RURAL LIVELIHOODS AND FOOD INSECURITY AMONG FARMING HOUSEHOLDS IN SOUTHWESTERN NIGERIA

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A Thesis in the Department of Agricultural Economics,

Submitted to the Faculty of Agriculture

in partial fulfillment of the requirements for the Degree of

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF IBADAN

APRIL, 2023

CERTIFICATION

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DEDICATION

This project is dedicated to Almighty Allah; verily with Him, all things are possible. I adore and glorify Him for giving me the opportunity, against all odds to complete this project. I also dedicate this thesis to my parents, Alhaji Abdul Rasaq Yaqoob and Mrs. Saudat Yaqoob. “O Allah, have mercy upon them as they brought me up” (Quran 17, verse 24).

ACKNOWLEDGEMENTS

All praises are due to the Almighty, the Custodian of the heavens and the earth, the most beneficent and the most merciful for the opportunity given to me to complete this thesis. Forever, I will glorify His name for no one can deny whosoever He blesses and no one can give to whosoever He denies.

I sincerely appreciate my supervisor, Professor Mohammad Abdul Yakeen, Rahji for his thoroughness, patience and mentorship. I am particularly grateful to him for his thought provoking arguments, suggestions and painstaking efforts that have helped to shape the quality of this thesis. May Allah bestow His special blessings on him and members of his household. Indeed, my appreciation knows no bound for he has bequeathed in me his vast experience in academics, professional and dynamics of real life. May Allah make his sojourn on the surface of the earth more glorious and may He as well crown his efforts with unprecedented achievements so that he will have course to glorify His name. My appreciation will be incomplete without acknowledging the contributions of other members of my supervisory committee, Prof. K.K. Salman and Dr. Oluwakemi Obayelu for their supports that contributed immensely to the quality of this thesis. While appreciating his specific efforts in ensuring prompt delivery on my doctoral pursuit without compromising the quality assurance of the project, Prof. K.K Salman is second to none in terms of openness, accessibility and dedication. I cannot but also appreciate the technical contribution of Dr. Oluwakemi Obayelu towards a successful completion of this project.

I also appreciate the Department of Agricultural Economics of University of Ibadan under the leadership of Prof. S.A. Yusuf for offering me the neccessary institutional support to actualise my academic ambition. I also appreciate the contributions of other academic staff members – Professors V.O. Okoruwa, T.T. Awoyemi, B.T. Omonona, Adetola Adeoti, O. A Oni, Kemisola Adenegan, Drs. Adeola Olajide, Abimbola Adepoju, Ogbeneruemu Obi-Egbedi, Olubunmi Alawode, Fatai Sowunmi, and C.Idiaye. May God continue to enrich their human capacity for the benefit of mankind. Also worthy of mentioning is the support of non-academic staff of the department- Departmental Secretary, Mrs Onifade, M.B., Mr. Jonathan Omolona, Mr. C.A. Ogbolu, Mr. Kolapo Moses and Mrs. Nike Adesina.

I would be glad to also extend my appreciation to my senior colleagues in the department for share of experience, advice and useful suggestions. They include Drs. W.A. Yusuf, Hashim Akin Olagunju, Kemi Obisesan, Luqman Agboola, Ajijola Sikiru and Salawu Mutiat, my colleagues at the postgraduate level – Mr James Idowu Fasakin, Mr. Toba Olaseyinde, Mr Ogunniyi Bayo, Mr Aliu Gafar, Mr. Tijani Isiaka, Mr. Samuel Kehinde, Mr Kolade Olapade, Mrs. Adu Oluwaseun, Mr. Gbenga Dada, Mrs Khadijat, Mr. Adesina Mohammed, Mr. Ojo Ayodeji, Mrs. Ayoola Adewale, Mrs. Kemi Alonge, and Mrs. Mobolaji Afolabi. My special appreciation also goes to Mr Olufemi Atunbi, Prof. James Jayeoba, Alh. Seriki, Mr Jubreel Alaga, Mr. Maleeq Oyewuni, Hon.Mikail Alarape, Surveyor Kareem Fatai and Mr. Bushari Ibrahim for their supports in cash or in-kind.

I cannot but also appreciate the moral supports of my friends and brothers – Alh. Abdul Rasheed Adekunle Odusanya, Mr. Badru Taofeeq, Mr. Olushola Hassan, Mr. Dauda Abdullahi, Mr. Ibrahim Ajuwon, Alh. Azeez Ayinla, Alh. Dauda Aderogba, Alh. Ismail Olanrewaju, Alh. Adewale Saheed, Alh. Alaka Semiu, Alh. Olayiwola Ibrahim, Mr. Shittu Habeeb, Mr. Ekuntakoro Kazeem, Mr. Sanusi Rasaq, Mr. Rasaq Abdullai and Mr. Salaudeen Muslim. My bundle of appreciation also goes to Dr. Y.Y. Muslim who made his official staff quarter at the Polytechnic Ibadan available and accessible for me at all time and my co-visitors in the official staff quarters- Alh. Mayowa Tajudeen, Barrister Bashir Olabode, Mr. Ganiyu Tajudeen and Mr. Wasiu Adesokan for their words of encouragement. I sincerely appreciate the supports of the entire staff of the Oyo State Cash Transfer Unit (SCTU) under the leadership of Prince Oladipo Oyekola for quality time shared together in the course of humanitarian and selfless service to our fatherland, Saki East Local Government Cash Transfer Desk Officer, Mr Adeyemo Jacob Babatunder, the GRO, Mr. Olabode Tajudeen and my co-facilitators – Mr. Adedigba Ayodele, Mr. Adedeji Babatunde, Mr. Jimoh Rasheed, Mr.Tiamiyu Rahman Oyedokun, Alhaja Azeez Bolatito (may Allah count her among the inmates of paradise) and Alhaja Monsurat Aderogba, for their moral supports.

My special appreciation goes to my parents Alhaji Abdul Rasaq Yaqoob and Mrs. Saudat Yaqoob for their spiritual and moral supports. May Almighty Allah spare their lives to further reap the fruit of their labour. My sincere appreciation also goes to my uncle, Alh.

Ismail Adebayo Yaqoob for his fatherly disposition to my course; my siblings – Mrs Sanusi Folashade Rashidat, Arimiyau Yaqoob, Balqees Yaqoob, Ajarat Yaqoob, Azeezat Yaqoob and Raimot Yaqoob. May Almighty Allah reward them abundantly.

My deep-rooted appreciation goes to my spouse, Mrs. Yaqoob Muibat Adetayo and my children, Yaqoob Abdul Martin Adebayo, Yaqoob Sufyan Olaide, Yaqoob Baashit and Yaqoob Rahmat Omolara for their love, perