who had experienced flooding in their farmlands and 52.5% of the population had experienced flooding in their areas of residence. The high percentage of people who had experienced/ been affected by flooding shows that the communities experience a perennial flooding problem (Plate 4.2 and 4.3).

Table 4.15: Flood experience

Flood experience	Frequency (Percent %)	
	Yes	No
Farmland flood experience	395 (98.7)	5 (1.3)
Residence flood experience	210 (52.5)	190 (47.5)

Source: Researcher's computation, 2017

Plate 4.2: Submerged yam farms in Atani, Ogbaru LGA (31/08/2016)

Plate 4.3: A partly submerged house in Oguta (29/09/2017)

4.3.2.2 Seasonal variations in flood occurrence

Seasonal variations in flood occurrence from the respondents' perspective show that flooding occurs mainly from June to November which fall within the peak of the Rainy season, and especially from September to October (second maxima). Flooding sometimes occur within the beginning of the Rainy season (March-May) as a result of torrential rainfall. The seasonal variations in flood occurrence as reported by the respondents correspond with rainfall

variability over the study area as analysed from a 40-year rainfall data (1974-2013) collected from NIMET, Lagos (Figure 4.15), which shows that maximum rainfall are received between May and October. Since flooding occurred mostly during the harvest season of most crops, harvest and productivity are negatively affected.

Table 4.16: Seasonal variation in flood occurrence

Flood occurrence month	Frequency (Percent %)	
	Yes	No
March – May	24 (6)	376 (94)
June – August	223 (55.7)	177 (44.3)
September – November	390 (97.5)	10 (2.5)
December – February	0 (0.0)	400 (100)

Source: Researcher's computation, 2017

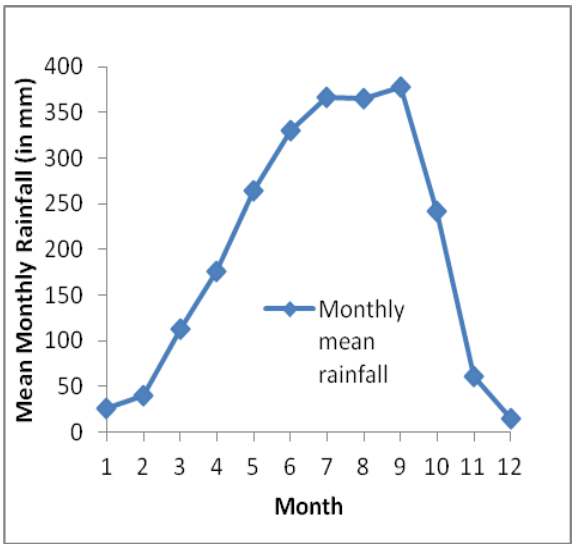
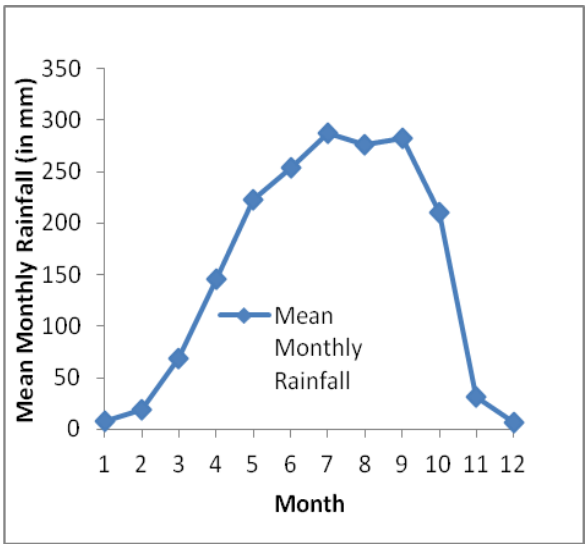


Fig.4.15: Mean Monthly Rainfall over Oguta and Ohaji/Egbema LGAs (in mm)



Mean Monthly Rainfall over Anambra East and Ogbaru LGAs (in mm)

4.3.3 Rainfall Trends over Southeastern Nigeria

The annual total rainfall as well as the mean annual rainfall from 1974 to 2013 were analysed to determine rainfall variability over a 40-year period in the study area with the rainfall data collected from NIMET, Lagos (Appendix 6). The rainfall curves (Figures 4.16 to 4.19) indicate variability in rainfall over the four LGAs. Within the period under study, Anambra East and Ogbaru LGAs received the highest annual rainfall (2924.3mm) with an annual mean of 243.69mm in 2011 while Oguta and Ohaji/Egbema LGAs recorded their maximum annual rainfall of 3209.1mm in 2006, with a mean of 267.43mm. On the other hand, Anambra East and Ogbaru LGAs received their minimum annual rainfall of 861.3mm and a surprising low

annual mean rainfall of 71.78mm in 2005 whereas Oguta and Ohaji/Egbema LGAs had their lowest recorded annual rainfall of 1557.9mm with an annual mean rainfall of 129.83mm in 1983. The rainfall curves depict varying rise and fall which shows fluctuations in annual rainfall over the study area.

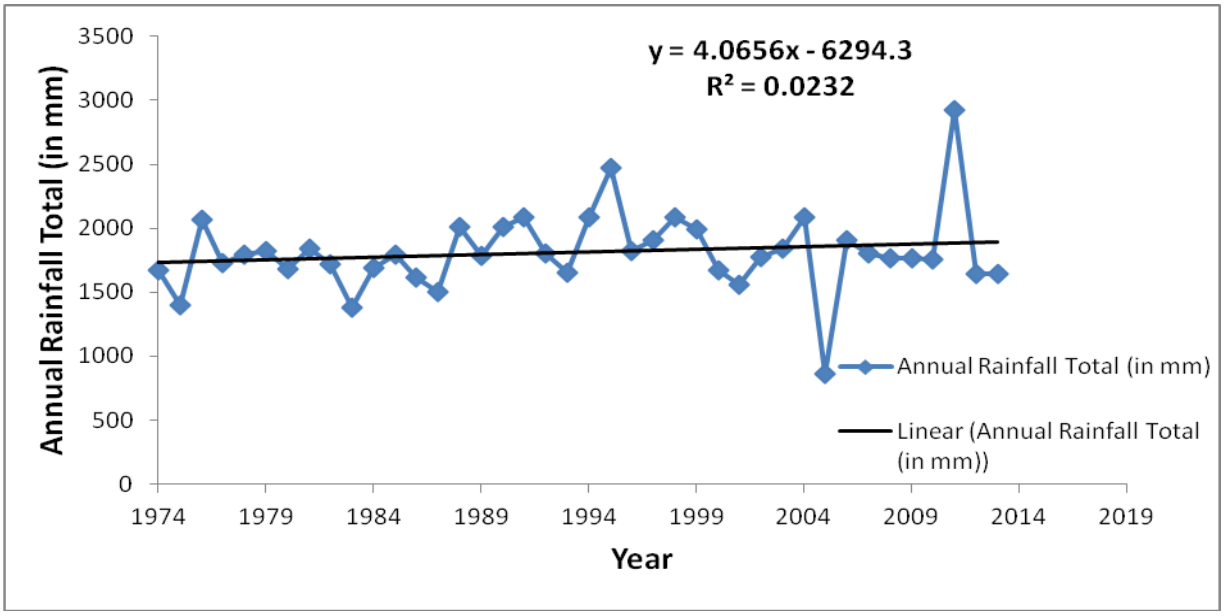


Figure 4.16: Annual Rainfall Total over Anambra East and Ogbaru LGAs (in mm)

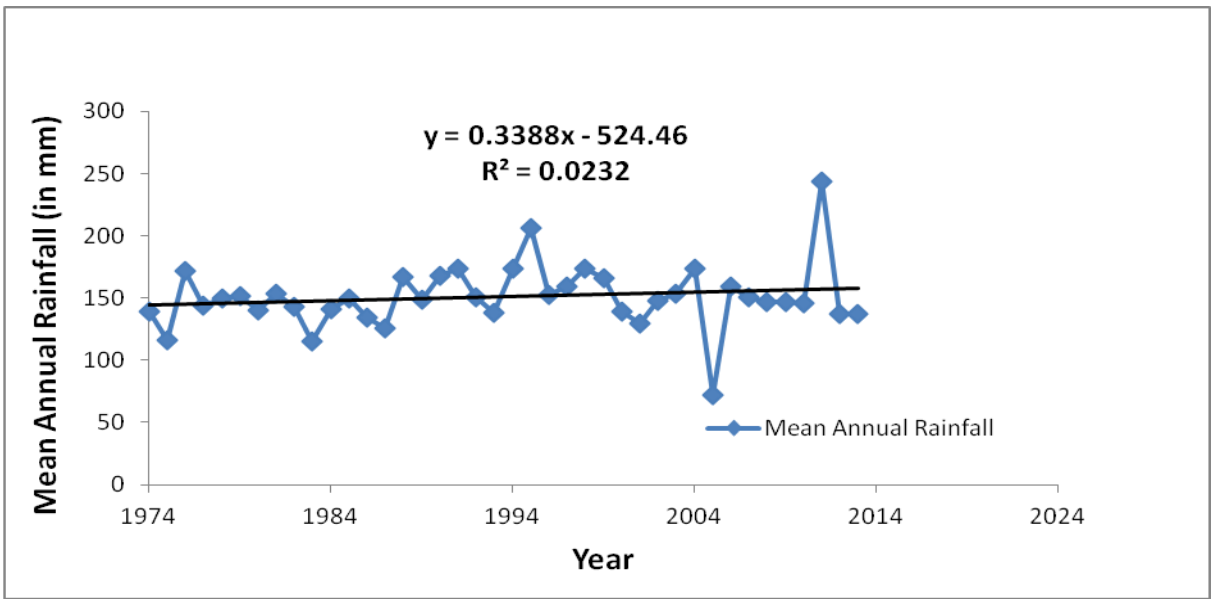


Figure 4.17: Mean Annual Rainfall over Anambra East and Ogbaru LGAs (in mm)

Trend analysis was carried out to show whether there was a general increase or decrease in annual rainfall over time. The results show positive slope (b) values generated from regression analysis for all the plots. A positive slope value depicts an increase in rainfall over the study area. For instance, the linear trend model, y = 0.3388x – 524.46 for the mean annual

rainfall over Anambra East and Ogbaru LGAs, shows a positive slope of 0.3388 and an intercept (constant) of 524.46 (Figure 4.17). This implies that annual rainfall over these areas has been increasing at an average rate of 0.3388mm.

Generally, there was an increase (though not abrupt) in rainfall over the study area as depicted in all the trend lines in the graphs. However, the almost horizontally straight trend lines in Figures 4.16 and 4.18 shows that there has been a slow but steady change in annual rainfall over the study area within the study period.

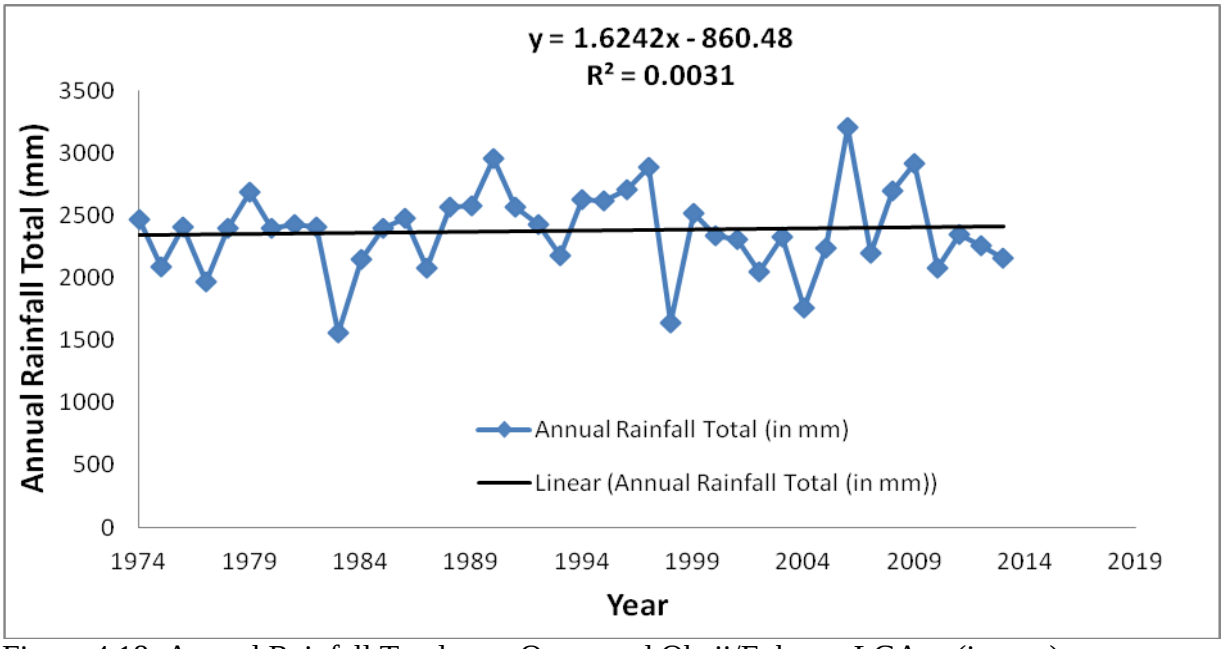


Figure 4.18: Annual Rainfall Total over Oguta and Ohaji/Egbema LGAs (in mm)

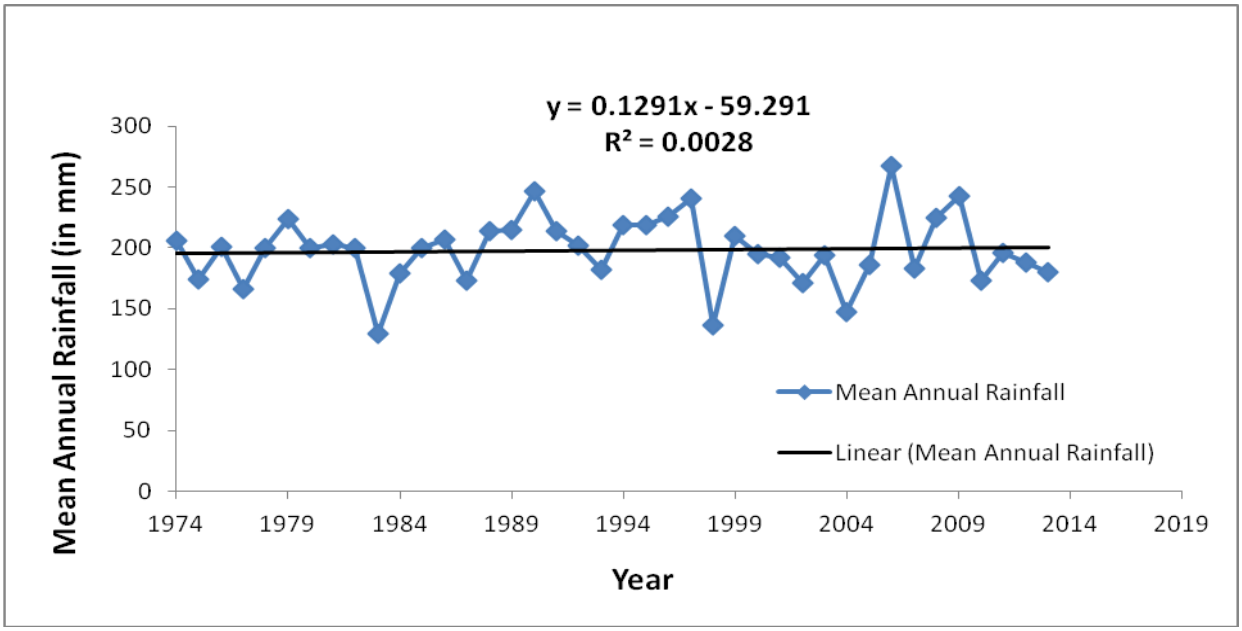


Figure 4.19: Mean Annual Rainfall over Oguta and Ohaji/Egbema LGAs (in mm)

4.3.4 Respondents' Perception of Causes of Flooding

The respondents identified eight (8) factors influencing flooding and their analysis shows that heavy rainfall is perceived to be the major cause of flooding with 99.2% respondents agreeing to it (Table 4.17). This is true since the study area receives an annual rainfall amount of about 1800mm, and several studies have adduced increased rainfall to cause flooding as concurred by Akinsanola and Ogunjobi (2014).

Table 4.17: Households' perceived causes of flooding (n =400)

Cause of flooding	Percent (%)	
	Yes	No
Heavy rainfall	99.2	0.8
Excess river discharge	85.0	15.0
Flat terrain (low topography)	36.8	63.2
Climate change	52.0	48.0
Building/farming on floodplains	59.0	41.0
Wrath of God	10.3	89.7
Impervious surfaces	22.3	77.7
Lack of gutters	44.5	55.5

Source: Researcher's computation, 2017

Flooding is perceived to be influenced by heavy rainfall and occurs whenever the precipitation rate exceeds that of infiltration and surface evacuation by available drainage facilities and rivers.

The next perceived significant cause of flooding is excess river discharge as indicated by 85% respondents. River flooding was the major form of flooding experienced in the study area and it occurred usually when rivers overflow their banks due to increased volume of water reaching the rivers at a point in time, thereby exceeding the rivers capacities.

A substantial number (59%) indicated that building/farming on floodplains caused flooding while 52% noted that flooding was caused by climate change. Building houses/farming in floodplains alter natural water channels which causes flooding.

Lack of gutters, flat terrain, impervious surfaces and wrath of God were indicated by 44.5%, 36.8%, 22.3% and 10.3% respectively respondents as causes of flooding. Inadequacy of drainage facilities (e.g. gutters) and impervious surface cause flooding because they lead to accumulated surface run-off which is generated faster than they are evacuated.

The study area is generally plains and vulnerable to flooding, thus the reason that flat terrain (low topography) formed one of the major causes of flooding. Flat terrain is exacerbated by

heavy rainfall and inadequate drainage facilities because the rate of evacuation of excess run-off is often slower in areas with flat terrain than when the slopes are pronounced. Paradoxically, some respondents still believe that flooding is a wrath of God because they believed that God is punishing them for something they could not explain. According to Jude Okafor, a 46-year old man in Ugada Oguta in 2016, "*I have never seen this kind of flooding in my lifetime, even my great grandparents, I believed never experienced this kind. I think God is angry with us for the bad things we have been doing, so He decided to punish us with that kind of flooding that took virtually everything we had worked for."*

However, heavy rainfall was noted to be the major cause of flooding as it exacerbated the degree of influence of the other factors that caused flooding in the study area.

4.3.5 Effects of flooding

The effects of flooding in Nigeria had been extensively studied and the findings of effects of flooding in south eastern Nigeria are in tandem with those of Folorunsho and Awosika (2001); Ologunorisa (2004); Jeb and Aggarwal (2008); Ogba and Utang (2008); Adeloye and Rustum (2011); Etuonovbe (2011); Olorunfemi (2011); Odufuwa et al. (2012); Duru and Chibo (2014) and Adewuyi and Olofin (2014).

The result shows that the effects of flooding in the study area range from physical, economic to emotional as shown in the Table 4.18. The reported effects of flooding in the study area shows that majority (93.3%) of households have had their farmlands destroyed as a result of flooding and 97.7% of them had experienced stream pollution after flood episodes. Flood-induced stream pollution is one of the intractable effects of flooding in the study area because a substantial proportion of households get their drinking water from streams. The study also found out that flooding had affected the income earning sources of 92.7% households which consequently led to majority of them (88.3%) having suffered from emotional trauma. However, disease outbreak such as cholera had been experienced in more than one-third of the sampled households' sequel to flooding. In the same vein, abandonment of property especially farmlands due to flooding were indicated by 30.3% respondents.

8.5% households had lost relatives in times of flooding and it was found out that those who lost their lives either were drowned, were bitten by animals like snakes and crocodiles or committed suicide after they lost their farmlands to flooding. Loss of household property and livestock (including fish ponds) were also noted as effects of flooding with 17.7% and 20%

respectively accounting for households that had experienced it.

Table 4.18: Effects of flooding (n = 400)

Effect of flooding	Percent (%)	
	Yes	No
Loss of life	8.5	91.5
Destruction of farmland	93.3	6.7
Abandonment of property	30.3	69.8
Traffic jams	11.0	89.0
Loss of household property	17.7	82.3
Seasonal displacement	24.3	75.7
Loss of livestock	20.0	80.0
Stream pollution	97.7	0.3
Disease Outbreak	36.7	63.3
Emotional trauma	88.3	11.7
Disruption of income earning opportunities	92.7	7.3

Source: Researcher's computation, 2017

Flooding also caused traffic jam, but only 11% households identified this and it was noted by mostly people living in the LGAs' headquarters of Atani, Otuocha, Oguta and Mmahu communities. In addition, flooding had forced (displaced) some households to migrate to safer land within the months of August to October. This seasonal displacement was recorded mostly in Oguta community (56.1%) and least in Opuoma community (9.6%).

Undoubtedly, the findings of the study have revealed that flooding is a kind of stressor which has some negative effects on households with stream pollution, destruction of farmlands, disruption of income earning sources and emotional trauma being the most experienced in the study area. Thus, flooding impact negatively on the livelihoods of majority households in south eastern, Nigeria since they are largely agrarian.

4.4 Assessment of Vulnerability to Flooding and its effects

Assessment of flood vulnerability is very important as it helps in determining who are vulnerable and why they are vulnerable to flooding and according to Balica (2012) vulnerability assessment is a core step towards successful disaster risk reduction. The conceptual framework used in this study expressed vulnerability in terms of adaptive capacity, sensitivity and exposure (see section 3.6.3) and Table 3.2 where a conceivable relationship between vulnerability and the indicators is attempted.

4.4.1 Results of the Principal Component Analysis (PCA)

The PCA of the data set on vulnerability indicators extracted thirteen (13) components with

Eigen values greater than 1. These 13 components explain 66.97% of the total variance in the data set. The first principal component explained most of the variation (16.09%) and the thirteenth component explained the least (2.79%).

Table 4.19: Component Score of the First Principal Component

Variable	Component
	1
Sex of head of household	-.466
Age of head of households (in years)	.327
Marital status	-.058
Literacy rate	.142
Level of educational	.306
Diversified Income	.599
Off-farm income	.655
Monthly income (in Naira)	.725
More than five dependants	.233
Type of dwelling unit	.479
Pre-flood awareness	.433
Group membership	.504
Private land ownership	.767
Sufficient own food production	.629
Livestock ownership	.407
Village poultry/poultry farm ownership	-.117
Farm size	.684
Storage facility availability	.595
Fertilizer use	.627
Fertilizer subsidy	.157
Irrigation practice	.464
Food/aid receipt	-.250
Early warning information access	.110
Phone ownership	.225
Radio/TV ownership	.259
Canoe ownership	.461
Access to improved water sources	.112
Remittance	.293
Access to credit	.315
Flood experienced in farmland	.077
House flood experience	-.024
Flood frequency	.055
Degree of flood experienced	.069
Flood depth	.146
Affected by flood in the last one (1) year	-.170
Floodable farm location	.162

Extraction Method: Principal Component Analysis.
a. 13 components extracted.

The first principal component which explained the majority of the variations were used in the computation of the vulnerability indices of the households across the eight communities (see methodology for explanation). The first principal component scores of most of the adaptive capacity variables were positively associated while few of the indicators under exposure and sensitivity were negatively associated (Table 4.19).

Only indicators of the adaptive capacity which are positively associated and those of sensitivity and exposure they are negatively associated were selected in calculating the vulnerability indices (as explained in methodology section). Consequently, the adaptive capacity variables selected were age, literacy rate, level of education, income diversification, off-farm income, monthly income, dependency ratio, type of housing unit, pre-flood awareness, group membership, land ownership, food production sufficiency, livestock ownership, farm size, availability of storage facility, fertilizer use, fertilizer subsidy, irrigation practice, early warning information access, phone ownership, radio/TV ownership, canoe ownership, access to improved water sources, remittance and credit access. Furthermore, the sensitivity and exposure variables selected were dwelling units flood experience and (1 year) flood experience.

4.4.2 Household Flood Vulnerability Analysis

At the household level, the Flood Vulnerability Indices (FVI) for the 400 households were calculated using the first principal components values against the selected socioeconomic and environmental variables. The minimum and maximum indices across the households were -10.73 and 10.44. The negative values are associated with high vulnerability while the positive are taken to be low vulnerability. Moreover, a higher value of the vulnerability index connotes lesser vulnerability and vice versa owing to the fact that when adaptive capacity of the household exceeds that of its sensitivity and exposure, the household becomes relatively less vulnerable to flooding impact.

Cluster analysis was used in grouping the various flood vulnerability indices (FVI) into three vulnerability levels; less, moderate and high (details in section 4.4.4). The three vulnerability levels are relative to one another. The less vulnerable households account for households that can relatively cope in times of flooding, though they are still vulnerable. The moderately vulnerable households would need some assistance (especially temporarily) to cope with flooding while the highly vulnerable households would need assistance for a long time to

cope. The less vulnerable class has an index range from 0.1 to 11 and comprises 49% households, the moderately vulnerable class range from -0.5 to 0.09 and consists of 3.5% households, while the highly vulnerable class ranges from -11 to -0.6 and constitutes 47.5% households (Table 4.20). This implies that in general, households in the south eastern region are almost as less vulnerable as they are highly vulnerable to flooding.

Table 4.20: Household Flood Vulnerability indices and Levels in South eastern Nigeria

Community	Household Vulnerability Index/Level (in percent %)			Total
	Less vulnerable Index (0.1 to 11)	Moderately vulnerable Index (-0.5 to 0.99)	Highly vulnerable Index (-0.6 to -11)	
Igbariam	41.9	2.3	55.8	64
Otuocha	50.0	4.5	45.5	64
Atani	43.7	6.3	50.0	44
Ossomala	46.9	3.1	50.0	43
Mmahu	51.9	0.0	48.1	41
Opuoma	48.1	3.8	48.1	40
Oguta	58.5	0.0	41.5	52
Ezi-Orsu	55.0	7.5	37.5	52
Total/Mean	49.0	3.5	47.5	400

Source: Researcher's computation, 2017

Due to the categorised nature of the flood vulnerability levels, less vulnerable households were assigned 1, moderately vulnerable assigned 2 and highly vulnerable assigned 3. The highly vulnerable households were assigned 3 because it consists of households whose FVI had high negative values, meaning that their adaptive capacity was below their sensitivity and exposure. 2 was assigned to households with nearly equal to zero FVI as a function of their adaptive capacity being almost equal to their sensitivity and exposure and lastly, households with positive FVI were assigned 1 because their adaptive capacity exceeded their sensitivity and exposure using the vulnerability definition by IPCC (2007;2012).

The computed flood vulnerability indices show that majority of the households in Igbariam, Ossomala and Atani were highly vulnerable to flooding while a large proportion of households in Oguta, Ezi-Orsu, Mmahu, Otuocha and Opuoma were relatively less vulnerable to the flooding and its associated effects in South eastern, Nigeria (Table 4.20).

4.4.3 Community and Local Government Area (LGA) Flood Vulnerability Analysis

The computed flood vulnerability indices (FVI) at household level were represented at the community and Local Government Area (LGA) levels by using the mean of all the household

vulnerability indices for each community and LGA (Table 4.21and Figure 4.20). The essence of representing this vulnerability analysis at the community and LGA levels is because households are connected to form a community and communities connected to the LGA. It also makes it easier to show the entire area on a map to represent the spatial pattern of vulnerability levels.

Table 4.21: Flood Vulnerability Indices of the Communities and LGAs

Community	Vulnerability index
Atani	-.17
Ossomala	-.74
Otuocha	.47
Igbariam	-1.22
Oguta	.81
Ezi-Orsu	1.03
Mmahu	-.32
Opuoma	.61
Local Government Area	
Ogbaru	-.46
Anambra East	-.38
Oguta	.92
Ohaji/Egbema	.15

Source: Researcher's computation, 2017

NB: the higher the vulnerability index, the lower the vulnerability level

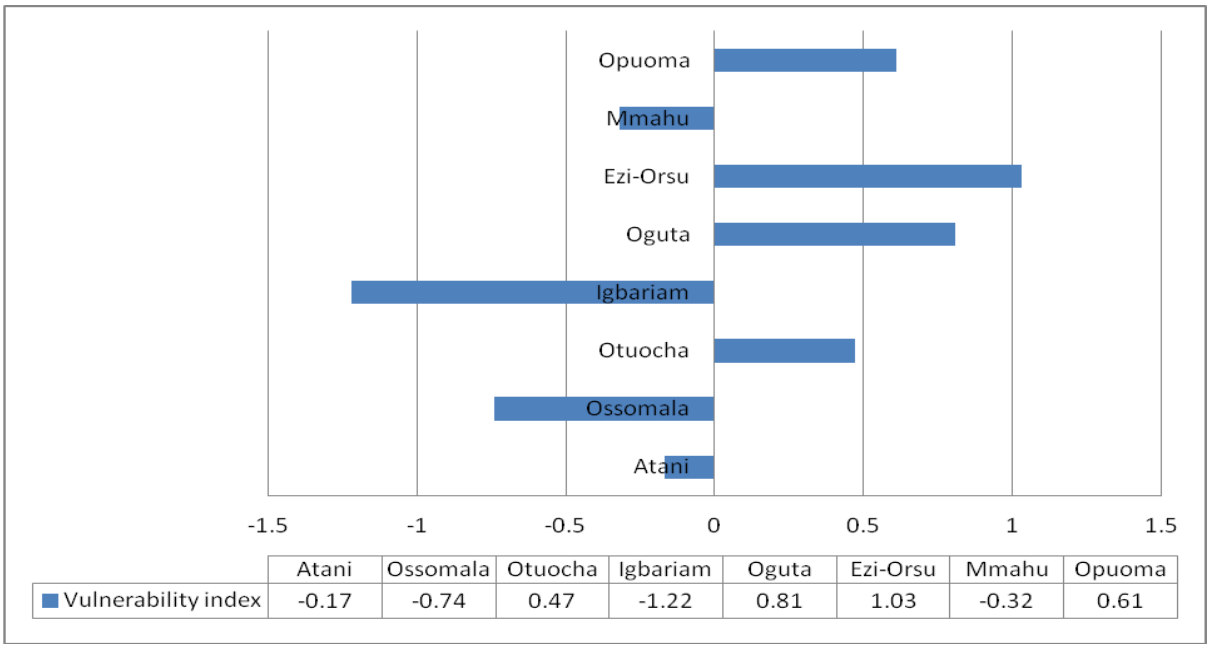


Figure 4.20: Vulnerability Indices of the Eight Communities

4.4.4 Classification of Vulnerability levels

The communities were classified by their flood vulnerability indices (Table 4.22) using Average Linkage cluster analysis classification method. Three clusters were extracted (on the basis of the FVI) from the dendrogram (tree graph) indicating three vulnerability levels in the study area (Figure 4.21). These three clusters formed the three community vulnerability levels namely; less vulnerable, moderately vulnerable and highly vulnerable. These flood vulnerability levels were named using a range of the households' vulnerability indices. The less vulnerable class has an FVI range from 0.1 to 11, the moderately vulnerable class range from -0.5 to 0.09 while the highly vulnerable class ranges from -11 to -0.6 (Table 4.22). The tree graph also reveals that the first cluster (less vulnerable group) consists of four (4) communities (Otuocha, Opuoma, Oguta, Ezi-Orsu); the second cluster (moderately vulnerable) is made up of two (2) communities (Atani, Mmahu) and the third cluster (highly vulnerable) comprises two (2) communities (Igbariam, Ossomala). Thus, Igbariam and Ossomala are known as the flood vulnerability *hotspots* in the study area. A pie chart representation of the summaries of the clusters was drawn to graphically illustrate the spatial variations in the vulnerability levels across the communities in south eastern region of Nigeria (Figure 4.22).

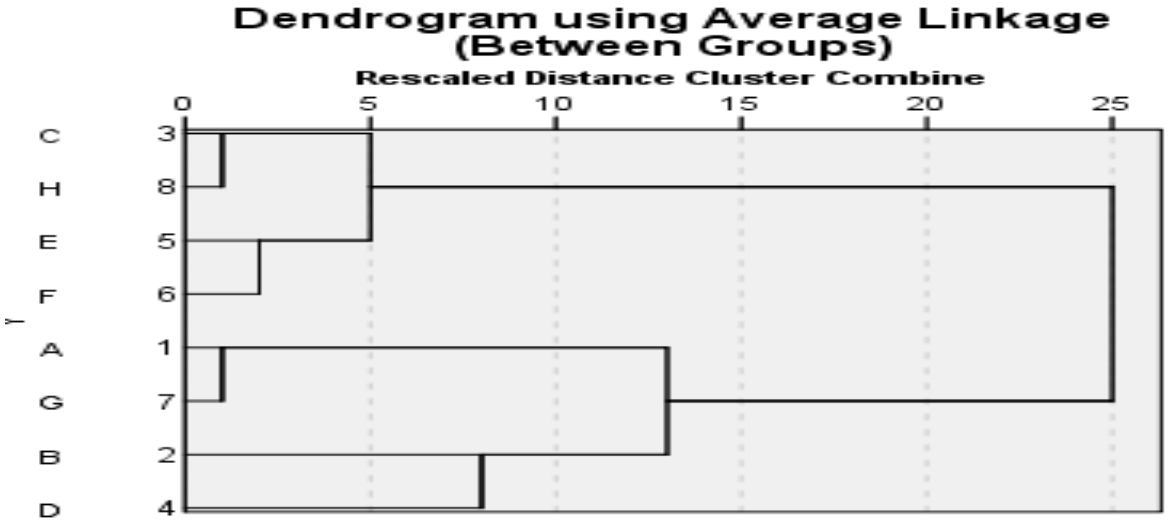


Figure 4.21: Dendrogram showing hierarchical clustering of the FVI of the 8 communities

Table 4.22: Community Flood Vulnerability Levels in SE, Nigeria

Community	Household Vulnerability Index/Level		
	Less vulnerable Index (0.1 to 11)	Moderately vulnerable Index (-0.5 to 0.99)	Highly vulnerable Index (-0.6 to -11)
Atani		✓	
Ossomala			✓
Otuocha	✓		
Igbariam			✓
Oguta	✓		
Ezi-Orsu	✓		
Mmahu		✓	
Opuoma	✓		

Source: Researcher's computation

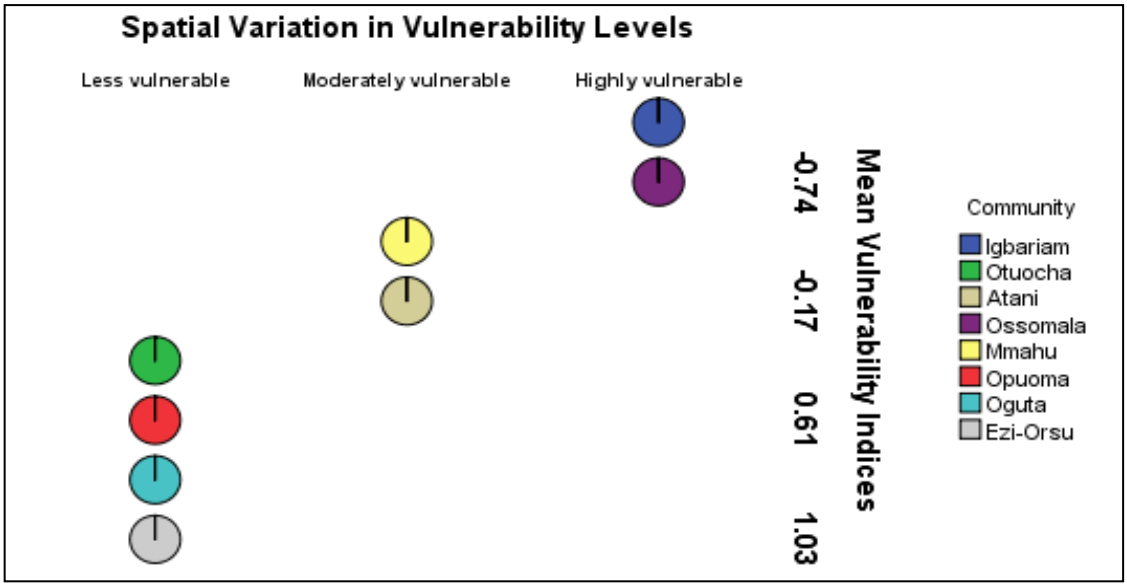


Figure 4.22: Spatial Variations in Community Vulnerability Levels

At the LGA level, a choropleth map (Figure 4.23) showing the spatial pattern in flood vulnerability levels across the four (4) LGAs was created using the mean flood vulnerability indices (FVI) of the eight (8) communities in Table 4.21.

Generally, Ogbaru and Anambra East LGAs in Anambra State were highly vulnerable while Oguta and Ohaji/Egbema LGAs in Imo State were less vulnerable to flooding and its effects. This implies that households in Imo State were less vulnerable to flooding than households in Anambra State. The reasons for the differences in vulnerability to flooding of some households have been attributed mostly to age and level of education of the household head, pre-flood awareness, phone/canoe ownership, off-farm income, private land ownership, group membership, remittance, food/aid receipt, severity of flood experienced, flood

frequency, flood depth and past flood experienced among others (Tables 4.23 to 4.25).

In addition, the spatial pattern shows that flood vulnerability increases with proximity to a river, hence the reason Anambra East and Ogbaru LGAs were relatively highly vulnerable to flooding than Oguta and Ohaji/Egbema LGAs.

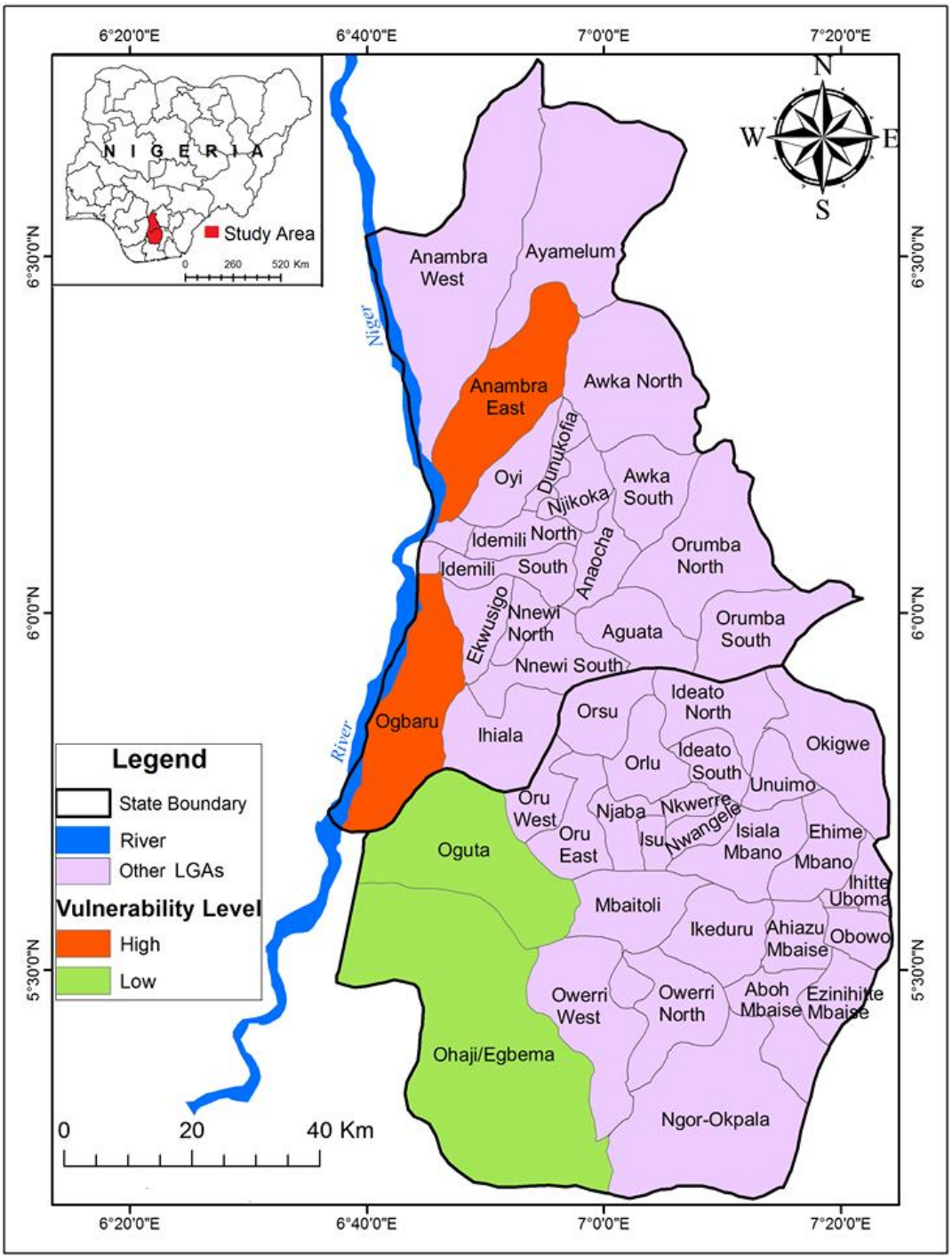


Figure 4.23: Spatial pattern in vulnerability levels across the four (4) LGAs

4.4.5 Determination of Factors that influence Household Flood Vulnerability in South East, Nigeria

The flood vulnerability indices have been used to show "who are vulnerable" but to show "why they are vulnerable", the factors influencing vulnerability and their direction of influence must be examined. In the model, Y is the dependent variable, in our case, they were three (3) categories viz; Y=1; Y=2; Y=3. Where; 1 is less vulnerable, 2 is moderately vulnerable and 3 is highly vulnerable.

X_1-X_n are the independent variables (vulnerability determinants), in this case, they were thirty-six (36). The result of the determinants of vulnerability and their significance in the South eastern region of Nigeria is shown in Table 4.23.

The factors that influenced flood vulnerability were further classified under socio-economic and environmental factors for better explanation of their percentage contribution to the levels of vulnerability to flooding in the study (Tables 4.25 and 4.26).

4.4.5.1 Results of the relationship between flood vulnerability and its determinants

The result of the regression analysis shows an intercept (constant), b_0, of 3.729 and that majority of the factors with a negative coefficient (which decreases vulnerability level) were socio-economic factors while those with a positive coefficient (which increases vulnerability level) were the environmental factors. Out of the thirty-six factors that influence flood vulnerability, only sixteen (44.4%) were statistically significant (at 0.05 level of significance) with 87.5% of them being accounted for by socio-economic factors and the remaining 12.5% attributed to environmental factors. The coefficient of determination, R^2 is .831 which means 83.1% probability of the vulnerability to flooding is explained by the model (Table 4.23).

4.4.5.2 Significant socio-economic and environmental factors and their effects on Flood vulnerability

The statistically significant ($p < 0.05$) factors influencing vulnerability to flooding and its effects were extracted from Table 4.23 above and discussed under socio-economic and environmental factors (Table 4.24). These significant factors were chosen for the reason that they did not just occur by chance.

Table 4.23: Determinants of vulnerability Coefficients[a]

Vulnerability determinants			T	Sig.
	B	Std. Error		
(Constant)	3.729	.351	10.631	<.0001
Sex of household head	.078	.060	1.287	.199
Age of household head (in years)	-.098	.024	-4.177	<.0001*
Marital status	-.003	.020	-.160	.873
Literacy rate	-.110	.080	-1.370	.171
Level of educational	-.073	.035	-2.107	.036*
Diversified income	.370	.106	3.475	.001*
Off-farm income	-.556	.099	-5.618	<.0001*
Monthly income (in Naira)	.007	.027	.242	.809
More than five dependants	-.017	.054	-.316	.752
Type of dwelling unit	.022	.016	1.330	.184
Pre-flood awareness	-.143	.029	-4.848	<.0001*
Group membership	-.132	.060	-2.191	.029*
Private land ownership	-.435	.070	-6.253	<.0001*
Food production sufficiency	-.292	.064	-4.524	<.0001*
Livestock ownership	-.057	.060	-.954	.341
Village poultry/ poultry ownership	.022	.054	.404	.686
Farm size	-.022	.013	-1.719	.086
Storage facility availability	-.466	.058	-8.075	<.0001*
Fertilizer use	-.302	.059	-5.085	<.0001*
Fertilizer subsidy	-.021	.035	-.611	.541
Irrigation practice	-.043	.093	-.458	.647
Food/aid receipt	-.117	.056	-2.087	.038*
Early warning information access	.104	.081	1.296	.196
Phone ownership	-.407	.102	-4.008	<.0001*
Radio/TV ownership	.001	.049	.027	.979
Canoe ownership	-.186	.053	-3.522	<.0001*
Access to improved water sources	-.027	.051	-.536	.592
Remittance	-.174	.061	-2.857	.005*
Access to credit	-.162	.088	-1.846	.066
Farmland flood experience	.434	.210	2.060	.040*
House flood experience	.040	.051	.784	.434
Flood frequency	-.038	.052	-.726	.468
Degree of flood experienced	.176	.058	3.038	.003*
Flood depth	-.046	.025	-1.814	.071
Affected by flood in the last one (1) year	-.072	.054	-1.335	.183
Floodable farm location	.092	.049	1.897	.059
R	.912			
R^2	.831			

a. Dependent Variable: Households vulnerability levels

*means significant at 0.05 level of significance ($P < 0.05$) in Table 4.23.

Table 4.24: Significant socio-economic and environmental factors and their effects on flood vulnerability

Variable	Effect on Vulnerability
Socio-economic variables	
Age	Negative
Level of education	Negative
Income diversification	Positive
Off-farm income	Negative
Pre-flood awareness	Negative
Group membership	Negative
Private land ownership	Negative
Food production sufficiency	Negative
Storage facility availability	Negative
Fertilizer use	Negative
Food/aid receipt	Negative
Phone ownership	Negative
Canoe ownership	Negative
Remittance	Negative
Environmental variables	
Farmland flood experience	Positive
Degree of flood experienced	Positive

Positive means the variable increases vulnerability while negative means it decreases vulnerability

4.4.5.2.1 Socio-economic factors and their effects on flood vulnerability

Majority of the socio-economic factors decreases flood vulnerability and this is true as they are mainly the adaptive capacity variables on which the vulnerability levels are dependent. Out of the twenty-nine (29) socio-economic variables perceived to influence household vulnerability to flooding and its effects, only fourteen (14) were statistically significant at 5% level of significance in the study area (Tables 4.23 and 4.24).

Cross tabulations were performed to explain the direction of the effects of these socio-economic factors on vulnerability to flooding and its effects (Table 4.25). The results show that vulnerability decreases with increasing age, level of education, off-farm incomes, pre-flood awareness, group membership, private land ownership, sufficient food production, available storage facility, use of fertilizer, receipt of food/aid in time of emergency, phone ownership, canoe ownership and financial support and increases with diversified income.

The implication was that younger heads of households were more vulnerable to flooding e.g. 100% of the highly vulnerable households had household heads within the age bracket of 20 and 29 years while 71% of the less vulnerable households had their households heads in the

ages of 60 and 69 years. The above was attributed to the fact that younger households' heads engaged solely in agricultural sources of livelihoods which were greatly affected in times of flooding. This could also be as a result of the elderly receiving financial assistance from their children and other relatives to help cushion the effects of flooding.

The study found that on overall, those with no formal education or with a primary school education were the most vulnerable with 61.2% and 59.1% households respectively, being highly vulnerable as a result of their lower or no level of education. This was due to the fact most heads of households with higher degree had acquired some formal farming techniques as well as being higher income earners holding other factors like years of farming experience constant.

The observed negative relationship between off-farm income and flood vulnerability level is expected because during flood events where and when farmlands had been affected, these households still had other non farming sources of livelihoods to sustain them as agreed by Tefera and Tefera (2014). Though, about two third (32.8%) of the highly vulnerable households got their income from other off-farm sources, it was lesser than the less vulnerable households with 62.7% getting their incomes from off-farm sources.

In the same vein, "pre-flood awareness influences the place where people reside and their flood preparedness as well as their exposure to flooding. However, the higher the number of households with high pre-flood awareness, the lower their vulnerability levels holding other factors constant" (Akukwe and Ogbodo, 2015:11; Table 3.2). This is obvious in Table 4.25 as a large proportion of highly vulnerable households had little (73.1%) or no (100%) awareness of flooding prior to their experience whereas a good number of less vulnerable households were either fairly aware (55.3%) or highly aware (72.6%) of the flooding.

Being a member of a group/association reduces one's vulnerability because "membership in a support network improves social capital of members and thereby, their resilience" (Akukwe and Ogbodo, 2015:9). This is also consistent with the findings of Blaikie et al. (1994); David et al. (2007); Adelekan (2009); Olorunfemi (2011) who argued that households that have access to resources and social networks are less vulnerable to flooding and other environmental pressures. This is evident in the study area as 62.8% of the less vulnerable households were members of one group or the other while 77% of the highly vulnerable households did not belong to any social group.

Table 4.25: Distribution of socio-economic factors influencing household vulnerability

Socio-economic variable	Component	Household vulnerability level (in Percent %)			Total
		Less vulnerable	Moderately vulnerable	Highly vulnerable	
Age	*20-29 years*	0.0	0.0	100	25
	30-39 years	30.2	10.8	59.0	83
	40-49 years	52.4	1.0	46.6	103
	50-59 years	52.4	1.2	46.4	84
	60-69 years	71.0	2.0	27.0	100
	70 years & above	40.0	20.0	40.0	5
Level of education	*Non formal*	35.9	2.9	61.2	103
	FSLC	40.0	0.9	59.1	115
	WAEC/SSCE	55.1	3.1	41.8	98
	NCE/OND	67.2	6.3	26.5	98
	B.Sc/Equivalent	76.5	17.6	5.9	17
	M.Sc/Equivalent	100.0	0.0	0.0	3
Income diversification	*No*	1.6	0.0	98.4	61
	Yes	57.5	4.2	38.3	339
Off-farm income	*No*	3.3	0.0	96.7	92
	Yes	62.7	4.5	32.8	308
Pre-flood awareness	*No awareness*	0.0	0.0	100.0	18
	Little awareness	26.1	0.8	73.1	119
	Fairly aware	55.3	5.3	39.4	150
	Highly aware	72.6	4.4	23.0	113
Group membership	*No*	19.5	3.2	77.3	128
	Yes	62.8	3.7	33.5	272
Private land ownership	*No*	17.9	5.1	77.0	235
	Yes	93.3	1.2	5.5	165
Food production sufficiency	*No*	21.2	3.9	74.9	207
	Yes	78.8	3.1	18.1	193
Storage facility	*No*	26.0	4.6	69.4	258
	Yes	90.8	1.4	7.8	142
Fertilizer use	*No*	24.6	2.7	72.7	224
	Yes	80.2	4.5	15.3	176
Food/aid receipt	*No*	53.3	3.3	43.4	304
	Yes	35.4	4.2	60.4	96
Phone ownership	*No*	0.0	4.3	95.7	23
	Yes	52.0	3.4	44.6	377
Canoe ownership	*No*	33.7	2.9	63.4	243
	Yes	72.6	4.5	22.9	157
Remittance	*No*	40.9	4.0	55.1	303
	Yes	74.2	2.1	23.7	97

Source: Researcher's computation, 2017

Private land ownership, sufficient food production, available storage facility and fertilizer use relate to farming activities which most households depend upon for survival. The inverse relationship between these factors and vulnerability shows that household that own land; produces sufficient food for themselves; have access to storage facilities and use fertilizer are less vulnerable to the effects of flooding. For instance, assuming flooding occurred and caused a decrease in crop harvest, if the cultivated land belongs to the affected household, then only the brunt of reduced crop harvest would be bored while it would mean more losses for households that rented the land.

A good number of farmers cultivate the same piece of land annually thereby reducing crop yield, therefore fertilizer use is needed to increase crop yield and productivity and invariably increase the resources (money) to cushion the negative effects of flooding. Sufficiency in own food production has a related importance to fertilizer use and private land ownership on reducing the effects of flooding. Storage facility availability reduces the rate at which households sold their harvested produce (which were usually sold at cheaper rates when there is no storage facility to avoid losses), thereby reducing the vulnerability of households to the effects of flooding.

Receipt of food/aid helps in reducing household vulnerability to flooding as well as improving the resilience of flood affected households as it plays a safety net role. This assistance came from either the government or other group/association members (e.g. Kinship network, religious group). A high percentage (60.4%) of the highly vulnerable households had received one or two forms of assistance, perhaps as a result of them being highly vulnerable and being the most affected by flood in the past than the less vulnerable households with a low percentage (35.4%) of food/aid receipt.

The “ownership of phone/TV is a measure of access to technology which is necessary as a means of being informed on impending flood hazards” as observed by Akukwe and Ogbodo (2015:10). This was one of the least significant socio-economic factors that influence household vulnerability because generally, only a small proportion of households (5.8%) did not own a phone.

Canoe ownership improves movement during flooding and minimizes the effects of flooding as households could migrate to safer land on reduced cost. Though canoe is a necessary asset in the flood prone communities of the study area, not all household owned one, thereby

making households that could afford one less vulnerable to flooding and its effects. Majority of the households that owned a canoe fell in the less vulnerable (72.6%) category whereas majority (63.4%) that did not own one fell in the highly vulnerable category.

Remittance in terms of financial support cushions the effects caused by flooding and reduces further vulnerability to flooding. This implies getting monetary assistance elsewhere without a pay back as it is with the case of loan. The findings reveal that the more remittance a household got, the less vulnerable they were.

Contrarily, income diversification was found to have a positive effect on household flood vulnerability when it was expected to have a negative effect. This implies that the more diversified income a household had, the more vulnerable they were. The reason was because a large proportion of households despite their vulnerability levels had more than one income sources related to agricultural activities which were also affected during flood events. This is in consonance with the findings of Devereux (2007) who noted more diversified households and economies to be less vulnerable to the direct impacts of droughts and floods, as long as their alternative income sources are neither in any way dependent on agriculture nor rainfall.

4.4.5.2.2 Environmental factors and their effects on vulnerability

These are mostly the biophysical variables that influence household vulnerability to flooding and its effects. The environmental factors are expected to have a positive relationship with household vulnerability, meaning they are expected to increase flood vulnerability. Seven (7) environmental factors were identified to influence vulnerability but only two (2) were statistically significant viz; farmland flood experience and severity of flood.

There exists a direct relationship between flood experience and vulnerability level because

people tend to be vulnerable if they had experienced flood more than those who have never. Correspondingly, the higher the flood severity perceived in terms of degree of damage, the higher the vulnerability to flooding and its effects. Table 4.26 shows that majority of the households had experienced flooding in their farmlands and had experienced highly severe flood which corroborates the findings of Ajaero and Mozie, 2014.

Table4.26: Distribution of environmental factors influencing household vulnerability (n=400)

Socio-economic variable	Component	Household vulnerability level (in Percent %)			Total
		Less vulnerable	Moderately vulnerable	Highly vulnerable	
Farmland flood experience	*No*	40.0	0.0	60.0	5
	Yes	49.1	3.5	47.3	395
Flood severity	*Mild*	46.2	0.0	53.8	13
	Moderate	50.5	2.7	46.8	111
	Severe	48.6	4.0	47.5	176

Source: Researcher's computation, 2017

4.4.6 Hypothesis testing: Variations in household vulnerability to flooding

Analysis of variance (ANOVA) was used to test the null hypothesis: "there is no significant difference in the vulnerability of households to flooding in the various agrarian communities" at 0.05 level of significance. The result of the ANOVA shows a statistically significant difference in the household vulnerability to flooding because the calculated Snedecor's F test value (49.662) is greater than the critical F test value (1.394) and the hypothesis was rejected (Table 4.27). The *p*-value for 49.662 is <.0001, so the test statistic is statistically significant at 0.05 level of significance. These variations in the household vulnerability levels are a function of the various factors (social, economic and environmental) earlier discussed.

Table 4.27: ANOVA[a] for variations in household vulnerability to flooding

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	320.779	36	8.911	49.662	<.0001[b*]
	Residual	65.131	363	.179		
	Total	385.910	399			

*means significant at 0.05 level of significance

a. Dependable variable: Household vulnerability levels

b. Predictors: (Constant), Floodable farm, Access to credit, Marital status, Canoe ownership, flood experienced in farmland, Food/Aid receipt, fertilizer subsidy, remittance, poultry farm ownership, affected by flood in the last one (1) year, early warning, flood frequency, phone ownership, livestock ownership, Radio/TV ownership, pre-flood awareness, access to potable water, dependency ratio, flood experienced in area of residence, irrigation practice, diversified income, flood severity, literacy rate, group membership, storage facility availability, type of dwelling unit, fertilizer use, sufficient own food production, sex, age, farm size, flood depth, monthly income, private land ownership, level of education, off-farm income.

One-way Analysis of Variance (ANOVA) was also run to test the variations between female-headed households and male-headed to vulnerability to flooding. Table 4.28 shows that there were significant differences in vulnerability to flooding between female-headed households and male-headed households since the calculated F value (66.245) is greater than the critical

F value (1.394) and the *p*-value for 66.245 is <.0001, meaning the differences are significant at 5% level.

Table 4.28: ANOVA Table between household vulnerability and Sex of household heads

Households vulnerability levels * Gender		Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)	55.067	1	55.067	66.245	<.0001*
Within Groups		330.843	398	.831		
Total		385.910	399			

*means significant at 0.05 level of significance

4.5 Food Security Situations and Determinants

Food security is conceptualized in this study to exist when households have adequate physical food for consumption as well as have the social or economic access to sufficient food for healthy life. This food security has four dimension namely; food accessibility, food availability, food utilization and stability (FAO, 2008a). However, in order to capture the multidimensional nature of food security in this study, household food availability was measured using sufficiency in own food production while stability was measured using irrigation agriculture practice since the sampled households were largely agrarian. Households' food accessibility and utilization were measured using per capita food expenditure and Food Consumption Score (FCS) respectively. The general food security situation was calculated using the Household Food Security Survey Module (HFSSM) developed by the United States Department of Agriculture (USDA) since it includes virtually all of the food security dimensions and could be used to show the percentages of households that are food secure and food insecure with/without hunger.

4.5.1 Food Security Assessment: Food Accessibility Dimension

Food accessibility is a measure of the ability to obtain/secure food. This was determined by affordability of food and money spent on food. Monthly food expenditure were analysed and on average households in Southeastern Nigeria spent fourteen thousand, two hundred and twenty-two Naira (₦14,222.00) per month on food.

The minimum monthly food expenditure is four thousand Naira (₦4,000) only while the maximum is twenty-eight thousand Naira (₦28,000) only. A high proportion (41%) of households spent between sixteen to twenty thousand Naira (₦16,000 to 21,000) monthly on

food and about a quarter (13.8%) indicated to have spent between four thousand to nine thousand Naira (₦4,000 to 9,000) monthly on food (Table 4.29).

In order to analyse the food accessibility dimension of food security, firstly, the per capita monthly food expenditure for each household was calculated by dividing the monthly food expenditure by the household size. Secondly, the per capita monthly food expenditure was divided by the 2/3 mean of the monthly food expenditure of all the households. Thirdly, households were categorised into food secure (calculated value ≥ 1) and food insecure (calculated value <1) (see methodology for details).

Table 4.29: Households' monthly food expenditure (n = 400)

Monthly food expenditure (in Naira)	Percent (%)
4000-9000	13.7
10000-15000	40.0
16000-21000	41.0
22000-28000	5.3
Mean	₦14222.00

Source: Researcher's computation, 2017

Table 4.30 shows the food security index (FSI) from food accessibility dimension using per capita monthly food expenditure. Oguta community recorded the highest number of food secure households with over two third (68.3%) of households being food secure. The reason for Oguta being the most food secure community is largely due to the fact that Oguta recorded relatively high per capita monthly food expenditure with associated low dependency ratio, the reverse is the case with Ossomala community with the highest number (67.2%) of food insecure households.

The headcount ratio which represents the percentage of households which are either food secure or food insecure, shows that more than half (53.5%) of all the households in the study area were food insecure with respect to their monthly food expenditure while 46.5% were food secure.

Analysis of the within community food security categories with respect to households' monthly food expenditure is represented in the graph below (Figure 4.24). Amongst the food insecure households across the eight communities, Ossomala recorded the highest with 20.1% of her households being food insecure in the entire south eastern region of Nigeria. Ossomala is followed by Atani that had about 17.3% food insecure households across the region. Oguta and Ezi-Orsu communities had the least number of food insecure households

(6.1% and 8.9% respectively). It could be deduced from the graph that Ogbaru LGA (Atani and Ossomala) was the most food insecure and Oguta LGA (Oguta and Ezi-Orsu) was the least food secure as regards food accessibility in the study area.

Table 4.30: Household food security status using per capita monthly food expenditure

Community	Food Security category (in Percent %)		Total
	Food insecure	Food secure	
Atani	57.8	42.2	64
Ossomala	67.2	32.8	64
Otuocha	52.3	47.7	44
Igbariam	60.5	39.5	43
Oguta	31.7	68.3	41
Ezi-Orsu	47.5	52.5	40
Mmahu	51.9	48.1	52
Opuoma	50.0	50.0	52
Total	53.5	46.5	400
Headcount Ratio (HR)	53.5%	46.5%	100.0%

Source: Researcher's computation, 2017

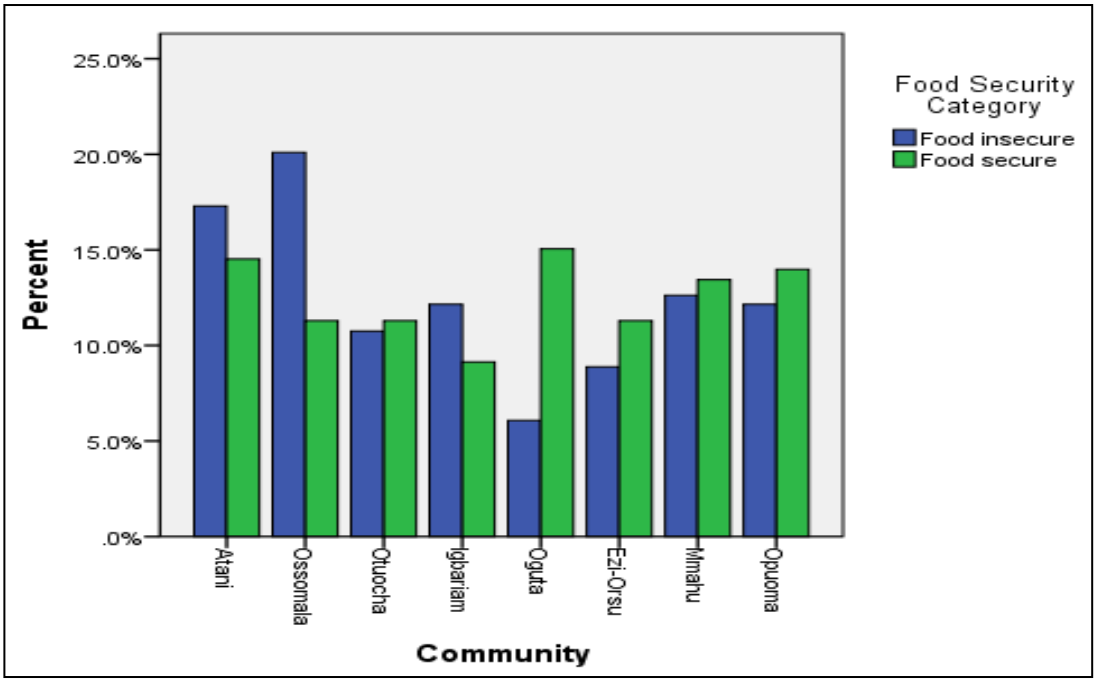


Fig. 4.24: Community food security category based on per capita monthly food expenditure

4.5.2 Food Security Assessment: Food Availability Dimension

4.5.2.1 Food Sources and Sufficiency in Own Food production

Food sources influence household consumption pattern and it could be used to determine households' vulnerability to food insecurity. Most households rely on their own food production for consumption and livelihood as evident in Figure 4.5, where 13.8% and 10.5% respectively indicated to have no other sources of livelihood apart from farming and other sources of livelihood related to agricultural activities (e.g. fishing). Not only did the households rely on their own food production, 48.2% households claimed to have produced enough food for their households. There was a clear correlation between sufficiency in own food production and food security as households that produced enough for themselves were found to be less vulnerable to food insecurity.

The sources of food were analysed to show the sources of households' food consumption. A large proportion (55.8%) of households food consumption were mainly from their own production which is not unexpected given that majority of the households are agrarian, while 44.2% consumed both food from their own production and those purchased from the market (Table 4.31). Households that mostly depend on their own food production were more vulnerable to flood-induced food insecurity as a result of crop failure, hence the reason for the observed high food insecurity during flooding in the study area.

Table 4.31: Distribution of food sources and Sufficiency in own food production

Food sources	Own production	Own production and market	Total
	55.8	44.2	400
Sufficiency in own food production	Yes	No	
	48.2	51.8	400

Source: Researcher's computation, 2017

4.5.3 Food Security Assessment: Food Utilization Dimension

"Food utilization refers to the use of food and how a person is able to acquirere essential nutrients from the food consumed. It covers the nutritional value of the diet, including access to potable water; its composition and methods of preparation and safety of food" (FAO, 2008:9).

The Food Consumption Score (FSC) was used to assess the food utilization dimension of food security since it can be used as a proxy for current food security. The "FCS is a composite score based on dietary diversity, food frequency, and the relative nutritional

importance of different food groups over a recall period of seven days" (WFP, 2008:1; Kuku-Shittu et al., 2013), though it does not provide the precise quantities of nutrient intake. Table 4.32 shows the food items classified under each food group and the weights used in calculating the FCS.

Table 4.32: The Frequency Weighted diet diversity score (Food Consumption Score)

S/N	"Food Items (examples)	Food groups (definitive)	Weight (definitive)
1	Maize, maize porridge, rice, sorghum, millet, pasta, bread and other cereals. Cassava, potatoes and sweet potatoes, other tubers, plantains	Main staples	2
2	Beans, peas, groundnuts and cashew nuts	Pulses	3
3	Vegetables, leaves	Vegetables	1
4	Fruits	Fruits	1
5	Beef, goat, poultry, pork, eggs and fish	Meat and Fish	4
6	Milk yogurt and other diary	Milk	4
7	Sugar and sugar products, honey	Sugar	0.5
8	Oils, fats and butter	Oil	0.5
9	spices, tea, coffee, salt, fish power	Condiments "	0

Source: WFP (2008:3).

Discussion

Generally, the household diet consists mainly of carbohydrates and this is in consistence with the findings of Kuku-Shittu et al. (2013). It was found that wealthier households consumed proteins (both plant and animal-based) on average of 3-4 days per week whereas the poorer household consume protein (especially plant-based) on average of 2 days per week.

Two standard thresholds distinguish the three food consumption levels viz; 21 and 35.

An FCS below 21 assumes a daily consumption of staple and vegetables by a household, which is considered a poor diet. Households with a recorded FCS between 21.5 and 35 known as the borderline food consumption consists of those with a daily consumption of staple and vegetables complemented by consumption of oil and pulses (with an exception of proteins especially animal proteins) by a frequency of four days per week (WFP, 2008).

In addition, households with an FCS of above 35 have the acceptable diet due to its high dietary diversity i.e. all the food groups were consumed by a frequency of at least four days per week.

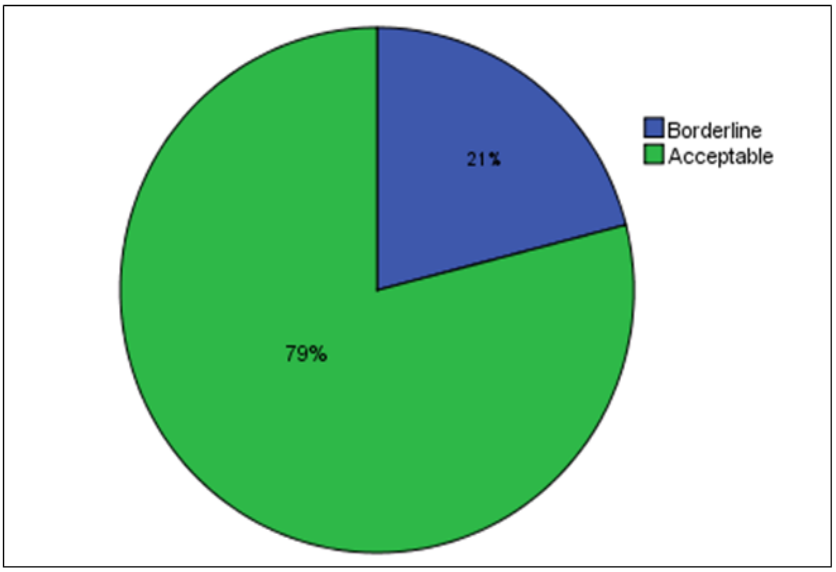


Figure 4.25: Food Consumption Score categories

The FCS calculations for households in south eastern, Nigeria revealed 21% borderline food consumption and 79% acceptable food consumption scores without any household considered to have a poor diet (Figure 4.25). This implies that 79% of the households recorded a high dietary diversity, meaning majority of the households consumed all food groups at least four days per week. It also reflects a high food frequency. Households that recorded a high food frequency (at least four days per week) in all food groups except in animal proteins consumption were 21%. It could be inferred from the results that more than three quarters (79%) of households were not vulnerable to food insecurity in terms of their food consumption scores within a recall period of seven days.

The reasons for most households recording high FCS have been attributed largely to their dependence on agricultural activities for their livelihoods as well as on their own food production (with 55.8% households dependent on their own food production); meaning households consumed mostly what they produced.

Figure 4.26 illustrates a disparity in FCS across the eight communities. The figure shows that within the 21% households with a borderline FCS, the highest percentage (25%) were in Ossomala community while Ezi-Orsu community recorded the lowest of 4.8%. There was relatively an even distribution of households with an acceptable FCS across the communities as shown in the figure. For these households (79%) within the acceptable diet, Atani community consisted of the largest proportion of 16.1% and Oguta community had the

smallest proportion of households (9.5%). The reason for this disparity is related to their sufficiency in own food production.

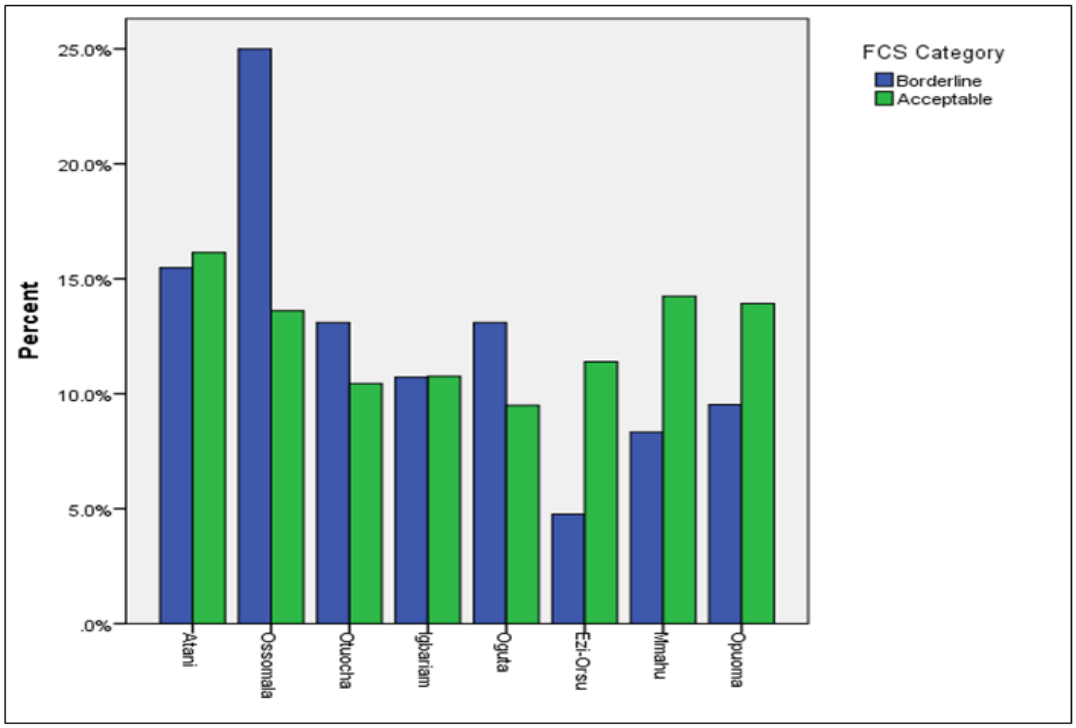


Figure 4.26: Distribution of household Food Consumption Scores (FCS)

4.5.4 Food Security Assessment: Stability Dimension

Dependencies on rain-fed agriculture or irrigation were used as a proxy to determine the stability dimension of food security in the study area. The analysis of data disclosed that majority of the households (88.5%) depended solely on rain-fed agriculture leading to seasonal harvest of most crops produced in the area which are usually affected because their harvest season (July to October) run concurrently with the seasonal occurrence of floods. Only few (12%) households have been able to harvest flood waters for post flood farming while only 11.5% households practised irrigation agriculture in addition to rain-fed agriculture (Table 4.33).

Table 4.33: Agricultural practices (n = 400)

Agriculture type	Percent (%)	
	Yes	No
Rain-fed	88.5	11.5
Mixed (Irrigation and rain-fed)	11.5	88.5
Post flooding	12.0	88.0
Irrigation and post flooding	6.0	94.0

Source: Researcher's computation, 2017

The over-dependence of households on rain-fed agriculture increases their vulnerability to flooding and food insecurity as agreed by Obayelu, 2010; Orewa and Iyanbe 2009; Kuku-Shittu et al., 2013 who opined that sole dependency on rainfall with little or no irrigation systems has resulted in poor agricultural output and food insecurity in Nigeria. Irrigation agriculture practice on the other hand, if largely practised would have helped in off-season planting as well as in reduction of the effects of flood on food productivity, thereby improving income generation and food security for households.

4.5.5 Comprehensive Household food security status/level: A USDA Approach

The Household Food Security Survey Module (HFSSM), developed by the United States Department of Agriculture (USDA) which categorizes households using a constructed food security scale was adopted for assessing the food security status of households. The scale measures different severity of food insecurity as well as food secure condition. The scale scores range from 0 to 10. Households with a scale value of zero (0) represent the absence of the measured condition while those with a scale value of near ten (10) have the most severe condition, represented by presence of all the available indicators (Bickel et al., 2000). The measured conditions and indicators are the eighteen (18) questions shown in Figure 3.2.

The result of the food security indices computed using the Rasch analysis in the methodology section and categorized using the categorical measure in Figure 3.3 are shown in Table 4.34.

Table 4.34: Differential household food security status/levels

Community	Category of food security status/level (in percent %)				Total
	Food Secure	Food insecure without Hunger	Moderately food insecure with hunger	Severely food insecure with hunger	
Atani	37.5	37.5	9.4	15.6	64
Ossomala	25.0	45.3	20.3	9.4	64
Otuocha	43.2	40.9	13.6	2.3	44
Igbariam	25.6	34.9	20.9	18.6	43
Oguta	26.8	43.9	9.8	19.5	41
Ezi-Orsu	30.0	35.0	20.0	10.0	40
Mmahu	44.2	34.6	3.9	17.3	52
Opuoma	32.8	48.1	3.9	15.4	52
Total (mean)	33.3	40.2	13.0	13.5	400

Source: Researcher's computation, 2017

4.5.6 Differential household food security status/levels

The score position of households on the food security scale is based on the overall pattern of response to the complete set of indicators by the households (Bickel et al., 2000). A large proportion of households' position on the scale was between 2.33 and 10 implying a high level of food insecurity. In general, one third of households in south eastern Nigeria were food secure with 40.2% households being food insecure without hunger. As regards households that were food insecure with hunger, 13% were moderately food insecure with hunger whereas 13.5% were severely food insecure with hunger. This implies that about two third of households in the study were food insecure while the remaining (one third) were food secure.

Discussion

4.5.6.1 Food secure households

Food secure households are those that reported very limited or no food insecurity or hunger experiences and had very low scores ranging from 0-2.32 on the food security scale. This is as a result of fewer affirmative responses to the structured food security questions.

Mmahu community recorded the highest percentage (44.2%) with food secure households and Ossomala community recorded the lowest (25%). Food secure households in Otuocha community accounted for 43.2% making it the second most food secure community after Mmahu. Atani, Opuoma and Ezi-Orsu communities in a decreasing order constituted households with the "food secure" status of ≥30%. More than a quarter of households in Oguta and Igbariam were food secure. This implies that a larger proportion of households in Mmahu, Otuocha, Atani and Opuoma communities had minimal evidence of food insecurity than were households in Ezi-Orsu, Oguta, Igbariam and Ossomala (Table 4.34).

The high food security level of these communities could be attributed to a majority of their households being headed by married people who were males and had other sources of livelihoods which generated off-farm income. In addition, a substantive number of them were high income earners who owned livestock/poultry with larger farm sizes as well as practised irrigation. They also had received financial support and had nutrition knowledge.

4.5.6.2 Food insecure without hunger households

Households in this category reported little or no reduced food intake of their members. These households had concerns as regards adequate food supply and household food management

as well as felt anxious about their food being sufficient to meet basic needs (Bickel et al., 2000; Ibok, Idiong et al., 2014) but, there was no presence of hunger among their members. This category's score ranges from 2.33 - 4.56 on the food security scale.

The majority of households across the eight communities fall into this category, with a percentage representation of more than one third of households in each community. Opuoma, Ossomala, Oguta and Otuocha had more than 40% households termed "food insecure without hunger" while Atani, Ezi-Orsu, Igbariam and Mmahu accounted for over 30% each of households in this category. This for instance shows that about half (48.1%) of households in Opuoma had inadequate food supplies and food budget as well as felt the anxiety of not having sufficient food and these were experienced least in Mmahu community.

4.5.6.3 Moderately food insecure households with hunger

Households in this category have affirmative responses to at least three adult hunger indicators/questions. Adults in this category had repeatedly experienced the physical sensation of hunger due to reduction in their food intake while their children in most cases had no such experience. The scale scores of this category fall between 4.57 and 6.53 on the food security scale. Adults in households in Igbariam, Ossomala, Ezi-Orsu and Otuocha communities who had experienced hunger were 20.9%, 20.3%, 20% and 13.6% respectively. Similarly, 9.8% and 9.4% households in Oguta and Atani comprised adults who had experienced reduced food intake whereas each of Mmahu and Opuoma communities have had 3.9% households of adults with reduced food intake as a result of insufficient food supply and funds to acquire more.

4.5.6.4 Severely food insecure households with hunger

Households in this category had repeatedly reduced food intake for all their members (adults and children). This implies that both adults and children experienced hunger, and the scale scores for this category range from 6.54–10.0 on the food security scale. This is the most extreme of all the categories consisting of households that have given an affirmative response to a large number of the severe conditions.

Otuocha community had the smallest number (2.3%) of severely food insecure households with both adults and children who had experienced hunger while Oguta community had the largest number (19.5%) of households followed by Igbariam with 18.6% in this category. A smaller number (9.4%) of households in Ossomala fall into this category with 17.3%, 15.6%,

15.4% and 10% of households in Mmahu, Atani, Opuoma and Ezi-Orsu having had both their adults and children repeatedly reduced their food intake as a result of insufficient food, inadequate food supply and no resources to acquire more food. Households in this category are the *food insecurity hotspots* that would need some assistance for them to cope in times of food shortage.

4.6 Determinant of Household Food Security in South eastern Nigeria

A binary logistic regression was run to examine the significance of the determinants of food security in the study area. Food security status was the dependent variable, Y, (p/1-p), while its determinants were the independent variables, X. Expressed in terms of the variables used in our study, the binary logistic regression equation is given as;

Log (p/1-p) = a + b_1x_1+...$b_{25}x_{25}$ (see methodology).

The Cox and Snell, coefficient of determination, R^2 is .426 which means 42.6% probability of the food security status is explained by the logistic model, and with an 82.5% correct classification, the model is good. The Log likelihood Ratio (LR) showed by the Chi-Squared test statistic (286.408) was significant at 5% level, meaning that the independent variables in the model explained the probability of the household food security status reasonably.

The result of the Logistic Regression Analysis showing the relationship between household food security status and its determinants is shown in Table 4.35. Twenty-five (25) variables were hypothesized as determinants of food security status in the study area. Out of these 25 variables, only eleven (11) were statistically significant at 5% level of significance (Table 4.35). The statistically significant variables that influence household food security status in Southeastern, Nigeria are; sex, marital status, level of education, off-farm income, monthly income, dependency ratio, sufficiency in food production, livestock ownership, village poultry/poultry ownership, irrigation practice and flood experience.

4.6.1 Sex

Sex had a positive and statistically significant relationship with food security at 5% level, indicating that male headed households were more food secure than their female headed counterparts. This may be as a result of men having more access to land which increases their own crop production as well as their food security since most of the respondents produced their own food. This could also be ascertained as most male headed households accounted for

higher percentages of households with high level of education and income which also have a positive relationship with food security. This is consistent with the findings of Omonona et al. (2007); Olagunju et al. (2012) and Yusuf et al. (2015) in Nigeria; Zakari et al. (2014) and Kassie et al. (2015) who found food insecurity incidence to be higher in female headed households in Niger Republic and Malawi respectively, but contrary to the findings of Ojogho (2010) and Ajaero (2017).

Table 4.35: Logit model output of determinants of food security status

Factors influencing food security	B	S.E.	Wald	df	Sig.	Exp(B)
Sex of household head	.945	.433	4.763	1	.029*	2.572
Age of household head	-.128	.163	.615	1	.433	.880
Marital status	.381	.142	7.239	1	.007*	1.464
Literacy rate	-.616	.581	1.124	1	.289	.540
Level of education	.502	.260	3.715	1	.054*	1.652
Diversified income	.206	.854	.058	1	.810	1.228
Off-farm income	1.432	.679	4.454	1	.035*	4.189
Monthly income	.680	.192	12.533	1	<.0001*	1.973
Dependency ratio	.879	.389	5.115	1	.024*	2.410
Group membership	-.197	.428	.211	1	.646	.822
Private land ownership	-.455	.454	1.004	1	.316	.635
Sufficiency in own food production	1.068	.430	6.175	1	.013*	2.908
Livestock ownership	.893	.410	4.743	1	.029*	2.443
Village or Agric. poultry ownership	.839	.386	4.711	1	.030*	2.314
Distance to farm	-.530	.434	1.489	1	.222	.589
Distance to market	.373	.382	.953	1	.329	1.451
Storage facility availability	-.019	.383	.003	1	.959	.981
Fertilizer use	.564	.373	2.293	1	.130	1.758
Irrigation practice	1.997	.659	9.193	1	.002*	7.367
Food/Aid receipt	.333	.397	.705	1	.401	1.395
Nutrition knowledge	.807	.536	2.265	1	.132	2.241
Farm size	.036	.300	.014	1	.906	1.036
Financial support	.328	.391	.704	1	.401	1.388
Credit access	-.540	.585	.850	1	.356	.583
Flood Experience	-1.110	.337	10.868	1	.001*	.330
Constant	-7.305	1.555	22.084	1	.000	.001
-2 Log likelihood	286.408					
Cox and Snell R^2	.426					
Nagelkerke R^2	.592					

* Significant at 0.05 level of significance ($P \leq 0.05$)

The odds ratio of sex of household heads was 2.572 implying that male-headed households (MHHs) are 2.572 times more likely to be food secure than female-headed households (FHHs) (Table 4.35). This is evident in Table 4.36 where 34.2% of MHHs were food secure as opposed to 32% of FHHs while only 6.2% of the MHHs were severely food insecure and 22.9% of FHHs were severely food insecure.

4.6.2 Marital Status of head of household

Marital status was statistically significant at 5% and the coefficient revealed that households headed by married people had the likelihood of being more food secure than those headed by single people, and this in line with the findings of Sekhampu (2013) who reported married respondents in Kwakwatsi, South Africa being more food secure than unmarried respondents as well as in consistence with the findings of Magaña-Lemus et al. (2013) in Mexico; Djangmah (2016) in Ghana; Habyarimana (2015) in Rwanda and Yusuf et al. (2015) in Nigeria. The reason for married people being more food secure could be traced to relative contributions (e.g. financial, labour wise) of married couples which increases different dimensions of food security. Contrarily, the findings of Aidoo et al. (2013) showed that household food security for unmarried respondents was relatively more than their married counterparts. The odds ratio revealed that married people-headed households are 1.464 times probable to be food secure than unmarried people-headed households (Table 4.35). Table 4.36 shows that 33.3% households headed by married people were more food secure while only 6.5% of those headed by unmarried people were food secure.

4.6.3 Level of Education of head of household

There was a positive and statistically significant (5%) relationship between level of education of head of household and food security of households, indicating that food security increases with higher level of education and vice versa. The odds ratio implies that with each unit increase in level of education, the probability of households to be food secure increases by 1.652 times (Table 4.35). Education has been viewed as a social capital which influence production and nutritional decisions (Ibok, Bassey, et al., 2014), so it is not surprising that more educated households in the study area were more food secure. The result agrees with those of Babatunde et al. (2007); Nyangwesoi et al. (2007); Omonona et al. (2007); Asogwa and Umeh (2012); Bashir et al. (2012); Olagunju et al. (2012); Henri-Ukoha et al. (2013); Ibok, Bassey, et al. (2014); Tefera and Tefera (2014); Wiranthi et al. (2014); Mungai (2014);

Table 4.36: Distribution of factors influencing household food security in SE, Nigeria

Food security determinants	Component	Food security category (in Percent %)			
		Food secure	Food insecure without hunger	Moderately food insecure with hunger	Severely food insecure with hunger
Sex	Male	34.2	41.8	17.8	6.2
	Female	32.0	38.2	6.9	22.9
Marital status	Single	6.5	61.2	19.4	12.9
	Married	33.3	40.3	14.0	12.4
	Divorced	80.0	20.0	0.0	0.0
	Separated	59.3	25.9	0.0	14.8
	Widowed	31.6	38.0	12.7	17.7
Level of education	No formal	29.1	42.7	11.7	16.5
	FSLC	22.6	40.0	15.7	21.7
	WAEC/SSCE	28.6	44.9	15.3	11.2
	OND/NCE	50.0	37.5	10.9	1.6
	B.Sc/Equivalent	82.4	17.6	0.0	0.0
	M.Sc/Equivalent	100.0	0.0	0.0	0.0
Off-farm income	No	10.9	47.8	10.9	30.4
	Yes	39.9	38.0	13.6	8.5
Monthly income	< 15,000	2.1	39.4	13.8	44.7
	15,001-30,000	26.2	55.2	12.4	6.2
	30,001-45,000	45.6	33.3	17.8	3.3
	45,001-60,000	64.7	26.5	8.8	0.0
	60,001-75,000	70.8	20.8	8.4	0.0
	75,001-90,000	100.0	0.0	0.0	0.0
	>90,000	100.0	0.0	0.0	0.0
More than 5 dependants	No	27.9	45.1	16.4	10.6
	Yes	41.7	32.7	7.7	17.9
Sufficient food production	No	11.1	45.9	17.9	25.1
	Yes	57.0	34.2	7.8	1.0
Livestock ownership	No	26.9	41.9	15.0	16.2
	Yes	52.5	35.3	7.1	5.1
Village or agric. Poultry ownership	No	30.5	43.4	12.9	13.3
	Yes	39.7	33.1	13.2	14.0
Fertilizer use	No	18.3	46.9	13.4	21.4
	Yes	52.3	31.8	12.5	3.4
Irrigation practice	No	26.8	44.1	13.8	15.3
	Yes	82.6	10.9	6.5	0.0
Flooding	No	42.6	28.9	15.8	12.7

Source: Researcher's computation, 2017

Mutinda (2015); Ajaero (2017) and Dawit and Zeray (2017) who revealed that more educated households are more food secure, though contrary to the findings of Yusuf et al. (2015) and Djangmah (2016), who noted a significant negative relationship between food security and number of years spent in education in Nigeria and Northern region of Ghana respectively. The evidence is obvious in Table 3.36 where respondents with Master's and Bachelor's degrees or their equivalent were 100% and 82.1% food secure respectively while households headed by people with no formal education were only 29.1% food secure.

4.6.4 Off-farm Income

The coefficient of off-farm income was positive and significant at 5% implying that the higher the household off-farm income, the higher the likelihood of that household to be food secure. Household's off-farm income will increase the food security status of that household by the factor 4.189 (Table 4.35). This could be attributed to the fact that off-farm income shows that agrarian households have diversified their sources of livelihoods (e.g. teaching, construction labourers, trading, basket weaving) away from farming activities which has a positive effect on food security because the income helps in times of flood-induced food insecurity with associated food shortage. In addition, off-farm income could be invested in agriculture to increase crop production as well as household food availability concurring with the findings of Asogwa and Umeh (2012) and Olagunju et al. (2012) in Nigeria; Aidoo et al. (2013) and Djangmah (2016) in Ghana; Mitiku et al. (2012); Tefera and Tefera (2014) and Dawit and Zeray (2017) in Ethiopia, and Wiranthi et al. (2014) in Indonesia.

The relationship between off-farm income and food security was further illustrated in Table 4.36 where 39.9% of households with off-farm income were food secure and only 10.9% without off-farm income were food secure.

4.6.5 Monthly Income of head of household

The coefficient of monthly income was positive and statistically significant at 5% level. This implies that the higher the household monthly income, the more the level of food security, and the lower the household monthly income, the more food insecure they are. The odds ratio in favour of households to be food secure increased by 1.973 times by every increase in monthly income (Table 4.35). This could be ascertained as income remains a very crucial factor that influences accessibility and availability of food as also supported by Battersby (2011) who noted income to make a significant difference in reducing (though not eliminate

totally) food insecurity. Similar findings of a positive relationship between income and food security were reported by Omotesho et al. (2006) ; Omonona et al. (2007); Arene and Anyaeji (2010); Battersby (2011); Bashir (2012); Aidoo et al. (2013); Henri-Ukoha et al. (2013); Sekhampu (2013); Mungai (2014); Mutinda (2015) and Djangmah (2016). Only 2.1% of households with <15,000 Naira monthly were food secure while 100% of all the households that earned 75,000 Naira and above monthly, were food secure, meaning none were food insecure (Table 4.36).

However, the presence of food secure and different levels of food insecure categories across households irrespective of their monthly income suggests that income is not the only determinant of food security in study area.

4.6.6 Dependency Ratio of household

The coefficient of dependency ratio was positive and statistically significant at 5%. Contrary to the findings of several researchers (Omonona et al., 2007; Ojogho, 2010; Asogwa and Umeh, 2012; Aidoo et al., 2013; Sekhampu, 2013; Ibok, Bassey, et al., 2014; Mutinda, 2015; Djangmah, 2016 and Dawit and Zeray, 2017) that households with larger number of dependants were more food insecurity, our results revealed that households with more than five (5) dependants were more likely to be food secure than those with lesser number of dependants. Our findings are in line with the findings of Oluoko-Odingo (2006) and Ajaero (2017). The odds ratio in support of food security enhances by the factor 2.41 as the number of dependant is increased by one (Table 4.35). Households with more than five dependants (41.7%) were more food secure than households with fewer number (27.9%) in Southeastern Nigeria (Table 4.36).

However, the observed likelihood of households with high dependency ratio being more food secure could be attributed to the fact that other factors (e.g. income) influence food security too, as evident in the study area where some high income earners had a dependency ratio of ≥5 dependants. According to Ibok, Bassey, et al. (2014), high dependency ratio means increase in the number of consumers which put pressure on household resources especially food, yet high dependency ratio could be an advantage in areas of cheap labour (more free hands to work in farms) and crop production in agrarian households which is depicted in our findings.

4.6.7 Sufficiency in own food production

Most households in our study are agrarian and agrarian households usually depend on their own food production. The regression result showed a positive and statistically significant (5%) relationship between sufficient food production and household food security implying that, the more sufficient a household is in own food production, the more likely food secure, that household will be. An odds ratio of 2.908 indicates that a household that produces sufficient food for its members was 2.908 times likely to be food secure than a household that had not (Table 4.35). This is in agreement with the findings of Ojogho (2010); Asogwa and Umeh (2012) and Ibok, Bassey, et al. (2014) in Nigeria and Djangmah (2016) in Ghana. Table 4.36 shows that 57% of households that produced sufficient food were food secure while only 11.1% of those that did not produce sufficient food were food secure.

4.6.8 Livestock ownership

Livestock ownership was statistically significant at 5% and the coefficient revealed that households who reared livestock were more food secure than those that did not. The positive contribution of livestock ownership to food security is the fact that it could serve as a source of income and food in times of food shortage and livestock (including poultry) are seen as asset, and our findings is in tandem with the findings of Mitiku et al. (2012); Welderufael (2014); Goshu (2016); Dawit and Zeray (2017) all in Ethiopia. Assets ownership as noted by Asogwa and Umeh (2012) are seen as one of the strategies for enhancing households' resilience in the face of economic crisis arising from crop failure among others. The odds ratio in favour of livestock ownership indicates that the probability of households to be food secure increases by 2.443 times (Table 4.35) and this is illustrated in Table 4.36 where 52.5% of households who owned livestock were food secure and 26.9% who did not own livestock were food secure.

4.8.9 Village poultry or Agricultural poultry ownership

The ownership of village or agricultural poultry was statistically significant at 5% and the positive coefficient showed that an increase in ownership of poultry leads to an increase in food security and a decrease in food insecurity. Ownership of poultry is a form of income diversification which impact significantly on food security and our finding is supported by the findings of Welderufael (2014). The odds ratio in favour of households that are food secure increases by 2.314 times by every increase in poultry ownership (Table 4.35).

Households that owned poultry were more food secure (39.7%) than those that did not (30%) own poultry (Table 4.36).

4.6.10 Irrigation practice

There was a positive and statistically significant (5%) relationship between irrigation practice and food security status, meaning that households that practised irrigation farming were more food secure. This contribution is most significant during off-season of some crops and in times of unpredicted weather fluctuations e.g. the rains starting late and little or no rains in the rainy season. The odds ratio revealed that households that practised irrigation were 7.367 times likely to be food secure than those that had not (Table 4.35). Table 4.36 shows that 82.6% of households that practised irrigation were food secure while only 26.8% of those that did not practise irrigation were food secure.

4.6.11 Flooding

The coefficient of the relationship between flood experience and food security was negative and statistically significant at 5%. The implication of the result is that, the more a household experiences flooding with their houses affected, the more food insecure that household becomes. The result implies that a unit increase in flood experience reduces the odd of household food security by 0.33times (Table 4.35). Concurringly, Ramakrishna et al. (2014) and Zakari et al. (2014) found out that floods have positive impact on household food insecurity in Khammam (India) and Niger respectively. The negative effects of floods include; destruction of farmland and storage facilities leading to crop failure and food shortage, thereby increasing food insecurity. 50.5% of households that had experienced flooding effect at home were food insecure while only 28.9% of those who had not were food insecure. Conversely, 24.8% of households that had experienced flooding effect were food secure while 42.6% of households that had not experience flooding were food secure (Table 4.36).

4.7 Hypothesis testing: Variations in determinants of household food security

Analysis of variance (ANOVA) was used to test the null hypothesis: “there is no significant difference in the determinants of food (in)security among households in the agrarian communities” at 0.05 level of significance. Since the calculated Snedecor’s F test value (6.896) is greater than the critical F test value (1.5173), the hypothesis was rejected (Table 4.37), implying a statistically significant difference in the determinants of household food

security. The *p*-value is <.0001 indicating that the test statistic is statistically significant at 0.05 level of significance. The variation in the factors influencing households' food security across the communities explains why households differ in food security levels within the same community.

Table 4.37: ANOVA[a] result of determinants of food security

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	126.694	24	5.279	6.896	<.0001[b*]
	Residual	287.066	375	.766		
	Total	413.760	399			

* means significant at 0.05 level of significance
a. Dependent Variable: Food Security status in times of flooding
b. Predictors: (Constant), access to credit, marital status, canoe ownership, food/aid receipt, poultry farm ownership, flood experience, financial support, livestock ownership, fertilizer use, dependency ratio, literacy rate, diversified income, storage facility availability, irrigation, group membership, sufficient own food production, farm size, sex, age, nutrition knowledge, monthly income, private land ownership, off-farm income, level of education.

One-way Analysis of Variance (ANOVA) was also run to test the observed variations in vulnerability to food insecurity between male-headed and female-headed households. Our study already found female-headed households to be more vulnerable to food insecurity, so, one-way ANOVA was used to test for significance in the variations. Table 4.38 shows that the differences in the household vulnerability to food insecurity is significant at 5% level since the calculated F value of 6.015 is greater than the critical F value of 1.394, and the *p*-value for 6.015 is .015.

Table 4.38: ANOVA Table between household food security and Sex of household heads

Food security Status * Gender		Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	(Combined)	5.943	1	5.943	6.015	.015*
Within Groups		393.234	398	.988		
Total		399.178	399			

*significant at 0.05 level of significance

4.8 Effects of Flooding on Food Security

This section discussed the observed (as noted by the respondents) effects of flooding on food security across households in Southeastern Nigeria using food expenditure and meal frequency.

4.8.1 Food Expenditure Differential across Households in South East, Nigeria

The effects of flooding on food security using household food expenditure was analysed with respect to the time (before, during and after) of the flood events in the study area as discussed below.

4.8.1.1 Food Expenditure Before, During and After flooding event in South eastern Nigeria

The sources of livelihoods as well as the income of the heads of households determine their food expenditure (i.e. how much is spent on food). Flooding has been said to cause a shift (increase) in food price which was also noted in our study. To further buttress this point, the amount (money) spent on food before, during and after a flood event was used to assess the effect of flooding on food security in the study area.

The mean amount of money spent by households per week prior to a flood event was three thousand, five hundred and fifty-five Naira, fifty Kobo (₦3555.50/week), and the minimum and maximum were one thousand (₦1000) and seven thousand (₦7000) Naira respectively.

During a flood event, households spent an average of six thousand, three hundred and thirty-three Naira, seventy-five Kobo (₦6333.75) while the minimum and maximum spent were two thousand, five hundred Naira (₦2500) and twelve thousand Naira (₦12000) respectively.

A mean of three thousand, nine hundred and thirty-one Naira, twenty-five Kobo (₦3931.25) was spent on food by households after a flood event whereas the minimum amount spent was two thousand Naira (₦2000) and the maximum is eight thousand Naira (₦8000).

The analyses show a mean increase of 78.14% in the tune of two thousand, seven hundred and seventy-eight Naira, twenty-five Kobo (₦2778.25) due to rise in food prices during flood events. Moreover, the slightly higher (₦375.75) than normal in the mean money spent on food after a flood event is an indication that when food prices rise, it takes time to come back to normal due to factors other than flooding that were not examined in this study.

To further illustrate the effect of flooding on food prices, respondents were asked to indicate how true flooding reduced their ability to afford food due to increase in food prices, and the result is shown in Table 4.39. It was revealed that flood causes rise in food prices as well as reduced the food affordability ability of households leading to food insecurity of some

households since 44.5% and 54.8% respondents avowed that flooding "often" and "sometimes" cause hike in food price, thereby hampering their ability to purchase food. This means that, households with a greater reliance on purchased foods were more vulnerable to food insecurity during periods of high food prices.

Table 4.39: Effect of flood on food prices (n = 400)

Could you not afford food during a flood event because of increase in food prices?	Percent
Often true	44.5
Sometimes true	54.8
Never true	.7
Total	100.0

Source: Researcher's computation, 2017

4.8.2. Examination of the effects of flooding on food security using Meal Frequency

The number of time meals are eaten in a household daily can also be used to determine food security level in terms of food availability in a household as households are usually expected to have meals thrice daily.

Based on household daily meal frequency data, it was noted that the daily meal frequency drastically reduced after a flood disaster in the study area. The before flood (normal) and after flood (forced) daily meal frequencies are shown in Table 4.40. Before any flood event, households that usually had meals twice a day, accounted for 0.8%, those with a daily meal frequency of twice-thrice and thrice respectively accounted for 16.7% and 82.5% while no household indicated to have eaten just once daily. As seen in Table 4.40, flooding forced the percentage of those who had meals once and twice daily to increase to 2.3% and 24.3% correspondingly as well as increased households that had twice-thrice daily meals to 51.7%, and it reduced the percentage of households with a daily meal frequency of thrice to 21.7%.

Table 4.40: Daily Meal Frequency in Southeastern, Nigeria (n = 400)

Event	Daily meal frequency (in Percent %)			
	Once	Twice	Twice-thrice	Thrice
Before flood	0.0	0.8	16.7	82.5
After flood	2.3	24.3	51.7	21.7

Source: Researcher's computation, 2017

This implies that flooding has a negative effect on daily meal frequency associated with food security, with a 60.8% reduction in the number of those who usually had three square; a 35% increase in the number of households who had two-three times meal daily; a 23.5% increase in households with a daily meal frequency of twice and a 2.3% increase in households who

ate just once daily. Consequently, the reduction in daily meal frequency is as a result of destruction of farmlands with associated crop yield failure; disruption in livelihood sources; rise in food prices and seasonal displacement.

4.8.3 Effects of flooding on food security: A USDA Approach

A comparative analysis of the food security situations before and after flooding was carried out in order to show whether flooding has a negative or positive effect on households' food security in south eastern Nigeria. The same Household Food Security Survey Module (HFSSM, developed by the United States Department of Agriculture (USDA) which categorizes households using a constructed food security scale was adopted for assessing the food security status of households after a flood event. The same methodology of coding "often true" and "sometimes true" as 1 and "never true" as 0 for the eighteen food security survey questions was applied as shown in section 4.5.5.1. The household food security scores were analysed on their positions on the food security scale of 0 to 10; where 0 to 2.32 is termed "food secure", 2.33 to 4.56 is "food insecure without hunger", 4.57 to 6.53 is "moderately food insecure with hunger" and 6.54 to 10 is "severely food insecure with hunger".

Table 4.41:Differential household food security status/levels after flooding event

Community	Category of food security status/level (in Percent %)				Total
	Food secure	Food insecure without Hunger	Moderately food insecure with hunger	Severely food insecure with hunger	
Atani	6.2	39.1	14.1	40.6	64
Ossomala	1.6	45.3	12.5	40.6	64
Otuocha	9.1	59.1	20.4	11.4	44
Igbariam	0.0	20.9	7.0	72.1	43
Oguta	22.0	19.5	43.9	14.6	41
Ezi-Orsu	7.5	40.0	12.5	40.0	40
Mmahu	7.7	40.4	13.4	38.5	52
Opuoma	7.7	44.2	7.7	40.4	52
Total (mean)	7.2	39.3	15.7	37.8	400

Source: Researcher's computation, 2017

The food security status of households during a flooding event is shown in Table 4.41. The table reveals that the general food secure levels of households was drastically affected by flooding as only 7.2% (Table 4.41) of households were food secure after flooding as opposed

to the 33.3% (Table 4.34) of households that were food secure before flooding. This implies that flooding has a 26.1% reduction in the number of food secure households.

Consequently, 39.3% households were food insecure without hunger which is a bit lower than 40.2% households that were food insecure without hunger before flooding. Flooding forced a larger proportion of households to go into extreme food insecurity as there were 2.7% and 24.3% respective increase in the number of households that were moderately food insecure with hunger and severely food insecure with hunger. With respect to households that experienced extreme food insecurity, 15.7% were moderately food insecure with hunger whereas 37.8% were severely food insecure with hunger.

Generally, in south eastern Nigeria, flooding reduced food security by increasing the number of food insecure households to 92.8%, indicating a 26.5% increase of food insecure households from normal.

The most affected in terms of flood-induced food insecurity was Igbariam community, where all the households became food insecure after flooding with 72.1% experiencing extreme food insecurity with hunger. The second most affected was Ossomala community which recorded only 1.6% food secure households after flooding. The negative effects of flooding on household food security is seen in Atani, Ezi-Orsu, Mmahu, Opuoma where <8% were food secure with more than 90% becoming food insecure after flooding. Oguta community seemed to be the least affected by flooding because 22% of her households were food secure after flooding which is just 4.8% lower than the number recorded before flooding.

Conversely, the number of households that experienced severe food insecurity in Oguta after flooding also reduced to 14.6% from the normal 19.5% before flooding. However, flooding forced majority of households to move from food insecure without hunger status to either moderately food insecure with hunger status or severely food insecure with hunger status (with the exception of households in Oguta community), thereby increasing the number of *food insecurity hotspots*. The implication is that, more households would be needing food assistance to aid them cope with the flood-induced food insecurity.

The reasons for the high percentage of the extreme food insecurity recorded by households were due to decrease in household food supply with associated reduction in children and adults food intake as a result of inadequate resources to acquire food. It was also revealed that flooding induced hunger, for example, more than 80% of households indicated to have been

hungry but never ate during a flood event while more than 90% of them either cut the size or skip their children and adults' usual meals as well as supplement with low quality food because of inadequate resources to acquire more.

The study has been able to demonstrate that flooding can induce food insecurity leading to changes in food consumption patterns, and this flood-induced food insecurity arises as a result of destruction of farmland, disruption of sources of livelihoods, rise in food prices which significantly affect food availability, accessibility and utilization over time.

4.8.4 Assessment of the Extent of the Relationship between flooding and food security

Flood has been associated with destruction of farmland, disrupting sources of income, changing food consumption patterns, thus affecting household food security. Though, flooding was a significant factor that affected food security negatively as shown in the multiple logistic regression result, there was need to run a simply ordinal regression analysis to show the influence of flooding on food security level holding other determinants constant. This is essential as it reduces the contributing effects of other factors on food security. The ordered nature of the households' food security levels viz; food secure, food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger guided the choice of ordinal regression analysis (see section 3.6.8).

Table 4.42: Relationship between flooding and food security Parameter Estimates

Variable		Estimate	Std. Error	Wald	Df	OR	Sig.
Threshold	[Food Security = 0]	-3.339	.888	14.147	1	28.191	.000
	[Food Security = 1]	-.925	.870	1.132	1	2.522	.287
	[Food Security = 2]	-.283	.869	.106	1	1.327	.744
Location	[FloodExp=1]	-.798	.874	.834	1	2.221	.361
	[FloodExp=2]	0[a]	.	.	0		.

Link function: Logit.
a. This parameter is set to zero because it is redundant.

The estimated coefficients for the ordinal regression model are shown in Table 4.42. The estimates labelled "Threshold" are the intercept. The estimates labelled "Location" are the coefficients for the predictor. The coefficient for the independent variable, FloodExp, (households that had experienced flooding) in the model, is –0.798. The negative coefficient indicates a negative effect of flooding on household food security. On the one hand, this implies that households that had experienced flooding are more likely to be food insecure. On

the other hand, a negative value means that the odds of being food secure decreases for households with flood experience.

However, the larger *p*-value of .361 shows that the relationship is not significant at 5% level, thus, the null hypothesis which states that "there is no significant relationship between flooding and food security of households in the agrarian communities" is accepted. Meanwhile, the observed negative relationship between flooding and food security makes flood a limiting factor that reduces food security, holding other factors constant.

The extent to which flooding affects food security was analysed using the odds ratio. An odds ratio (OR) is a measure of association between an exposure and an outcome. The OR represents the odds of an outcome occurring given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. It is simply the exponential function of the regression coefficient (e^{b1}) associated with a one-unit increase in the exposure (Szumilas, 2010). When OR=1, there is no association between the response and predictor and this serves as the baseline for comparison, and an OR>1, shows the odds of success are higher for higher levels of the independent variable (in this case, flooding). An OR<1 implies that the odds of success are less for higher levels of a predictor while OR with values farther from 1 represent stronger degrees of association ("Logistic regression", 2018).

The odds ratio for our predictor, flooding, is 2.221, and this shows a strong degree of association between flooding and food security (Table 4.42). This implies that households that had experienced flooding are 2.221 times more likely to be food insecure than households that had not.

4.8.5 Comparative Analysis of the positive and negative effects of flooding on Food Security

Flooding has both positive and negative effects on food security in the study area. The analysed effects of flooding were both direct and indirect e.g. flooding is assumed to increase soil fertility through alluvium deposits increases crop harvest, thereby increasing food availability. Similarly, increased crop harvest might increase farm income derived from crop sales and an increased fish catch might increase food accessibility, and conversely, flooding affects all the areas listed above.

4.8.5.1 The positive effects of flooding on Food Security

The positive effects as identified from observations and responses of household heads were six (6) namely; flooding increases crop harvest; increases farm income derived from crop sales; increases labour demand; decreases food item prices; increases soil fertility through alluvium deposits; and increases fish catch. Household heads were required to indicate the extent to which flooding affect their household's food security positively using a five-point likert scale of 1= to no extent; 2=to little extent; 3= to a moderate extent; 4= to a great extent and 5= to a very great extent.

The results of the extent of the positive effects of flooding on food security as perceived by households are shown in Table 4.43.

Table 4.43: Positive Effects of flooding on food security (n = 400)

Positive effect of flooding on food security	Extent of effect (in Percent %)				
	1	2	3	4	5
Increases crop harvest	99.0	1.0	0.0	0.0	0.0
Increases farm income derived from crop sales	88.7	11.3	0.0	0.0	0.0
Increases labour demand	80.8	17.7	1.5	0.0	0.0
Decreases food item prices	99.0	1.0	0.0	0.0	0.0
Increases soil fertility through alluvium deposits	17.5	3.0	43.7	25.8	10.0
Increases fish catch	17.5	0.8	33.0	36.3	12.4

A 5-point scale with 1= To no extent; 2=To little extent; 3= To a moderate extent; 4= To a great extent; 5= To a very great extent.

Among the six (6) perceived positive effects of flooding on food security, only two (2) viz; increases soil fertility through alluvium deposits and increases fish catch had all the 5-point extent accounted for. About a quarter (25.8%) of households reported flooding to increase soil fertility to a great extent and 43.7% indicated that flooding brings about a moderate increase in soil fertility. 10% of households indicated that flooding could increase soil fertility to a very great extent while 3% and 17.5% households perceived flooding to respectively increase soil fertility to little or no extent. Households that perceived flooding to increase fish catch either to a moderate extent, great extent or very great extent were 33%, 36.3% and 12.4% correspondingly. The reason for the 17.5% that indicated flooding to have "no positive effect on fish catch" was because flooding caused loss of fish ponds affecting the income of fish pond farmers.

Finally, the table reveals that the other perceived positive effects of flooding were negligible as majority of the households indicated them to be either in little or no extent on food security which contradicts the assumption that an increase in soil fertility might increase crop harvest and sales. This indicates that flooding has two major positive effects on food security (increases soil fertility and fish catch) in the south eastern region of Nigeria as shown in Table 4.43.

4.8.5.2 The negative effects of flooding on Food Security

The ten (10) negative effects of flooding on food security were identified analysed were; flooding reduces crop harvest; decreases farm income derived from crop sales; destroys road; destroys food/ farm storage facilities; reduces labour demand; pollutes streams; reduces the number of times food is consumed; affects the quality of food eaten; increases food items prices and it affects the quantity of food eaten (Table 4.44). Some of the identified negative effects of flooding on food security are indirect, for instance, roads are important in the transportation of agricultural products from farms to market and when these roads are destroyed by flooding, food security is affected indirectly. In the same vein, when crop failure occurs as a result of flooding, food availability is affected with an associated reduction in meal frequency and quantities.

Flooding was found to reduce crop/fish pond harvest and farm income, thereby affecting household food security in the study area especially as majority of the households are agrarian (depending on agriculture for their food and income). Food prices usually are low during harvest periods, but flooding alters this seasonal pattern by causing a rise in food prices as a result of crop failure and flood events occur mostly between August and October, the harvest season for staples like yam in south eastern Nigeria.

Floods also upset the balance between labour supply and demand because after flood events, there is often an abrupt rise in labour supply (especially as households take up casual labour to help themselves after flood-induced poor harvest) with an associated decrease in labour demand due to the reduced number of households that required the labour. Table 4.44 reveals that the ten (10) identified negative effects of flooding on food security were to a great extent with the largest proportions of households indicating that it increases food prices (63.5%), destroys roads (56%), reduces crop harvest (55.7%) and reduces farm income derived from crop sales (55.5%).

Similarly, a larger proportion of households indicated flooding to affect the quantity of food eaten (47.5%), reduce the number of times food is consumed (46.8%), destroy food and farm storage facilities (43.5%), pollute streams (40.3%), affect the quality of food eaten (37%) and reduce labour demand (25.3%) to a great extent.

In addition, flooding was found to have caused streams pollution a great deal as a high percentage of households (52.5%) had responded that the effect was to a very great extent.

Table 4.44: Negative Effects of flooding on food security

Negative effect of flooding on food security	Extent of effect				
	1	2	3	4	5
Reduces crop harvest	0.0	1.3	2.3	55.7	40.7
Decreases farm income derived from crop sales	0.0	2.5	4.0	55.5	38.0
Destroys road	0.0	10.3	18.0	56.0	15.7
Destroy food and farm storage facilities	0.0	5.0	29.3	43.5	22.2
Reduces labour demand	3.3	24.0	25.7	25.3	21.7
Pollutes streams	0.0	2.5	4.7	40.3	52.5
Reduces the number of times food is consumed	0.0	16.7	27.5	46.8	9.0
Affects the quality of food eaten	6.0	18.5	26.5	37.0	12.0
Affects the quantity of food eaten	0.0	16.0	31.0	47.5	5.5
Increases food items prices	0.0	0.5	19.7	63.5	16.3

A 5-point scale with 1= To no extent; 2=To little extent; 3= To a moderate extent; 4= To a great extent; 5= To a very great extent

The study found a widened effect gap between the negative and positive effects of flooding on food security. It has shown flooding to have serious negative effects on food security as most of the households indicated the effects to be “to a great extent” (Table 4.44).

Furthermore, there was need to analyse the disparity between the negative and positive effects, and mean scores were adopted to show if the effects (both positive and negative) of flooding on food security were significant or not. The coefficient of reliability (consistency) of the items was measured using the Cronbach’s alpha reliability statistic with an acceptable reliability value of ≥0.70. The reliability coefficient of ≥0.70 is a prerequisite for running mean scores. The positive effects recorded an alpha reliability coefficient of below 0.70 while the negative effects had an alpha reliability coefficient of 0.80.

The effects were analysed on a Likert scale with an expected mean of 3.0. Mean scores of both the positive and negative effects were computed with an average value of 1.78 and 3.82

respectively. Since the mean score for the negative effects of flooding is greater than 3.0, it could be concluded that flooding had more and significant negative effects than positive effects in the Southeastern region of Nigeria.

4.8.6 Principal Component Analysis of the negative effects of flooding on food security

The Principal Component Analysis (PCA) was employed to reduce and group the ten (10) analyzed negative effects of flooding on food security. That means PCA was run on the negative effects of flooding on food security to determine the underlying dimensions (summary). The PCA extracted three (3) components with Eigen values greater than 1, explaining 68.02% of the dataset's total variance. The first, second and third components explained 33.65%, 18.23% and 10.22% respectively of all variations (Table 4.45). This implies the PCA explained 68.02% of the negative effects of flooding on food security summarized as three (3) underlying dimensions coined from the negative effects loaded significantly on the 3 extracted components (Table 4.46).

Table 4.45: Total Variance Explained of the PCA

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumula-tive %	Total	% of Variance	Cumula-tive %	Total	% of Variance	Cumula-tive %
1	3.913	39.126	39.126	3.913	39.126	39.126	3.365	33.652	33.652
2	1.823	18.232	57.358	1.823	18.232	57.358	1.819	18.186	51.838
3	1.066	10.663	68.021	1.066	10.663	68.021	1.618	16.183	68.021
4	.811	8.110	76.131						
5	.726	7.258	83.389						
6	.514	5.141	88.530						
7	.459	4.588	93.118						
8	.309	3.091	96.209						
9	.221	2.207	98.416						
10	.158	1.584	100.000						

Extraction Method: Principal Component Analysis.

Table 4.46: Rotated Component Matrix[a] of the PCA

Direct and indirect effects of flood on food security	Component		
	1	2	3
Reduces crop harvest (X1)	.095	.908*	.027
Decreases farm income derived from crop sales (X2)	.009	.899*	.166
Destroys road (X3)	.570*	.243	.285
Destroy food/ farm storage facilities (X4)	.066	.236	.811*
Reduces labour demand (X5)	.215	-.001	.777*
Pollutes streams (X6)	.445	-.022	.369
Reduces the number of times food is consumed (X7)	.895*	.008	-.012
Affects the quality of food eaten (X8)	.883*	-.031	.155
Affects the quantity of food eaten (X9)	.911*	-.012	.103
Increases food items prices (X10)	.610*	.263	.276

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
*The significant loadings exceeding +/-0.60

4.8.6.1 Interpretation of the components

4.8.6.1.1 Component one

With an Eigen value of 3.91 (Table 4.45), it loaded positively and significantly on X3- destroys road (.57), X7- reduces meal frequency (.895); X8- affects the quality of food eaten (.883), X9- affects the quantity of food eaten (.911) and X10- increases food items prices (.61) (see Table 4.46). The underlying dimension is thus termed, *food supply and distribution* considering the variables (X3, X7, X8 and X10) with significant loadings. The positive relationship (shown by the component values) gives credence to the fact that flooding did actually affect food security negatively in the study area.

4.8.6.1.2 Component two

It has an Eigen value of 1.82 (Table 4.45), with positive and significant loadings on X1- reduces crop harvest (.908) and X2- decreases farm income derived from crop sales (.899) shown in Table 4.46 and has been termed *influence on household income and investment*. Respectively, 96.4% and 93.5% households reported flooding to influence X1 and X2 to a great and very great extent collectively (Table 4.44).

4.8.6.1.3 Component three

Eigen value of 10.66 (Table 4.45) was reported for this component which was positively and

significantly loaded on X4- destroy food/farm storage facilities (.811) and X5- reduces labour demand (.777) as shown in Table 4.46. Households that reported flooding to influence X4 and X5 to a great and very great extent were 65.7% and 47% correspondingly (Table 4.44). The underlying dimension for this component could be termed *farm labour and facilities*.

However, the positive loadings on all the significant variables, further buttress the point that flooding affects food security negatively in the study area. For instance, as flooding increases, there is also an increase in crop harvest reduction as depicted by the significant positive value (.908) on X2- reduces crop harvest under component 2.

In conclusion, the ten (10) identified negative effects of flooding on food security in the study area have been reduced to three (3) underlying dimensions namely;

1. Food supply and distribution;
2. Household income and investment;
3. Farm labour and facilities.

4.9 Households' adaptation strategies to flooding and food insecurity

Adaptive capacities are those things which enable people to cope with stresses such as flooding, climate change, food shortage etc. Coping strategies are what households are reliant on to develop means to maintain their livelihoods during and after a disaster and its analysis focuses on what people do when they are already affected by a hazard (e.g. flood).

Thus, coping strategies are adopted when dealing with the hazard ("Complete coping strategies analysis", 2018). In this study, we looked at stress such as flooding and food insecurity and since these stresses are sometimes inevitable, households had to concentrate on measures to improve their adaptive capacity. The extent of the effects of flooding and food insecurity varies across households and because households experienced them differently, different coping strategies were employed by households to protect themselves from further hazard or to maintain their livelihoods in the face of stressful events such as flooding. The driving forces for their adaptation were noted to include; willingness to sustain their livelihoods and stay alive, the industrious nature (where laziness is strongly abhorred) of the Igbos and their attachment towards their land. Since the livelihoods in the study area are dominated by agriculture and they are likely to be affected by frequent flood events with their associated effects (e.g. food insecurity), the households therefore had to adopt some coping strategies to survive.

4.9.1 Households' adaptation strategies to flooding

Households living in areas experiencing seasonal or perennial floods in the study area have been noted to adopt some adaptation strategies which helped them to live with floods. The adaptation strategies employed by households during flooding are shown in Table 4.47. As had been earlier revealed that flooding causes seasonal displacement of some households, households had adopted seasonal migration especially between August and October as a adaptation strategy. On the one hand, the concerned households revealed that these migration were planned with respect to the already known seasonal occurrence of floods, on the other hand, seasonal migration might be abrupt usually forced by sudden flooding. Seasonal migration is practised by mostly households residing in areas with lower elevation, near river channels and flood plains especially in Oguta and Ossomala LGAs, and 24.3% households reported to have employed migration to safer land during flood episodes to reduce the effects of flooding on their welfare.

The surveyed households were largely agrarian and majority of their livelihoods were agricultural based, so, majority had changed the planting times for some crops to sustain their livelihood sources. Change in planting season for certain crops (e.g. yams, potatoes) in order to hasten their harvest before the expected flood periods had been employed. Over 82% households reportedly had varied the time of the year they sowed, though, they revealed that its efficiency is highly dependent on weather variability (early onset of rains and its consistency was good for this practice) as well as using quick-maturing varieties of crops. Sequentially, early harvest is sometimes accompanied by early planting (change in planting time) and the use of fast-maturing seeds which mature before expected flood occurrence. Early harvest as noted by respondents could be driven by intuition with respect to observed weather signs predicting potential flood disasters. This however, showed how years of farming experience is vital in the adaptation strategies adopted and could explain why 61.5% households had adopted this strategy.

Digging of pits to collect excessive run-off on farmlands was mostly practised by rice farmers to help in post flooding farming. These pits later served as post flooding reservoir- a micro irrigation project, but only a small proportion (<20%) households practised this. This implies that flood waters could be harvested by farmers to serve as irrigated water which in turn would enhance their food security level.

Table 4.47: Household Adaptation strategies to flooding

Adaptation strategy	Frequency (Percent %) n = 400		Within household headship (For "YES" (valid) response only)	
	Yes	No	FHH	MHH
Seasonal migration	97 (24.3)	303 (75.7)	39 (22.3)	58 (25.8)
Change in planting season	331 (82.7)	69 (17.3)	142 (81.1)	189 (84.0)
Digging runoff collection pits	77 (19.3)	323 (80.7)	29 (16.6)	48 (21.3)
Elevating buildings	105 (26.2)	356 (73.8)	33 (18.9)	72 (32.0)
Building makeshift houses	113 (28.2)	287 (71.8)	67 (38.3)	46 (20.4)
Joining social networks/ other groups	94 (23.5)	316 (76.5)	28 (16.0)	66 (29.3)
Income diversification	232 (58.0)	168 (42.0)	69 (39.4)	163 (72.4)
Early harvest	246 (61.5)	154 (38.5)	103 (58.9)	143 (63.6)
Building small bridges and creating flood water pathways with bamboos	62 (15.5)	338(84.5)	26 (14.9)	36 (16.0)
Others	129 (32.2)	253 (67.8)	56 (32.0)	73 (32.4)

Source: Researcher's computation, 2017
NB: Figures in parentheses () are the valid responses in percentage

Housing units had been elevated during construction to prevent total submersion during flood events and this was noted to be linked to the flood awareness level of the households. Households with elevated structures were 26.2% and these households were observed to be built in low-lands of the study area (Plate 4.6).

Low quality/makeshift houses were mostly seen in the farm settlements where people stay during the planting and harvest seasons. It was observed that while these makeshift houses served as the temporary abodes for certain farmers in order to reduce the cost of transport as well as for them to be close to their farms, they served as permanent abodes for migrant farmers. These kinds of houses could easily be re-erected when inundated and 28.2% had been practising this (Plate 4.4).

Group membership has been adduced to provide social capital in times of shocks or calamity and as opined by Woolcock (2001), social capital is an asset for stress recovery especially for the poor. 32% of the surveyed population belonged to one group or the other, but only 24.5% of them indicated belonging to these groups as a adaptation strategy. Social networks e.g. friends' club and age grades were one of the groups reported to have helped flood victims survived during flooding and food shortage periods, and 24.5% households avowed this in the study area, and this is in agreement with the findings of Blaikie et al. (1994); David et al. (2007); Adelekan (2009) and Olorunfemi (2011).

Plate 4.4:Makeshift houses in Umuorodogwum Village, Oguta

Plate 4.5: Bamboo constructed flood water pathway in Igbariam

Plate 4.6: An elevated building in Otuocha

Livelihoods diversification has been noted to be a commonly adopted strategy for coping with economic and environmental shocks in various communities (Ellis, 2000; Barrett et al., 2001; Marschke and Berkes, 2006; Yaro, 2013; Gautam and Andersen, 2016; Epstein et al., 2018). A large proportion (58%) had indicated to have diversified their income for livelihoods sustenance during flooding. Income diversification helps to cushion the effects of flooding, though, this would play a more fundamental role if the diversified incomes are not within the same agricultural activities which have been revealed to be grounded during flood episodes in the study area.

Creating flood water pathways lined with sand bags and bamboos to channel run-off to rivers was also observed to have been practised to prevent inundation of houses (Plate 4.5). Small

wooden bridges were also built for crossing inundated areas. These combined practices were reported to have been adopted by 15.5% households.

Irrespective of the fact that the respondents had adopted some coping/adaptation strategies to cushion the effects of flooding, a good number of them (32.2%) reported to either have done nothing or pray, which was classified as "others" under the adaptation strategies. According to these respondents, nothing could be done rather than allow nature to take its course or pray that the flooding effects are reduced.

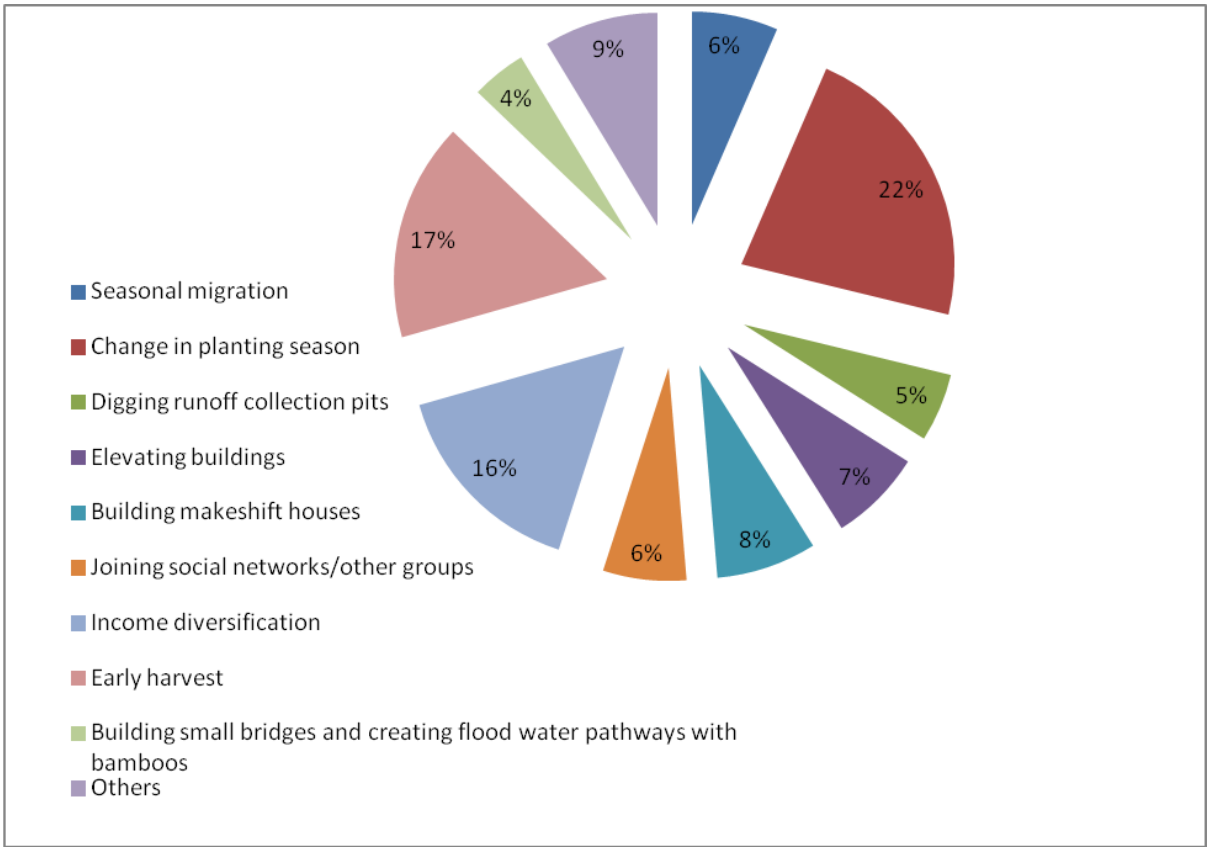


Figure 4.27: Percentage distribution of the adopted adaptation strategies to flooding

The overall percentage distribution of the different coping strategies against flooding adopted by households is shown in Figure 4.27 with "change in planting time" and "building small bridges or creating pathways for flood water" recording the highest (22%) and lowest (4%) respectively. Early harvest was the second most practised coping strategy with 17% households adopting it and "digging of run-off collection pits" was the second to the least adopted adaptation measure which recorded only 5%. Income diversification was practised by 16% households and 8% "built makeshift houses" to reduce the effects of flooding on their households (see Figure 4.27 for other adaptation strategies adopted).

In conclusion, the findings have demonstrated how indispensable sources of livelihoods are to people and households in the study area are no exceptions, so, varying coping/adaptation strategies had been adopted for their livelihoods sustainability as well as to cushion the effects of flooding with a positive multiplier effect on household food security.

4.9.1.1 Differential adaptation strategies to flooding adoption in relation to household type

There were some observed differences in the adaptation strategies against flooding by the two household types viz; female-headed households (FHHs) and male-headed households (MMHs). The MHHs were found to have engaged in more of these strategies than the FHHs with the exception of building makeshift/low quality houses (Table 4.47). The reason for the huge difference between MHHs (72.4%) and FHHs (39.4%) in terms of diversification of income is due partly to the fact that female heads of households in the study are saddled with other domestic responsibilities, hence have limited time to engage in several money making activities. In addition, prior to flooding, female heads were noted to be engaged full time in their farm labour because they could not afford hired-labour, so, income diversification outside agricultural activities was difficult for them.

Similarly, men were noted to belong to more social networks than women in the study area, and this accounts for the reason why membership in social networks as a coping strategy was higher (29.3%) in MHHs than in FHHs (16%). The reasons given above for the high involvement of MHHs in diversification of income apply to social network membership for MHHs. Moreover, digging run-off collection pits was practised mostly by rice farmer with a higher male representation than female in the study area. Thus, MHHs recorded high (21.3%) adoption of this strategy because more men are involved in rice farming than women in the study.

Finally, the slight difference in some of the adopted adaptation strategies with respect to household types shows how households are poised to survive in the face of crises irrespective of who heads the household.

4.9.2 Households' adaptive capacities and coping strategies against food insecurity

The adaptation strategies employed by households in times of food shortages as a result of food insecurity are shown in Table 4.48 as disaggregated by gender.

Households that actively devised strategies to live with food insecurity had comparative advantage over others in terms of adaptation. The outcome of the analysis of coping strategies adopted shows a variation across female- and male-headed households.

Skipping of meals serves as an indicator for determining food security levels as well as a coping strategy. Normally, household members would not skip meals except in times of crises which affect food availability and affordability or due to poverty. The most practised coping strategy in times of flood-induced food shortages was "skipping meals" as 90% households reported in the study area. Skipping of meals could be voluntary (where household members decided to purposely skip or keep meals served for later) or forced (where households members were hungry but did not have anything to eat). 91.4% of all the female-headed households (FHHs) had skipped their meals at some point in time during food shortages while 55.6% of the male-headed households (MHHs) had employed "skipping of meals" as a food insecurity adaptation strategy.

In agricultural communities, it is not unusual to informally borrow either food or money, this is also evident in Southeastern Nigeria as 31.5% households reported to have done this in order to sustain their households as a result of food shortage caused by destruction of their farmlands or seasonal displacement caused by flooding. The analysis also shows that MHHs (36%) had engaged in the practice of informal borrowing more than FHHS (25.7%).

Accompanied by meals skipping are "reducing portion size of meals" and "reducing meal frequency". A significant percentage, 80.7% and 82.3% of households had reduced portion size of their meals and reduced the number of times food was eaten to cope with food shortage induced by flooding and this corroborates the findings of Tefera and Tefera (2014) in Ethiopia, Gupta et al. (2015) in India and Farzana et al. (2017) in Bangladesh. Within the FHHs, 87.4% and 80% had reduce their households meal portions and reduced their meal frequency respectively while 75.6% and 84% MHHs had respectively employed reduction of meal portions and meal frequency as coping strategies. These coping strategies had made households survived throughout the crises' period and they emanated from the conditions of households not having enough food nor resources to afford more.

In order to survive the low food availability as well as high food prices, majority of the households reported to have eaten their seed stock and/or stocked seeds (e.g. dried maize, yam tubers) usually kept for next planting season. Though, the practice of eating seed stock is

a coping strategy, it consequently affected these households during subsequent planting season as majority of them noted their stocked seeds from previous harvest to be one of the major sources of their planting seeds with 56.6% FHHs and 57.3% MHHs having practised this adaptation strategies in the study area.

Table 4.48: Adaptation strategies to food insecurity

Adaptation strategy	Frequency (Percent %) n = 400		Within household headship (For "YES" (valid) response only)	
	Yes	No	FHH	MHH
Skipping meals	360 (90.0)	40 (10.0)	160 (91.4)	200 (55.6)
Buying less preferred/desired food	247 (61.8)	153 (38.2)	104 (59.4)	143 (63.6)
Reducing portion size of meals	323 (80.7)	77 (19.3)	153 (87.4)	170 (75.6)
Casual jobs	82 (20.5)	318 (79.5)	42 (24.0)	40 (17.8)
Informal borrowing (money/food)	126 (31.5)	274 (68.5)	45 (25.7)	81 (36.0)
Reducing number of times food is eaten	329 (82.3)	71 (17.7)	140 (80.0)	189 (84.0)
Collecting loan	10 (2.5)	390 (97.5)	6 (3.4)	4 (1.8)
Sale of assets	51 (12.8)	349 (87.2)	18 (10.3)	33 (14.7)
Church Charity	43 (10.7)	357 (89.3)	28 (16.0)	15 (6.7)
Begging	8 (2.0)	392 (98.0)	7 (4.0)	1 (0.4)
Purchase food on credit	84 (21.0)	316 (77.0)	42 (24.0)	42 (18.7)
Remittance	97 (24.3)	303 (75.7)	134 (76.6)	169 (75.1)
Eat seed stock or stocked seeds	229 (57.2)	171 (42.8)	99 (56.6)	130 (57.3)

Source: Researcher's computation, 2017
NB: Figures in parentheses () are the valid responses in percentage

Households have been noted to take up casual jobs (e.g. masonry) to augment incomes and support food purchase, and 20.5% had engaged in such jobs to boost their food security level during times of food insecurity with a 24% and 17.8% involvement of the FHHs and MHHs respectively.

Furthermore, collection of loans to sustain livelihoods is not a common practice in the study area, partly due to the fact that loans come with interest and because the household heads are not sure of paying back due to likely crop failures with an associated negative effect on household income. Only 10 households (2.5%) had collected loans in times of food insecurity with FHHs having collected more loans than MHHs.

In the same vein, sale of assets (e.g. livestock, bicycle) to purchase food or settle some other households' needs had been employed by 12.8% households, and some of these assets sold out of desperation had actually been sold at an unimaginable cheaper price according to Eze

(2017). Assets in this study, connote valuable things (tangible) but could be regarded differently with respect to place, Rakodi and Llyod-Jones (2002) noted people's possession of and access to assets as well as their livelihoods to be influenced by the context within which they live. Table 4.48 revealed more MHHs to have sold more assets than FHHs because of the income and asset poverty found to be higher in the FHHs in the study area.

A very few households (10.7%) had benefitted from church charity in times of food shortages and begging is not a usual practice as only 8 (2%) households indicated to have applied begging and these households were among the poor female-headed households with a monthly income of <15,000 Naira.

Moreover, FHHs had more proportions that resorted to church charity and begging than MHHs because FHHs had been shown to be the most food insecure with 22.9% classified under "severely food insecure with hunger" during times of flood events. Food had been purchased on credit to sustain households as 21% households reported to have done this with 24% FHHs and 18.7% MHHs reported to have employed it.

This study has been able to show an inverse and significant relationship between remittance and flood vulnerability, meaning the more remittance a household is entitled to, the less vulnerable that household becomes to flooding. Remittances are money sent back home from relatives or family members who live elsewhere. Invariably, remittance is a valid coping strategy to help households cope with food insecurity as well as to withstand other shocks. This is in line with the findings of Babatunde and Martinetti (2010) who noted increases in remittances to be associated with increased food security of rural households in Nigeria and Ponsot and Obegi (2010) who opinionated that a household's saved remittances served as insurance against unforeseen events.

The percentage distribution showing the average household adaptation and coping strategies adopted in times of food insecurity is shown in Figure 4.28 where households have been illustrated to adopt mostly skipping of meals, reducing meal frequency as well as reducing meal portion. The chart also indicates begging and collecting loan to be the least adopted coping strategies.

However, the slightly observed variations in the coping strategies adopted by the FHHs and MHHs have been linked to facts such as income and asset poverty gaps including differential

household food insecurity levels, for instance, the FHHs being more income and asset poor as well as being the most affected in terms of flood-induced food insecurity in the study area.

Conclusively, the study has shown how households respond in times of emergency of food insecurity, the vastly adopted strategies by these households for survival and how the strategies vary according to the headship of the households. Additionally, the outcomes of the analysis indicate that most of the coping strategies employed were self-devised strategies that provided temporary means of survival in times of food shortages done at the household level. Therefore, more sustainable strategies having more institutional undertone (e.g. social security, food safety nets for flood victims) are suggested in times of flooding and food insecurity to reduce more pressures on households e.g. which will prevent them from eaten up their seed stock or stocked seeds against the next planting season.

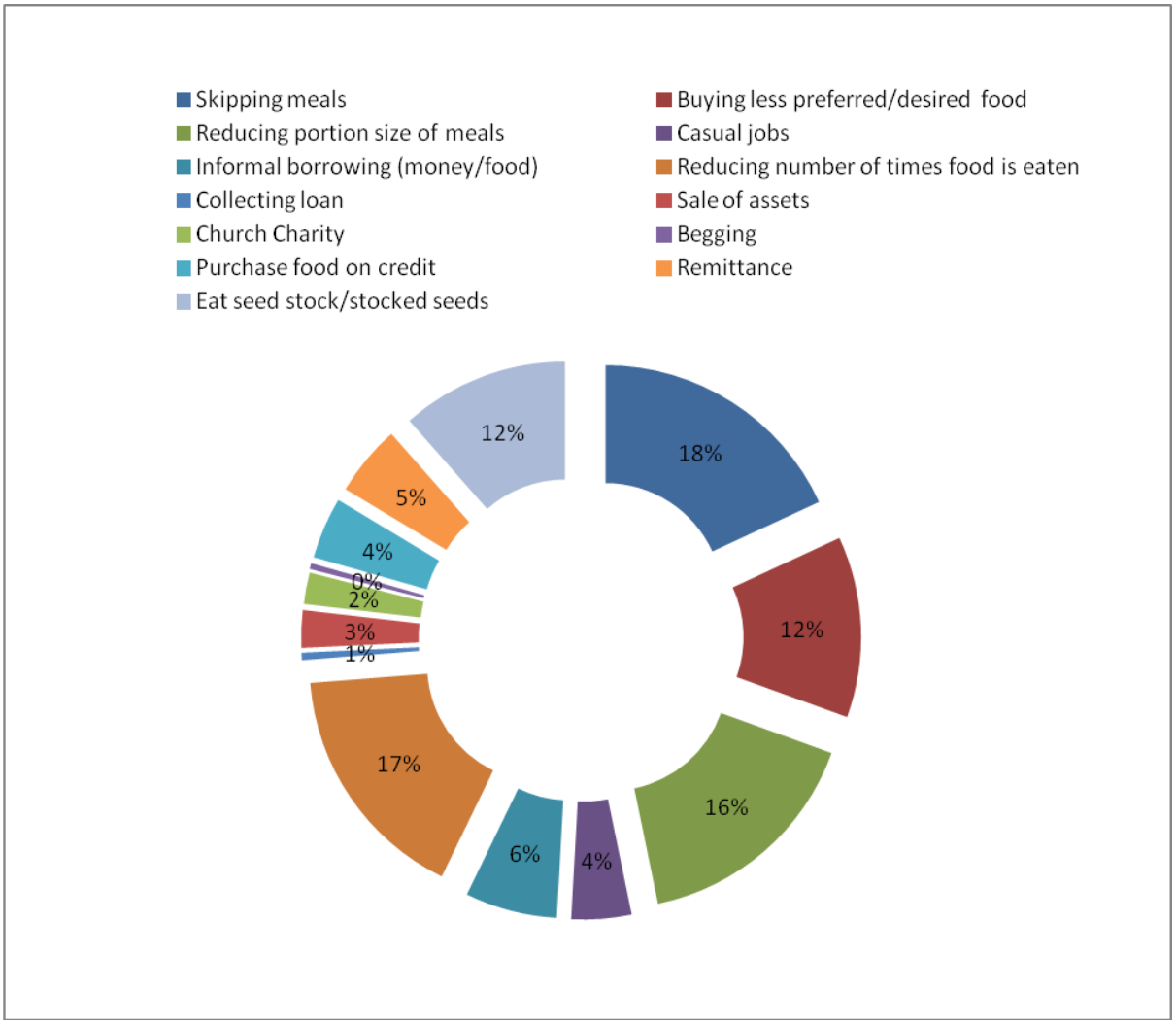


Figure 4.28: Percentage distribution of adaptation and coping strategies to food insecurity

4.10 Resilience Analysis

The recovery length/period i.e. how long it took people to recover from the shock of flood episodes in south eastern Nigeria is presented in Table 4.49. Resilience according to Epstein et al. (2017) is often used to describe how a community, household or person is able to "bounce back" from a disaster event. There is a plausible relationship between recovery and resilience. The shorter the time it takes an affected household to bounce back to normal life after being affected by a flood episode, the more resilient that household is which signifies their ability to cope or live with flood. Analysis of peoples' resilience is very important as it has been noted to have a negative proportionality with their vulnerabilities. Vulnerability according to Pelling (1999) has 3 components; exposure, resilience and resistance. Exposure has a direct relationship with vulnerability while resilience has an inverse relationship (Akukwe and Ogbodo, 2015). The data on recovery period were obtained from questionnaire where participants were asked to answer the question "how long it took them to recover from the shock of floods?" The baseline for answering "how long it took each household to recover from flood disaster" was the 2012 devastating flood as had been noted to be the most recent extreme floods experienced by all the households.

The table displays a disproportionate recovery period from flood disaster across communities in the study area. On average, the recovery period was 1-2 years as 51% of the households took between 1-2 years to bounce back after the devastating flood in 2012 with Ossomala (35.9%) and Ezi-Orsu (60.5%) communities recording the least and highest number of households that recovered within this period. Above one quarter of all the households (28.3%) reported to have recovered between 10 and 12 months after the flood disaster with Oguta community having fewer households in the category in relation to other communities. Consequently, Opuoma and Otuocha communities had the largest proportions (13.6% each) of households with a long recovery period of 3-4 years while Igbariam had the lowest (2.3%). Meanwhile, 14.1% households in Ossomala community bounced back after 4-6 months with only one (1) household each in Igbariam and Oguta communities indicated to have recovered within 4-6 months. No household in Otuocha recovered within 1-6 months while Mmahu and Ossomala each had two (2) households that bounced back between 1 and 3 months.

With respect to the time taken to bounce back by households in the eight communities, the study inferred that Ossomala seemed the most resilient of all the communities

However, the observed differentiated flood recovery period by households in the study area could be linked to factors such as age of the household head, income, livelihood diversification, off-farm income, level of education, food/aid receipt, pre-flood awareness (preparedness), remittances and overall well-being (measured by access to potable water, sanitary conveniences and proper waste management).

Table 4.49: Flood recovery period by Community

Community	Flood Recovery Period (in Percent %)							Total
	1-3 months	4-6 months	7-9 months	10-12 months	1-2 years	3-4 years	others	
Atani	1.6	3.1	3.1	31.3	48.4	10	1.6	64
Ossomala	3.1	14.1	1.6	37.5	35.9	7.8	0	6
Otuocha	0.0	0.0	2.3	27.3	56.8	13.6	0	44
Igbariam	0.0	2.3	2.3	30.2	60.5	2.3	2.3	43
Oguta	0.0	2.4	4.9	22	61	9.8	0.0	41
Ezi-Orsu	0.0	5	7.5	22.5	60	5	0.0	40
Mmahu	3.8	9.6	1.9	26.9	48.1	9.6	0.0	52
Opuoma	1.9	5.8	7.7	23.1	48.1	13.5	0.0	52
Total	1.5	5.8	3.8	28.3	51	9.3	0.5	400

Source: Researcher's computation, 2017

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The major findings of this study are summarized in this chapter with respect to the objectives namely; examination of the nature (extent, frequency, severity) of floods; assessment of households' vulnerabilities to floods; assessment of the food security situation and its determinants; assessment of the effects of flood on households' food security; and the examination of households' adaptive capacities to flooding and food insecurity in the study area. Nevertheless, the socio-economic, demographic and some farm-related characteristics of the households were summarized.

5.1.1 Households' socio-economic, demographic and farm-related characteristics

The socio-economic, demographic and farm-related characteristics were analysed because they were factors used to investigate the five objectives of this study. A demographic assessment revealed that the study comprised 56.2% male-headed households (MHHs) and 43.8% male-headed households (FHHs) with about a quarter of them being either in the age brackets between 40 and 49 years and between 60 and 69 years. The analysis also revealed that 73% of the heads of household were between the ages of 40 years and above while 27% were between 20 and 39 years of age. In addition, majority (64.5%) of the heads of households were married while only 7.8% reported to have never been married (single) with women constituting a greater number (74.7%) of people with the "widowed" status.

Only 25.8 % heads of households had no formal education. A gender-based disparity in educational level was found to be related to income and livelihood sources as 63% (out of the 25.8% of those who had no formal education) were women who were solely farmers and earned lesser monthly. In terms of monthly income, 23.5% households fell below the poverty line and the FHHs constituted the largest proportion (70.2% i.e. 66 out of 94 of households) classified as "poor" because they earned <₦15,000 or $30 monthly.

The mean household size and number of dependants per household in the study area was approximately five (5) members (5.14 and 5.01 respectively). The correlation analysis between level of education and income as well as with dependency ratio revealed that higher

income earners had higher educational degrees and those with higher educational degrees had fewer dependants, thereby making the poorer households more vulnerable to food insecurity as well as being less resilient.

Apart from farming which was predominant, other sources of livelihoods includes; fishing, trading, hunting, civil services, artisanship, pension-dependent among others. Majority of the households heads had long years of farming experience since a large proportion (47.6%) reported to have spent between 30 to 49 years while only 2% of households' heads had spent <10 years in their communities.

About half of the sampled households had access to potable water with streams forming the major source of drinking water, and 70% of the houses were made of block and zinc roof while 1.5% were constructed from wood with thatch roof. There was an observed asset disparity gap as asset poverty was linked to income because the poor did not own many assets with the exception of mobile phones and wheel barrows.

The average land holding of households is approximately 1.0 acre with 85% households cultivating communal land (major land acquisition method). Majority of the farm lands are located in flood plains and lowlands increasing the households' vulnerability to flooding and food insecurity.

5.1.2 The nature, extent, causes and occurrence of flood

Flooding was reported to be perennial with all (100%) households having been affected by flooding within the study period. The study revealed that most household (69%) suffered severe degree of flood damage which had a very close link with the frequent flood occurrence with a gargantuan percentage (91.2%) of households experiencing flood events most times in the rainy season.

The most devastating floods within a 5-year period (study period; 2012 to 2016) occurred in 2012 when all (100%) were affected and this corroborates the findings of UN-OCHA (2012) that reported the 2012 floods as the worst flood in Nigeria in the last 40 years. It could be inferred from the percentage of households affected that devastating flooding occur on a two-year basis in Anambra and Imo States since all sampled households (100%) were affected in 2012, 9.8% in 2013, 34% in 2014, 22.5% in 2015 and 48.5% in 2016. Generally, the flood depth within dwelling units ranges from <1m to >5m with majority houses being submerged by floods between 2-4m deep. River flooding was the prominent type of flooding experienced

resulting from the overflowing of the banks of Duo River, Mamu River, Ezu River, Nkisi River, Anambra River and River Niger.

Eight (8) factors were found to influence flooding in south eastern, Nigeria namely; heavy rainfall, excess river discharge, building/farming on floodplains, climate change, lack of drainage facilities, low topography, impervious surfaces and wrath of God in decreasing order.

Flood analysis from the MODIS and SRTM DEM images showed that the maximum elevation inundated in the study area was 35m above sea level, thus any area with an elevation below the 35m threshold was inundated. Owing to the fact that majority of the sampled communities are situated within an elevation of between 1-50m above sea level, they were highly inundated by the 2012 flood water. Generally, Atani, Ossomala, Mmahu and Opuoma communities were highly submerged with a recorded flood depth of above 10m. A large proportion of Ezi-Orsu and Oguta communities were partly submerged with an average flood depth of between 1-10m while a small proportion of Otuocha and Igbariam communities were submerged with flood water as deep as above 10m.

With respect to the area affected by flood, Anambra East Local Government Area (LGA) recorded the smallest proportion of 158.004 km^2 followed by Oguta, Ohaji/Egbema and Ogbaru LGAs with an inundated area of 241.982 km^2, 305.706 km^2 and 391.789 km^2 respectively. The implication is not only on the area affected but also on the proportion of the entire LGA affected. Ogbaru LGA suffered severe effects of flooding, followed by Oguta, Anambra East and Ohaji/Egbema LGAs in a decreasing order with percentage inundated area of 98.5%, 50.6%, 41.7% and 26.6% respectively. Elevation was the predominant factor that influenced the area of inundation (flood extent) in the communities and LGAs e.g. the 1.5% areas not flooded in Ogbaru LGA are on an elevation between 100-150m above sea level and the entire inundated area in all the LGAs were mainly plains between 1-50m above sea level.

Increased rainfall intensity was the major cause of flooding in the study area. The trend lines (slopes) from the trend analysis (of a 40-year rainfall data; 1974-2013) depicted rainfall increase over the study area, with a mean increase of 0.34mm over sampled communities in Anambra State and 0.13mm over Imo States' communities. Flood occurrence was seasonal and from the respondents' perspective, it occurs mainly from June to November which fall within the peak of the Rainy season, and especially from September to October (second

rainfall maxima). There was a direct correlation between the indigenous knowledge of the occurrence floods (including seasonal variations) and scientific proof as rainfall variability over the study area (as analysed from a 40-year rainfall data (1974-2013) collected from

NIMET, Lagos) shows that maximum rainfall is received between May and October.

Conclusively, flooding in the study area was caused chiefly by heavy rainfall and excess discharge from rivers, and largely severe in terms of damages as well as highly frequent as it occurred in most times of the rainy season. In addition, the flood extent was a function of elevation of the area and majority of the farmlands in the study area was submerged resulting in household food insecurity as concurred by the findings of FEWS NET (2012; 2013).
Therefore, it is concluded that since flooding occurred mostly during the harvest season of most crops (June to November), harvest and productivity are negatively affected.

5.1.3 Household Flood Vulnerability Analysis

The study considered vulnerability as the net effect of adaptive capacity (socio-economic), and sensitivity and exposure (biophysical) as defined by IPCC (2007; 2012). The Flood Vulnerability Index (FVI) for each household was computed using the first principal component (that captures the largest amount of information common to all the variables) against the standardized values for all the considered adaptive capacity, sensitivity and exposure variables. Indicators (36) were adopted to assess the exposure, sensitivity and coping/adaptive capacity of the households. The computed minimum and maximum indices across the households were -10.73 and 10.44. The negative values were associated with high vulnerability while the positive were linked to low vulnerability. Higher FVI connoted lesser vulnerability and vice versa, because when adaptive capacity of a household exceeds that of its sensitivity and exposure, the household becomes relatively less vulnerable to flooding and its effects.

Three relative flood vulnerability levels (less, moderate and high) were arrived at by running cluster analysis of the FVIs. At the household level, the less vulnerable class had FVI from 0.1 to 11 and comprised 49% households, the moderately vulnerable class recorded FVI from -0.5 to 0.09 and consisted of 3.5% households, while the highly vulnerable class had FVI from -11 to -0.6 and constituted 47.5% households. The less vulnerable households accounted for households that could relatively cope in times of flooding, though they were vulnerable. The moderately vulnerable households needed some assistance (especially

temporarily) to cope with flooding while the highly vulnerable households would need a long time assistance to cope with flooding.

"Hierarchical cluster analysis was performed on the FVIs to group the households and communities according to similarity in their degree of vulnerability using Average linkage method, and the spatial pattern of the different vulnerability levels were mapped using ArcGIS 10.2". At the community level, the tree graph revealed that Otuocha, Opuoma, Oguta and Ezi-Orsu communities were less vulnerable; Atani and Mmahu communities were moderately vulnerable while Igbariam and Ossomala communities were highly vulnerable to flooding. Consequently, Igbariam and Ossomala are known as the *flood vulnerability hotspots* in the study area.

At the LGA and State level, Ogbaru and Anambra East LGAs in Anambra State were highly vulnerable while Oguta and Ohaji/Egbema LGAs in Imo State were less vulnerable to flooding and its effects. Thus generally implying that, households in Imo State were less vulnerable to flooding and would need lesser assistance than households in Anambra State to cope with flooding.

The most vulnerable group were the households headed by younger people (especially between 20-29 years of age) whose major livelihood sources were agricultural.

Multiple Regression was used to determine the significant factors that influence household flood vulnerability in Southeastern Nigeria. The regression analysis was based on a plausible construction of the relationship between flood vulnerability (dependent variable, Y) and sixty-six (36) socioeconomic and environmental factors (independent variables, X). Out of the thirty-six (36) factors that influenced flood vulnerability, only sixteen (44.4%) were statistically significant ($P < 0.05$) at 5% level of significance, with 87.5% and 12.5% accounting for socio-economic and environmental factors respectively. The result of the regression analysis shows an intercept (constant), b_0, of 3.729 and that majority (92.9%) of the factors with negative coefficients (decreasing flood vulnerability) were connected to socio-economic factors while a third (66.7%) of those with positive coefficients (increasing flood vulnerability) were related to environmental factors. The coefficient of determination, R^2 was .831 implying that, 83.1% probability of the vulnerability to flooding was explained by the model.

Consequently, flood vulnerability predominantly and significantly decreases with increasing

age, level of education, off-farm incomes, pre-flood awareness, group membership, private land ownership, sufficient food production, available storage facility, use of fertilizer, receipt of food/aid in time of emergency, phone ownership, canoe ownership and financial support, and increases with diversified income, farmland flood experience as well as the severity of flood experienced.

Analysis of variance (ANOVA) was used to test the null hypothesis: "there is no significant difference in the vulnerability of households to flooding in the various agrarian communities" at 0.05 level of significance. The null hypothesis was rejected because the calcultaed Snedecor's F test value (49.662) was greater than the critical F test value (1.394) and the *p*-value for 49.662 was <.0001. Thus, there was a statistically significant difference in the households' vulnerability to flooding in Southeastern Nigeria and these variations in the households' flood vulnerability levels were as a result of the social, economic and environmental factors mentioned earlier. Furthermore, ANOVA was employed to show whether significant intra-household variations in vulnerability to flooding existed in the study area, and the results revealed significant differences in vulnerability to flooding between female-headed households (FHHs) and male-headed households (MHHs) since the calculated F value (66.245) was greater than the critical F value (1.394) and the *p*-value was <.0001.

5.1.4 Assessment of food security and its determinants

Food security has four pillars namely; food availability, food accessibility, food utilization and stability (FAO, 2008a). However, in order to capture the multidimensional nature of food security in this study, household food availability was measured using food sources and sufficiency in own food production while stability was measured using irrigation agriculture practice. Households' food accessibility and utilization were measured using per capita food expenditure and Food Consumption Score (FCS) correspondingly. The Household Food Security Survey Module (HFSSM) developed by the United States Department of Agriculture (USDA) was adopted to compute the comprehensive household food security status for each household.

Using the per capita food expenditure, households were classified into food secure (FSI $\geq$1) and food insecure (FSI <1) and 53.5% households accounted for food insecure households while 44.5% were food secure. Oguta community was the most food secure since it had 68.3% households with FSI $\geq$1 while Ossomala community was the most food insecure with

67.2% households having an FSI <1. Thus, food security assessment from the food accessibility dimension revealed majority of the households in the study area to be food insecure.

Non availability of data on food production influenced the use of food sources and sufficiency in own food production to assess the food availability dimension since the duo influence household consumption pattern and it could be used to determine households' vulnerability to food insecurity. The results showed that about a half (48.2%) of the sampled households produced enough food for their households. There was a lucid correlation between sufficiency in own food production and food security as households that produced enough for themselves were less vulnerable to food insecurity. However, 55.8% households depended on their own food production whereas 44.2% households relied on their own food production and markets as food sources, and it was concluded that households that depended on their own food production were more vulnerable to flood-induced food insecurity as a result of crop failure, hence the reason for the highly observed food insecurity in times of flooding in the study area.

An assessment of the food utilization dimension of food security using the FCS (developed by WFP, 2008) shows that 79% households were food secure since they had an FCS of >35 (acceptable diet) while 21% were food insecure as a result of them recording an FCS of 21.5 and 35 (borderline diet) and 0% household had an FCS of <21 (poor diet). This implies that 79% of the households recorded a high dietary diversity, indicating that majority of the households consumed all food groups at least four days per week (reflecting a high food frequency) and 21% households recorded a high food frequency (at least four days per week) in all food groups except in animal proteins consumption. However, the reasons for most households being food secure as a result of their recording high FCS, have been attributed basically to their reliant on own food production for consumption since they are largely agrarian.

There was an observed FCS disparity across the eight (8) sampled community es as Ossomala community accounted for the largest proportion (25%) of food insecure households while Ezi-Orsu community recorded the least (4.8%) within the 21% households with a borderline FCS. Similarly, for households (79%) within the acceptable diet, Atani community comprised the largest proportion (16.1%) of food secure households while Oguta community had the

smallest proportion (9.5%) of food secure households. The disparity has been related to the communities' sufficiency in own food production.

In terms of assessment of the stability dimension of food security, reliance on rain-fed agriculture or irrigation were used as proxies. These proxies were opted for because it was noted that over-reliance of households on rain-fed agriculture increases their vulnerability to flooding and food insecurity as supported by the findings of Obayelu, 2010; Orewa and Iyanbe 2009; Kuku-Shittu et al., 2013 who related poor agricultural output and food insecurity to households' sole dependency on rainfall with little or no irrigation systems in Nigeria. The results showed that 88.5% households depended exclusively on rain-fed agriculture while only 11.5% households practised irrigation agriculture in addition to rain-fed agriculture. It could be inferred from the result that 88.5% households were vulnerable to food insecurity as a result of seasonal harvest (July to October) running concurrently with the seasonal occurrence of floods, and had not benefitted from the all-season planting with an associated income generation and improved food security that come from irrigation agricultural practice.

In order to take into cognizance the multi-dimensional nature of food security, the HFSSM (developed by USDA) was adopted to assess food security comprehensively, since the (18) questions captured virtually all the food security dimensions. The differential categorization of households' food security statuses using different food security measurements/methods facilitated the adoption of the USDA approach as a standard food security assessment method in the study area. The USDA approach of measuring food security applied the Rasch model to extract scores for the food security scale used to classify food security statuses/levels into four viz; food secure (had scores between 0 and 2.32), food insecure without hunger (scores from 2.33 to 4.56), moderately food insecure with hunger (scores from 4.57 to 6.53) and severely food insecure with hunger (scores between 6.54 and 10). The score position of households on the food security scale is based on the overall pattern of response to the complete set of indicators (HFSSM, 18 questions) by the households (Bickel et al., 2000). Generally as shown by the Rasch analysis results, 33.3% households were food secure, 40.2% households were food insecure without hunger, 13% households accounted for the moderately food insecure with hunger, and 13.5% made up the severely food insecure with hunger households. The implication is that two third (66.7%) of households in the study were food insecure while only (33.3%) were food secure. It was revealed that Mmahu community

was the most food secure with 44.2% households being in this category while Igbariam community was the most food insecure with the largest proportion (39.5%) of households falling into either the moderately food insecure with hunger or the severely food insecure with hunger categories.

On the one hand, food secure households were those that reported very limited or no food insecurity or hunger whereas food insecure without hunger households had little or no reduced food intake, but had concerns regarding adequate food supply. On the other hand, moderately food insecure households had their adults (with exception of their children) repeatedly experiencing hunger due to reduction in their food intake while the severely food insecure with hunger households termed *food insecurity hotspots*, had all members (adults and children) repeatedly reducing their food intake, and would need some assistance (usually not for a short time) for them to cope with food insecurity.

However, binary logistic regression model was used to show the direction, strength and extent to which twenty-five (25) demographic, social, economic and environmental factors (independent variable, X) influence food security (dependent variable, Y) in Southeastern Nigeria at 5% significant level. The statistically significant factors with $P < 0.05$ were; sex, marital status, level of education, off-farm income, monthly income, dependency ratio, sufficiency in food production, livestock ownership, village poultry/poultry ownership, irrigation practice and flood experience. Ten (10) out of the eleven (11) significant factors had a positive coefficient with the exception of "flood experience" which had a negative coefficient. This is an indication that flooding decreases the probability of being food secure by causing a negative shift in different aspects of food security, *ceteris paribus*. Moreover, households headed by men who were married with higher income and level of education, as well as produced sufficient food for their households and practised irrigation agriculture, in addition to owning poultry and livestock were more food secure. Surprisingly, the study found a positive correlation between dependency ratio and food security, meaning households with larger number of dependents were more likely to be food secure and this has been linked to cheap farm labour as extra hands are available to cultivate more available communal land thereby increasing crop production for the agrarian households.

ANOVA was used to test the null hypothesis: "there is no significant difference in the determinants of food security among households in the agrarian communities" at 0.05 level of

significance and since the *p*-value was <.0001, lesser than 0.05, the null hypothesis was rejected, showing a statistically significant variations of the factors influencing food security across households. Similarly, ANOVA was run to show variations in vulnerability to food insecurity between FHHs and MHHs and a *p*-value of .015 was extracted, and since it is <0.05, it means the differences in the inter-household vulnerability to food insecurity were significant at 5% level.

5.1.5 Assessment of the effects of flood on households' food security

The effects of flooding on food security in Southeastern Nigeria were assessed using food expenditure before, during and after flood events; meal frequency before and after flood events; food security statuses before and after flooding using the USDA approach, comparative analysis between positive and negative effects of flooding and ordinal regression analysis to show the direction and extent of flooding on food security.

Flooding caused a mean increase of 78.14% in the tune of two thousand, seven hundred and seventy-eight Naira, twenty-five Kobo (₦2778.25) weekly in terms of amount of money spent on food (food expenditure), resulting from rise in food prices during flood events. 44.5% and 54.8% households confirmed that flooding "often" and "sometimes" respectively cause hike in food price, thereby hindering their ability to purchase food.

According to the daily meal frequency data, flooding drastically caused a 60.8% reduction in daily meal frequency (three square meal); from 82.5% households that had three square meal before flood events to 21.7% after flood events. This implies that majority of the household became food insecure after flooding.

The differential household food security status/levels before and after flooding events using the USDA approach showed that flooding generally reduced food security by increasing the number of food insecure households to 92.8% (from 66.7% households before flooding), indicating a 26.5% increase of food insecure households from the normal in Southeastern Nigeria. Similarly, flooding caused a 26.1% reduction in the number of food secure households from 33.3% that were food secure before flooding to 7.2% after a flood event. The proportions of households with the statuses of food insecure without hunger, moderately food insecure with hunger, severely food insecure with hunger were 39.3%, 15.7% and 37.8% respectively after flooding. Igbariam community was the most affected in terms of flood-induced food insecurity because all her households became food insecure after flooding

with 72.1% experiencing extreme food insecurity with hunger. The second most affected was Ossomala community which recorded only 1.6% food secure households after flooding while Oguta community was the least affected by flooding because 22% of her households were food secure after flooding which is just 4.8% lower than the number recorded before flooding. However, flooding forced majority of households to move from food insecure without hunger status to either moderately food insecure with hunger status or severely food insecure with hunger status (with the exception of households in Oguta community), thereby increasing the number of *food insecurity hotspots*. The implication is that, more households would be needing food assistance to aid them cope with the flood-induced food insecurity.

The comparative analysis of the positive and negative effects of flooding on food security showed that the negative effects outweighed the positive effects in the study. Six (6) positive and ten (10) negative effects were identified and analysed on a 5-point scale likert scale with the negative effects having a mean score of 3.88 greater than the expected 3.0 while the positive effects had a mean score of 1.78 lesser than the expected 3.0.

Principal Component Analysis (PCA) was used to determine the major areas that flooding affected food security and three components were extracted with eigen values >1 explaining 68.02% of the total variance, thus summarizing these negative effects of flooding on food security in three (3) aspects namely; food supply and distribution; household income and investment; and farm labour and facilities.

The Ordinal Regression Analysis was run to show the direction and extent to which flooding (independent variable, X) affected food security (dependent variable, Y). Ordinal regression analysis was chosen because of the ordered nature of the households' food security levels viz; food secure, food insecure without hunger, moderately food insecure with hunger and severely food insecure with hunger. The coefficient for the independent variable (flood experience) in the model was –0.798. The negative coefficient indicates a negative effect of flooding on household food security. The extent to which flooding affected food security was analysed using the odds ratio. The odds ratio for the predictor, flooding, was 2.221 indicating a strong degree of association between flooding and food security as it is greater the 1, the baseline for comparison. This implies that households that had experienced flooding were 2.221 times more likely to be food insecure than households that had not.

However, the null hypothesis which states that "there is no significant relationship between flooding and food security of households in the agrarian communities" at 5% significant level was accepted because the *p*-value of .361 is greater than 0.05, though, flooding significantly and negatively affected food security as shown in the multiple logistic regression result. Meanwhile, the observed negative relationship between flooding and food security makes flood a limiting factor that reduces food security, holding other factors constant.

5.1.6 Analysis of households' adaptation strategies to flooding and food insecurity

The study revealed a varied extent of the effects of flooding and food insecurity across households and because households experienced them differently, they adopted different coping strategies to protect themselves from further hazard or to maintain their livelihoods in the face of the stressful events (e.g. flooding).

Change in planting season, early harvest, income diversification, seasonal migration, digging run-off collection pits, elevating buildings, building makeshift houses, joining social networks, building small bridges, creating flood water pathways with bamboos and others were examined as the adaptation/coping strategies adopted by households in times of flooding. The percentage distribution of these adopted coping strategies against flooding revealed that "change in planting season" (82.7%) and "building small bridges/creating pathways for flood water" (15.5%) respectively were the most and least adopted adaptation strategies by households.

The analysed adaptation and coping strategies practised by households in times of flood-induced food insecurity and food shortages were thirteen (13) viz; skipping meals, reducing meal frequency, reducing portion size of meals, buying less preferred/desired food, eat seed stock/stocked seeds, informal borrowing (money/food), remittance, purchase food on credit, casual jobs, sale of assets, church charity, loan and begging in decreasing order of practice. Majority of the households (>80%) adopted the "skipping meals", "reducing meal frequency" and "reducing portion size of meals" and about 60% adopted buying less preferred food coping measures, thereby compromising the quantity and quality of food consumed.

However, there were some observed variations in the coping strategies adopted in times of emergencies of food insecurity and flooding by the FHHs and MMHs. The reasons for the varied adaptation strategies according to the headship of the households have been linked to

facts such as income and asset poverty gaps including differential household food insecurity levels.

Additionally, the outcomes of the analysis indicate that most of the coping strategies employed were drastic and self-devised strategies that provided momentary means of survival in times of food shortages and flooding at the household level. Therefore, more sustainable strategies having more institutional connotation (e.g. social security, food safety nets for flood victims) are suggested in times of flooding and food insecurity to reduce more pressures on households e.g. it will prevent them from eating up their seed stock/stocked seeds against the next planting season.

5.2 Conclusion

The study set out to investigate the spatial analysis of the effects of flooding on food security in the agrarian communities of Southeastern Nigeria. Flooding was found to cause negative shifts in all dimensions of food security by reducing crop harvest, decreasing income, destroying roads, destroying food/ farm storage facilities, reducing labour demand, polluting streams, reducing meal frequency, affecting the quality and quantity of food eaten as well as increasing food prices in Anambra and Imo States. Consequently, flooding was found to have a statistically significant negative effect on food security when correlated with other factors but was a limiting factor (though not significant) that affects food security negatively when regressed against the latter alone.

However, floods caused some positive effects on food security, though the negative effects were quite significant, making flooding an intractable environmental problem. Though some adaptation strategies had been adopted to cushion the effects of flooding and flood-induced food insecurity, they are ephemeral, thus, expediential long-term policies in relation to the study's flood and food insecurity analyses and maps are needed for livelihoods sustainability.

The study produced a flood vulnerability map showing the spatial variations in vulnerability levels across the study area and this would aid flood emergency response team plan evacuation in times of flood disasters. There was a statistical significant difference in households' vulnerability to flood and in the determinants of households' food security. Moreover, communities mapped as highly vulnerable to flooding recorded the largest proportions of households affected by flood-induced food insecurity, suggesting a direct proportionality between flood vulnerability and flood-induced food insecurity. Seemingly,

the state of a households' vulnerability to flooding and food insecurity are significantly determined by a combination of socio-economic, demographic and environmental factors. Consequently, households headed by younger persons were revealed to be more vulnerable to flooding whereas female-headed households were more vulnerable to food insecurity in the study area.

The study categorically revealed that larger household size is a resource in agrarian communities as it generally connotes cheaper labour and more man power for households to cultivate more land, invariably boosting their food security, *ceteris paribus*.

Therefore, our study concludes that, "The higher the dependency ratio of a household with respective higher income of the household head, the higher the level of food security". Conversely, this implies that, poorer agrarian households with higher number of dependants were highly vulnerable to food insecurity in times of flooding which had associated hike in food prices in the South eastern region of Nigeria.

5.3 Major findings and contributions to knowledge

- There are little or no safety nets for agrarian communities in Southeastern Nigeria.
- Most farmers have no idea about and have not benefitted from Agricultural programmes such as FADAMA Projects.
- Agricultural extension services are lacking in the study area.
- Socio-economic and demographic factors are the major determinants of vulnerability to flooding and food insecurity.
- There were significant inter- and intra-household differences in the vulnerability to flooding.
- There were significant inter-household variations in the determinants of food insecurity.
- Gender-based disparity in vulnerability to flooding and food insecurity was significant with FHHs having the greatest propensity to be adversely affected.
- All four dimensions of food security were measured using different indicators and it was noted that food security measurement based on one dimension of food security leads to over categorization of households into various food secure/insecure categories.
- Vulnerability to flooding is directly proportional to flood-induce food insecurity.
- Larger household size is a resource in agrarian communities as it increases the possibility of being food secure through cheaper farm labour and more man power to cultivate more land.

- Female-headed households were more vulnerable to food insecurity.
- Households headed by younger heads were more vulnerable to flooding.
- Income from off-farm activities has a decreasing effect on vulnerability to flooding and food insecurity.
- Compromising food quantity and quality are first steps taken by agrarian households in times of food insecurity.
- Flooding is a significant environmental factor that affects food security negatively.

5.4 Recommendations

In the light of the findings from the study and to assist vulnerable groups strengthen their adaptation and eventually boost the well-being of households as well as to achieve the Sustainable Development Goals especially Goal 2 which seeks to "end hunger, achieve food security and improve nutrition, and promote sustainable agriculture" with special emphasis on Target 2.4 which includes strengthening capacity for adaptation to flooding by 2030 and the Nigeria's Vision 20:2020, recommendations have been made. These recommendations are categorized into area-specific and specific policies implementations.

The area-specific recommendations are;

5.4.1. Storage facilities

Absence of storage facilities was among the major reason for decreased crop production in the last five years in the agrarian communities as many were forced to harvest early to avoid impending flood damages. Storage facilities such as yam and maize barns were found to be owned by only 22.7% households while 12.8% households had other forms of storage facilities. Thus, a construction of standard-mega-capacity storage facilities (e.g. silos for grains) at the Local Government Level would help the agrarian households store their farm produce with a multiplier effect on reducing crop wastage and economic losses during flooding, and improving food security. This could be sustained by farmers paying a maintenance fee either monthly, quarterly, biannually or annually.

5.4.2. Irrigation schemes (including flood water harvesting)

Micro irrigation was practised by only 11.5% households especially rice farmers, which negates the expected as regards the availability of rivers in the study area. Instituting irrigation schemes (micro and macro) to encourage all (off- and on-) season growing of crops is essential since majority of the households are agrarian. This will increase crop yields (by

reducing dependency on rainfall) and help agrarian households produce more during off-flood season. What is needed is for the appropriate government authorities (e.g. Anambra-Imo River Basin Development Authority) to dam the rivers that already surround these agrarian communities. Controlled flooding as a result of river damming could be an advantage to the communities since they are mostly affected by river flooding. In addition, flood water harvesting through constructed reservoirs are also encouraged to improve post flooding planting especially for rice farmers.

5.4.3. Access to Micro-credit schemes/ Economic empowerment of agrarian households

The survey showed that most agrarian households had access to little or no loan/credit facilities. Economic empowerment of these agrarian households will increase productivity as it was found out that land availability was not a problem but inadequate funds to cultivate the available land. This could be realised by incorporating into policies micro-credit schemes for agricultural households or implementing already existing policies. It will encourage larger land holdings as some farmers claimed they did not have the resources to cultivate the available (free) large expanse of communal land.

5.4.4. Social protection fund/Internally Displaced Persons (IDPs) camps

Early flood warning had been regular after the 2012 devastating flood episodes, but that is not enough as proper social protection fund and IDPs camps are encouraged to help affected households cope with flood impacts. This should be incorporated into the State's Flood Mitigation measures to enable victims settle in after flood disaster.

5.4.5. Farmers' associations, formal marketing group/market linkage

There were observed economic losses resulting from crop wastage in the agrarian communities because of lack of buyers and due to supply exceeding demand during harvest seasons. Similarly, a substantial number of household heads were not members of any Farmers' association or groups, thereby missing out on the benefits of such associations. Thus, households are encouraged to join social networks (e.g. table contribution group, organized cooperatives) to encourage savings and reduce their vulnerabilities to flooding and food insecurity. However, to curb crop wastages and supply failures, a formal marketing group is suggested to create a market linkage between registered farmers and buyers within and outside the communities. These groups could be facilitated by the government (State's Ministry of Agriculture) and non governmental agencies with farmers as executive officers.

5.4.6. Households' sensitisation and Flood insurance

There was no recorded flood insurance among the sampled households, therefore it is recommended that households are sensitised on the flood insurance and importance of having their properties insured. This will be feasible and sustainable if the flood insurance is subsidized for the farmers by the government, that is, the government contributes part of the flood insurance while farmers pay the rest.

5.4.7. Access to technology, mechanization, improved seeds, agricultural extension services

The study area was devoid of mechanized agricultural with only 10% households reported to have used tractor. Acquiring tractors is quite expensive, but the State can provide tractors and encourage farmers (especially medium- and large-scale farmers) to use them under subsidy plans. In addition, encouragement of locally constructed tractors with lesser expertise to operate is an option suggested. The animal-driven technology practised mostly in Northern Nigeria should be encouraged in these agrarian especially for small-scale farmers.

Access to agricultural extension services and improved seeds were observed to be lacking in the sampled communities, thus the services of agricultural extension personnel should be deployed in agrarian communities to aid them with improved seeds and on agricultural practices which will increase their crop productivity, improve income generated from crop sales, and thereby, their food security.

Strengthening and implementations of initiatives and policies such as;

5.4.8. Agriculture Promotion Policy (APP)

The judicious implementation of the Agriculture Promotion Policy (APP) would enhance food security in the agrarian communities. The Agriculture Promotion Policy (APP) (2016-2020) is a continuation of the Agricultural Transformation Agenda (ATA) policy (2011-2015) built on the principle that agriculture is a business. The APP aims at enhancing access to land, inputs, finance, information and knowledge, climate smart agriculture as well as increasing production.

5.4.9. Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL)

The strengthening of Nigeria Incentive-Based Risk Sharing system for Agricultural Lending (NIRSAL) initiative was launched in 2011 and integrated by the Central Bank of Nigeria (CBN) in 2013. It was proposed to enable the flow of affordable financing to all stakeholders

within the whole agricultural value chains. The Southeastern region has comparative advantage in the production of two (maize and cassava) among the six pilot crops (tomatoes, rice, soya beans, cotton, maize and cassava) of NIRSAL. This will reduce poverty, increase access to credit, improve productivity and food security in the agrarian communities.

5.5 Recommendations for Further Research

The study has been able to demonstrate that flooding induces food insecurity leading to changes in food consumption patterns, and this flood-induced food insecurity arises as a result of destruction of farmland, disruption of sources of livelihoods, rise in food prices which significantly affect food availability, accessibility and utilization over time. Thus, the following are suggested for further studies;

- Relationship between vulnerability to flooding and food insecurity in other regions with emphasis on how flood extent influence crop yield since crop yield could not be integrated in the survey used for our analysis due to lack of data.
- The role of food prices as a determinant of household food security to test the robustness of this study's findings.

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APPENDIX 1: Household Questionnaire on the spatial analysis of the effects of flooding on food security in the agrarian communities of Southeastern Nigeria

Questionnaire number:	**Name of interviewer:**
Name of community/town:	**Interview date:**
Ward/LGA/State:	**Time started:**
GPS coordinate: **Elevation:**	**Time ended:**

Section A: Socio-economic characteristics

1. Gender of head of household: Male [ ] Female [ ]
2. How long have you lived in this community? Years..... Months.....
3. What is your age in years? .....
4. Marital status: Single [ ] Married [ ] Divorced [ ] Separated [ ] Widowed [ ]
5. What is your educational qualification? FSLC [ ] WAEC [ ] NCE/OND [ ] HND/B.Sc/B.Ed [ ] M.Sc or its equivalent [ ] Ph.D [ ] None [ ]
6. If married, what is the level of education of spouse and occupation.....and.....
7. Which is/are your main source(s) of income (occupation): Farming [ ] Fishing [ ] Trading/Business [ ] Civil servant [ ] Pension [ ] Technician/artisan [ ] Apprentice [ ] Student [ ] Hunting [ ] Others (specify).e.g water and fruit sales.....
   .....
8. Which is/are your other source(s) of income (occupation): Farming [ ] Fishing [ ] Trading/Business [ ] Civil servant [ ] Pension [ ] Technician/artisan [ ] Apprentice [ ] Student [ ] Hunting [ ] Others (specify).e.g water and fruit sales.....
   .....
9. Monthly income (in Naira): <15,000 [ ] 15,001-30,000 [ ] 30,001-45,000 [ ] 45,001-60,000 [ ] 60,001-75,000 [ ] 75,001-90,000 [ ] 90,001 and above [ ]
10. Number of children..... Number of male..... Number of female.....
11. Number of dependants.....
12. How much do you spend on food weekly? .....
13. During a flood event, how much do you spend on food weekly? .....
14. After a flood event, how much do you spend on food weekly? .....
15. How many times do you eat before a flood event? Once [ ] Twice [ ] Twice-Thrice[ ] Thrice [ ]
16. How many times do you eat after a flood event? Once [ ] Twice [ ] Twice-Thrice[ ] Thrice [ ]

Section B: Flood Characteristics/Household Vulnerability to flooding

17. The house you live in is made of? Block with zinc roof [ ] Block with thatch roof [ ] Zinc with zinc roof [ ] Mud with zinc roof [ ] Wood with zinc roof [ ] Mud with thatch roof [] Wood with thatch roof [ ] Others (specify).....
18. Have you experienced flood in your farmland? Yes [ ] No [ ]
19. Have you experienced flood in your area of residence? Yes [ ] No [ ]
20. When do you usually experience flooding? March-May [ ] June-August [ ] Sept-Nov [ ] Dec-Feb [ ]
21. In which year(s) did you experience extreme flood events? .....
    .....

22. How frequently does flood occur in your area? Rarely [ ] Occasionally [ ]
Whenever it rains [ ] Throughout the rainy season [ ]
23. What is the degree of flooding experienced? Mild [ ] Moderate [ ] Severe [ ]
24. What type(s) of flood have you experienced? Rain flood [ ] River flood [ ]
Others (specify).....
25. What is the height/depth of flood water in your area? < 1m [ ] 1-2m [ ] >2m [ ]
>3m [ ] >4m [ ] >5m [ ]
26. Have you ever been affected by flood? Yes [ ] No [ ]. If yes, in which year(s).....
.....
27. Have you been affected by flood in the last 6 months? Yes [ ] No [ ];
in the last 1 year? Yes [ ] No [ ]
28. How long did it take you to recover from the shock caused by flooding? 1-3 weeks [ ]
1-3 months [ ] 4-6 months [ ] 7-9 months [ ] 10-12 months [ ] 1-2 years
[ ] 3-4 years [ ] Others (specify).....
29. How aware were you of the effects of flooding before you experienced them?
Highly aware [ ] Fairly aware [ ] Little awareness [ ] Not aware [ ]
30. Are you a member of any group/association? Yes [ ] No [ ]
31. Which of these are you a member of? CBO [ ] Voluntary Organisation [ ]
Social networks [ ] Kinship network [ ] Religious group [ ] Farmers' Association [ ]
Age grade [ ] Women Association [ ] Others (specify).....
32. Have any of the groups in question 29 helped in times of suffering from the effects of flood? Yes [ ] No [ ]
33. If yes, which of them.....and what was done/given? .....
.....

Section C: Food security situation/level of households

34. If you are a farmer, how did you acquire the land you farm on? Inheritance [ ]
Sharecropping [ ] Hired/rented/leased [ ] Purchased [ ] Gift [ ]
Communal [ ] Others (specify).....
35. What types of crop do you cultivate with **1 given to the most significant/important**?

Rice		Yam		Cassava		Maize		Cocoyam		Pepper		Vegetable (ugu)		Egusi		Okra			
								Potatoes				Tomatoes							

36. What are your sources of food? Own food production [ ]
Own food production and market [ ]
37. Do you produce what is sufficient for your household? Yes [ ] No [ ]
38. How much do you usually consumed per month of the crops you produce?

Crops	Amount consumed (bags/kg)

39. What are the food items you normally buy from the market? .....
.....
40. During or after flood events, what food items do you buy from the market?
.....
.....

41. How would you describe your crop harvest in the last five years?
Increasing [ ] Decreasing [ ] The same [ ]
42. If decreasing, what would you say is/are the reason(s) .....
.....
.....
43. If increasing, what would you say is/are the reason(s).....
.....
.....
44. What type of livestock do you keep? Goats [ ] Sheep [ ] Pigs [ ] Cattle [ ] None [ ]
Others (specify).....
45. Do you have a village poultry (VP) or agric poultry farm? Yes [ ] No [ ]
46. How true are the statements below as regards food security in your household?

s/n	Question	Response		
		Often true	**Sometimes true**	**Never true**
i	Do you always have enough food to eat?			
ii	Do you always have the kinds of food you want?			
iii	Do you worry if your food stock will run out before you get another to eat?			
iv	Do you have enough resources to acquire enough food?			
v	Could you afford to eat balanced meals?			
vi	Do you supplement your children's feed with low cost foods?			
vii	Can you afford to feed your children balance meals?			
viii	Were your children not eating enough, because you couldn't afford enough food?			
ix	Do adults in your household skip meal or cut the size of their usual meals?			
x	Do you eat less than what you feel, you should?			
xi	Were you ever hungry, but didn't eat?			
xii	Did you lose weight, because there wasn't enough food to eat?			
xiii	Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?			
xiv	If true for question xiii, how often did this happen?			
xv	Did you ever cut the size of your children's meal because there wasn't enough money for food?			
xvi	Did any of the children ever skip meals, because there wasn't enough food to eat?			
xvii	Did any of the children ever not eat for a whole day?			
xviii	Were the children ever hungry but you just couldn't afford more food?			

47. How true are the statements below as regards food security in your household **during flood events**?

s/n	Question	Response		
		Often true	**Sometimes true**	**Never true**
i	Do you always have enough food to eat?			
ii	Do you always have the kinds of food you want?			
iii	Do you worry if your food stock will run out before you get another to eat?			
iv	Do you have enough resources to acquire enough food?			
v	Could you afford to eat balanced meals?			
vi	Do you supplement your children's feed with low cost foods?			
vii	Can you afford to feed your children balance meals?			
viii	Were your children not eating enough, because you couldn't afford enough food?			
ix	Do adults in your household skip meal or cut the size of their usual meals?			
x	Do you eat less than what you feel, you should?			
xi	Were you ever hungry, but didn't eat?			
xii	Did you lose weight, because there wasn't enough food to eat?			
xiii	Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?			
xiv	If true for question xiii, how often did this happen?			
xv	Did you ever cut the size of your children's meal because there wasn't enough money for food?			
xvi	Did any of the children ever skip meals, because there wasn't enough food to eat?			
xvii	Did any of the children ever not eat for a whole day?			
xviii	Were the children ever hungry but you just couldn't afford more food?			
xix	During flood events, did you go hungry because your farmland, yam or corn barn was destroyed?			
xx	Did transport fare increase during flood events?			

48. How true are the statements below as regards food security in your household **after flood events**?

s/n	Question	Response		
		Often true	**Sometimes true**	**Never true**
i	Do you always have enough food to eat?			
ii	Do you always have the kinds of food you want?			
iii	Do you worry if your food stock will run out before you get another to eat?			
iv	Do you have enough resources to acquire enough food?			
v	Could you afford to eat balanced meals?			
vi	Do you supplement your children's feed with low cost foods?			
vii	Can you afford to feed your children balance meals?			

viii	Were your children not eating enough, because you couldn't afford enough food?			
ix	Do adults in your household skip meal or cut the size of their usual meals?			
x	Do you eat less than what you feel, you should?			
xi	Were you ever hungry, but didn't eat?			
xii	Did you lose weight, because there wasn't enough food to eat?			
xiii	Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?			
xiv	If true for question xiii, how often did this happen?			
xv	Did you ever cut the size of your children's meal because there wasn't enough money for food?			
xvi	Did any of the children ever skip meals, because there wasn't enough food to eat?			
xvii	Did any of the children ever not eat for a whole day?			
xviii	Were the children ever hungry but you just couldn't afford more food?			
xix	After flood events, could you not afford food because of increase in food prices?			

48. Do you know about balanced/adequate diet? Yes [ ] No [ ]
49. How often do you consume the under listed food items in your household?

Food item	Food group	Frequency of consumption (in days/week)			
		Often (4-7 days)	Sometimes (2-3 days)	Rarely (a day)	Never (0 day)
Maize, rice, sorghum, millet, pasta, bread, wheat and other cereals. Cassava, potatoes and sweet potatoes, other tubers, plantains	Main staples				
Beans, peas, groundnuts and cashew nuts	Pulses				
Vegetables, leaves	Vegetables				
Fruits	Fruits				
Beef, goat, poultry, pork, eggs and fish	Meat and Fish				
Milk yogurt and other diary	Milk				
Sugar and sugar products, honey	Sugar				
Oils, fats and butter	Oil				
spices, tea, coffee, salt, fish power	Condiments				

Section D: Determinants of food (in)security

50. Estimate the distance to your farmland (from your house) (in min/hr) by
Foot.....Bicycle..... Motorcycle.....
51. Estimate the distance to main road (from your house) (in min/hr) by
Foot.....Bicycle..... Motorcycle.....
52. Estimate the distance to the market (from your house) (in min/hr) by

Foot.....Bicycle..... Motorcycle.....

53. Estimate the distance to the hospital (from your house) (in min/hr) by
Foot.....Bicycle..... Motorcycle.....
54. Do you farm on scattered pieces/parcels of land? Yes [ ] No [ ]
55. What is the size(s) of your farmland?.....and the size of farm in the compound?.....
56. Where do you sell your farm produce? Farm gate [ ] Market [ ]
Formal marketing group [ ] Others (specify).....
57. Where is your farm located? Lowland [ ] upland [ ] Floodplain [ ] Downstream [ ] Upstream [ ] Valley [ ]
58. Which means of transportation do you carry your farm produce to your home/market? Head [ ] Wheel barrow [ ] Bicycle [ ] Tricycle [ ] Motorcycle [ ] Vehicle [ ] Canoe [ ] Speed boat [ ] Others (specify).....

59. Where do you source your seeds for planting? Market [ ] Other farmers/friends [ ] Agric. Extension workers [ ] Relatives [ ] Others (specify).....
60. Where do you store your farm produce? .....
.....
.....
61. Do you use tractor? Yes [ ] No [ ]
62. Do you use fertilizer? Yes [ ] No [ ]
63. Does the government subsidize fertilizer for farmers in your community? Yes [] No []
64. How much is a bag of fertilizer sold (in Naira)? .....
65. What type of agriculture do you practise? Rainfed [ ] Irrigation [ ] Mixed (rainfed-irrigation) [ ] Post flooding[ ]
66. Have you ever received food aid? Yes [ ] No [ ]
67. If yes, which year(s)..... from whom..... and why/what happened?.....
68. What are factors that hinder crop production in your community? .....
.....
.....
.....

Section E: Causes and Effects of flooding and on food security

69. Which of the following do you know as the causes of flooding in your area?
Heavy rainfall [ ] Excess river discharge [ ] Flat terrain [ ] Climate change [ ] Building/farming on floodplains [ ] Wrath of God [ ] Impervious surfaces [ ] Lack of gutters [ ] Others (specify).....
.....
70. Do you think that flooding has a positive effect on food security? Yes [ ] No [ ]

71. If you agree that flooding does, can you rate the extent of this effect of flooding using a 5-point scale with 1= To no extent; 2=To little extent; 3= To a moderate extent; 4= To a great extent; 5= To a very great extent

Positive effect of flooding on food security	**1**	**2**	**3**	**4**	**5**
Increases crop harvest					
Increases farm income derived from crop sales					
Increases labour demand					

Decreases food item prices					
Increases soil fertility through alluvium deposits					
Increases fish catch					
Others (specify)					

72. Do you think that flooding has a negative effect on food security? Yes [ ] No [ ]

73. If you agree that flooding does, can you rate the extent of this effect of flooding using a 5-point scale with 1= To no extent; 2=To little extent; 3= To a moderate extent; 4= To a great extent; 5= To a very great extent

Negative effect of flooding on food security	**1**	**2**	**3**	**4**	**5**
Reduces crop/fish pond harvest					
Decreases farm income derived from crop/fish sales					
Destroys road					
Destroy food/ farm storage facilities					
Reduces labour demand					
Pollutes streams					
Reduces the number of times food is consumed (skipping of meals due to lack of money)					
Affects the quality of food eaten					
Affects the quantity of food eaten					
Increases food items prices					
Others (specify)					

74. What effect(s) of flooding have you experienced? Loss of life [ ]
Destruction of farmland [ ] Abandonment of property [ ] Traffic jams [ ]
Loss of household property [ ] Seasonal displacement [ ] Loss of livestock [ ]
Stream pollution [ ] Disease Outbreak [ ] Emotional trauma [ ]
Disruption of income earning opportunities [ ] Others (specify).....
.....

75. What measures have you employed to minimise effects of flooding or manage flood?
Seasonal migration [ ] Change in planting season [ ] Building runoff collection pits [ ]
Sand filling [ ] Elevating buildings [ ] Building makeshift houses [ ]
Joining social networks/other groups [ ] Flood insurance [ ] Income diversification [ ]
Early harvest [ ] Building small bridges/creating flood water pathways [ ]
Others (specify).....
.....

76. What has the Government done to combat flooding and its effects in your area?
Monetary compensation [ ] Provision of relief materials [ ]
Early warning of flood through radio, TVs etc [ ] Construction of drainage systems [ ]
Evacuation [ ] Built low cost houses for affected people [ ] Created IDPs Camp [ ]
Loan [ ] Others (specify).....

77. In your opinion, what do think can be done to reduce the effects of flooding on food security? .....
.....
.....

Section F: Household assets/amenities and Coping strategies/adaptive capacity

78. Which of the items does your household have?

Electricity		Wheel barrow		Refrigerator		Phone		Furniture (sofa, chairs)	
Generator		Motorcycle		Television		Car		Bank savings	
Electric fan		Bicycle		Radio		Cart		Canoe Others (specify)	

79. Has any of the above items been sold because you needed money to buy food? Yes [ ] No [ ]
80. Has flood ever forced you to sell any of your household assets? Yes [ ] No [ ]

81. What is/are your source(s) of drinking water in the rainy season? Rain harvest [ ] Pond [ ] Tank supply [ ] Own hand-dug well [ ] Public hand-dug well [ ] Stream [ ] Public tap/Pipe-borne water [ ] Compound bore-hole [ ] Community bore-hole [ ] Others (specify).....
82. What is/are your source(s) of drinking water in the dry season? Pond [ ] Tank supply [ ] Own hand-dug well [ ] Public hand-dug well [ ] Stream [ ] Public tap/Pipe-borne water [ ] Compound bore-hole [ ] Community bore-hole [ ] Others (specify).....
83. How do you dispose of waste? River [ ] Open dumping [ ] Burning [ ] Dumping in pit/drum [ ] Burying [ ] Others (specify).....
.....
84. Do you have a toilet? Yes [ ] No [ ]
85. If yes, what type of toilet? Water cistern [ ] Pit [ ] Others (specify).....
.....
86. What coping strategies have been adopted by your household in times of food shortages/food insecurity? Skipping meals [ ] Buying less preferred/desired food [ ] Reducing portion size of meals [ ] Casual jobs [ ] Informal borrowing (money/food) [ ] Reducing number of times food is eaten [ ] Collecting loan [ ] Sale of assets [ ] Church Charity [ ] Begging [ ] Purchase food on credit [ ] Remittance [ ] Eat seed stock [ ] Others (specify).....
.....
87. At what level do your children/dependants enjoy free education? Primary [ ] Secondary [ ] Tertiary [ ] Nil [ ]
88. Did/Does the government/school proprietor feed your children/dependants daily in school? Yes [ ] No [ ]
89. If yes to question 85 above, how often are they fed? Daily [ ] Thrice/week [ ] Twice/week [ ] Once/week [ ]
90. Does the family receive financial support from other members living elsewhere? Yes [ ] No [ ]
91. How often do you receive financial support from this/these family member(s)?

Frequency	**amount**	**Sender (relationship)**
Occasionally		
Weekly		
Monthly		
Quarterly		
Twice in a year		

92. Do you have access to credit/loan/microfinance from any source? Yes [ ] No [ ]
93. If yes, name it/them.....
.....
94. Are you aware of any Farmers' Associations? Yes [ ] No [ ]
95. If yes to the question 94 above, list them.....
.....
.....
96. Are you a member of any of them? Yes [ ] No [ ]
97. What is/are your reason(s) for your answer to question 96 above? .....
.....
.....

Appendix 2: Focus Group Discussion/ Key Informant Interview

1. Flooding has been observed as a problem faced in this town, yet people have been able to sustain their livelihoods, what could be the reason(s)?
2. In which month(s) of the year is flooding usually experienced?
3. When is the effect of flooding felt most?
4. What type of flood is experience? Its frequency and severity?
5. When is the usual planting season? If different from the known, then reasons should be given.....
   ……...
6. What are the factors that hinder crop production in your community?
7. Is fertilizer subsidized in your community?
8. Do farmers have access to credit/loan/microfinance?
9. What are major sources of drinking water?
10. Do farmers' have Associations?
11. Are Agric. Extension workers available?
12. Do you have access to early flood warnings?
13. What are the measures to reduce the effects of flooding in your community?
14. How often did flood victims receive relief materials/food aid?
15. Does flooding have positive or negative effects on crop production?
16. Does flooding affect food security in your community? How or in what aspect(s)…..
    ……..
    ……
17. What are the coping strategies adopted against food insecurity?
18. Can you estimate how much your community contribute to the economy of your State?
19. Are people happy to be farmers or do they think of it as the only thing they can do?
20. How is land acquired and do woman have access to land?
21. What type of flood is experience? Its frequency and severity?
22. What are the major crops produced.
23. Why do they cultivate certain crops and not others?
24. Do farmers practice irrigation farming?
25. Do farmers produce enough for their households and also sell?
26. What would you say about crop harvest in the last 5 years? Increasing, decreasing or the same.....
27. Can reasons of any of the answers above be given? .....
    ……
    ……
28. What are the major means of transporting farm produce?.....
    ……...
    ……..
29. Is free education also enjoyed here? If yes, at what level?

Food security, according to FAO (2008) exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. A state of food security requires that: sufficient food is available; all people have economic and physical access to the food they need; access and availability are ensured over time (stability), and the food is effectively utilised. Achieving food security requires not just achieving an adequate level of food consumption and good nutrition, but maintaining this level at low risk over time.

Working definition: exists when households do have adequate physical food for consumption, and have the social or economic access to enough food for an active, healthy life at all times.

APPENDIX 3: Spearman's correlation result between number of children and number of Dependants

Correlations

			Number of children	Number of dependants
Kendall's tau_b	Number of children	Correlation Coefficient	1.000	.806**
		Sig. (2-tailed)	.	.000
		N	400	400
	Number of dependants	Correlation Coefficient	.806**	1.000
		Sig. (2-tailed)	.000	.
		N	400	400
Spearman's rho	Number of children	Correlation Coefficient	1.000	.883**
		Sig. (2-tailed)	.	.000
		N	400	400
	Number of dependants	Correlation Coefficient	.883**	1.000
		Sig. (2-tailed)	.000	.
		N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX 4: Spearman's correlation result between level of education and income

Correlations

			Educational level	Monthly income (in Naira)
Kendall's tau_b	Educational level	Correlation Coefficient	1.000	.365**
		Sig. (2-tailed)	.	.000
		N	400	400
	Monthly income (in Naira)	Correlation Coefficient	.365**	1.000
		Sig. (2-tailed)	.000	.
		N	400	400
Spearman's rho	Educational level	Correlation Coefficient	1.000	.426**
		Sig. (2-tailed)	.	.000
		N	400	400
	Monthly income (in Naira)	Correlation Coefficient	.426**	1.000
		Sig. (2-tailed)	.000	.
		N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix 5: Spearman's correlation result between level of education and number of dependants

Correlations

			Educational level	Number of dependants
Kendall's tau_b	Educational level	Correlation Coefficient	1.000	-.129**
		Sig. (2-tailed)	.	.001
		N	400	400
	Number of dependants	Correlation Coefficient	-.129**	1.000
		Sig. (2-tailed)	.001	.
		N	400	400
Spearman's rho	Educational level	Correlation Coefficient	1.000	-.164**
		Sig. (2-tailed)	.	.001
		N	400	400
	Number of dependants	Correlation Coefficient	-.164**	1.000
		Sig. (2-tailed)	.001	.
		N	400	400

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX 6: Rainfall Data (1974-2013) collected from NIMET

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oguta and Ohaji/Egbema	1974	0	23.2	86.6	240.3	309.6	280.9	580.4	377.2	300.7	244.9	26.4	0
65252	1975	0	51.1	94.7	138.9	239	142.1	291.7	274	527.9	214.9	88.3	30.2
65252	1976	0	158.8	209.8	211.1	133.6	409.7	220.5	265.4	239.8	400.8	53.8	102.6
65252	1977	24	19.3	85.5	86.4	165.3	286.9	399.8	284.2	383.4	228.5	0.2	25.4
65252	1978	0	47.9	177	265.8	309.4	200.5	227.5	355.9	432.5	326.4	53.5	0.1
65252	1979	26	89.7	143.1	167.2	213.3	420.7	297.7	366.3	534.6	319.7	107.6	0
65252	1980	0	9.9	83.8	221.7	161.3	494.8	309.9	463.3	234.7	251	167.8	0
65252	1981	84.9	17	104.4	180.5	342.1	345.1	339.9	322	543.5	122.2	31.1	0
65252	1982	59.2	110.6	134.6	102.5	326.5	303.4	429.9	258.7	268.5	313.3	97.1	0
65252	1983	0	1	50.8	54.3	257.6	293.8	274.8	157.9	373.5	23.3	32.1	38.8
65252	1984	0	3.5	108.5	204.8	218.5	372.8	285.6	336	297.1	291.5	29.8	5.1
65252	1985	51	8.8	259.7	149.5	354.3	279.2	416.2	433.5	250.7	125.2	64.4	3.6
65252	1986	105.3	15.5	147.2	148	190.3	211.5	426.8	244.8	546	399.4	47.6	0.5
65252	1987	0	26.9	97.6	62.4	201.5	305.4	223	475	449	214.8	19.9	0
65252	1988	10.9	12.2	172.2	187.6	220.6	428.6	327.1	278.9	446.1	392.7	34.4	52.4
65252	1989	0	0	86.4	225.6	304.3	469.5	321.6	431.6	316.6	360.8	26	39.1
65252	1990	9.8	10	7.1	213.2	185.2	256.9	650.1	641	571.1	273.3	119.7	23.9
65252	1991	0	42.5	107.1	182.6	245.2	498.3	402.9	521.1	193.9	349.8	24	0
65252	1992	0.9	2.8	157.5	216.8	248.1	373	489.9	289.4	333.7	214.9	79.5	17.6
252	1993	0	58.7	90.2	177.8	291	293.9	464.3	315.5	218.8	176.6	73.7	22.3
65252	1994	37.1	34.3	45.9	99.6	298.8	185.9	468	438.2	622.2	284.3	111.7	0
65252	1995	59.6	12.5	72.2	115.9	361.5	339.2	484	381.6	460.9	292.4	26.7	15.8
65252	1996	21.1	74.6	68.7	238.4	252.7	395.3	350	502	573.2	228	1.5	0
65252	1997	31.7	0	215.1	309.8	542.7	504.8	311.9	304.3	242.5	262.5	137.4	28.7
65252	1998	14.6	0	48.7	130.5	253.7	289.4	288.9	168.5	254.2	179.2	12.4	0
65252	1999	49.1	73.9	118.7	161.5	256.7	218.3	270.5	302.7	609	354.5	100.5	0

	65252	2000	39.1	0	53.2	354.2	47.3	391.8	382.7	356.4	344	246.5	116.5	5.5
	65252	2001	5.5	62	206.4	172.2	140.8	385.4	301.7	348.7	430.8	213.4	22.6	14.8
	65252	2002	27.9	90.4	241.7	265.6	198.3	391.5	131.5	293.5	372.4	40.9	0	0
	65252	2003	92.6	136.9	73.3	278.1	277.4	439.5	379.2	476.4	123.8	50.6	0	0
	65252	2004	73.5	32.4	173.3	163.1	225.2	240.4	185.4	309.1	322.9	37	0	0
	65252	2005	35.5	58.4	102.6	194.3	469.8	367	260	302.4	232.9	199.8	13.9	0
	65252	2006	89.8	1.8	167.9	81.9	358.2	454.7	625.5	286.7	479.4	360.6	302.6	0
	65252	2007	0	0	46.7	31.2	261.5	309.8	480.9	507.1	302	186.4	75.2	0
	65252	2008	0	0	117.4	169.2	169.6	470.6	630.2	289.6	433.6	382.9	9.2	25.2
	65252	2009	38.6	33.2	68.9	248.9	413.5	239	509	528.8	483.8	245.9	106.3	0
	65252	2010	0	53	34.1	164.2	292.8	255.1	272	453.2	237.8	294.6	22.4	1.6
	65252	2011	0	133.7	79.8	114.8	342.1	176.7	305.9	500.4	377.1	280.9	40.3	0
	65252	2012	0	74.1	22.1	138.1	234.4	284.2	415	285.4	501.9	192.3	113.2	0
	65252	2013	46.5	40	130.9	190.5	270.4	181.6	254.1	491	273.8	96.7	48.6	132.4

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ogbaru and Anambra East	1974	0	9.7	83.3	135.4	156.7	205.7	345.4	271.3	216.9	210.2	1.6	36.1
65245	1975	0	7.1	27.4	120.7	274.8	231.9	153.5	115.4	213.5	172	71.9	10.4
65245	1976	0	153.2	53.8	121.6	186.1	289.1	230.4	276.8	308.3	335.5	79.7	32
65245	1977	8.7	0.4	77.7	64.1	194.1	180.4	303.4	248.6	362.3	264.5	3.8	20.9
65245	1978	0	66.4	47.1	248.4	334.9	238.9	192.6	188.6	228.5	236.8	7.9	7.6
65245	1979	0	23.5	28.1	189.2	204.1	254.6	182.5	403	316.8	146.1	75.2	0
65245	1980	0	43.1	88.9	79.9	249.3	174	361	173.7	232.4	193.4	67.1	15.6
65245	1981	5.6	20.7	32.9	79.3	337.3	315	375.7	113.7	311.8	222.7	27.4	0
65245	1982	16.1	53.5	96.9	103.1	235	260.3	287.2	177	264.3	211.5	12.8	0
65245	1983	0	0	83.4	16.9	216.8	232.4	294.2	114.4	342.2	72.4	6.5	0
65245	1984	5.3	0	90.6	116.6	241.1	309.6	237.1	297.3	253.1	117.9	18.6	0
65245	1985	6	0	197.3	156.4	255.1	223.4	312.2	273.3	234	127.2	9.5	0

65245	1986	2.6	27.2	60.2	95.5	222.7	107	265.8	138.6	410.2	216.9	71.2	0
65245	1987	0	9.7	21.2	8.1	72.8	257.2	245	505.4	203.2	163.4	3.7	13.8
65245	1988	11.1	0.4	93.6	81.4	154.4	247.2	478.2	204.6	529.7	192.1	1.8	13.7
65245	1989	0	0	19.2	135.8	213.7	268	213.3	360.8	276.5	267.2	27.5	0
65245	1990	1.8	0	0	266.6	131.9	268.5	449.3	314.9	312.8	179.3	32	52.5
65245	1991	0	42.3	64	186.3	216.4	286.4	290.5	390.4	341.1	243.1	6	16.9
65245	1992	0	0	13.5	99.7	266	311.3	475.6	200.4	280.2	101.9	56.3	0
65245	1993	0	17.2	9	94.7	84.6	234.3	325.7	364.1	311.9	166.3	37.5	8.9
65245	1994	23.6	0	17.2	175.6	285.4	215.2	326.1	256	348.5	377.7	56.4	0
65245	1995	64.1	60.2	118	112.4	249.3	382.7	429.4	347.2	295.4	362.5	49	0.3
65245	1996	1.1	22.3	79	103.1	281.3	236.8	171.9	352.4	317.6	256.3	4.9	0
65245	1997	1.6	0	114.2	305.7	300.1	216.7	214.5	188.5	247.3	252.7	45.9	19.8
65245	1998	0.2	24.6	30.4	170.5	344.3	291.5	362.7	91.2	360.6	407.1	0.5	2.6
65245	1999	27.9	12.9	52.2	98.6	320.9	186.2	279.9	255.6	347	353.9	53	0
65245	2000	36	0.2	155.2	91.6	167.5	313.5	201.2	367.7	164.9	164.9	8.7	3.4
65245	2001	0.1	0.2	40.1	236.9	188	267.8	225.3	272.8	177.2	146.3	1.5	0
65245	2002	22.8	22.7	79.2	220.7	258.6	251.9	330.9	242.1	316.4	32	0	0
65245	2003	6.8	40.1	136.1	161.2	200.9	425.4	212.5	383.3	249.5	28.1	1.3	0
65245	2004	23.6	3.8	225.3	415.2	257.9	384.1	223.8	339.5	170.8	37.9	6	0
65245	2005	0	0	22	42.9	90.5	209.8	132.4	112.7	159.4	91.6	0	0
65245	2006	54.8	9.1	198.3	91.6	251.4	345.6	114.7	234.5	386.5	220.3	0	0
65245	2007	0	0	0	82.3	283.8	209.9	218.5	397.9	279.8	283.8	46.4	0
65245	2008	0	0	44.9	237.7	238.8	159.5	236.7	318.6	354.6	160.5	13.8	0
65245	2009	8.2	1.7	18.6	73	142.5	139.4	540.2	410.1	122.1	213.3	96.7	0
65245	2010	0	0.5	27.6	280	111.3	246.6	246.7	336.5	200.1	189.5	113.9	0
65245	2011	0	54.5	98.4	169.3	465.2	269	454.5	498.5	458.7	456.2	0	0
65245	2012	0.1	15.8	20.6	164.3	68.2	209.4	294.5	328.5	144.7	296	104.8	0
65245	2013	7.7	5.1	60	200.2	137	311.6	255.7	167.3	235.9	224.3	19.9	19.7

Source: Nigeria Meteorological Agency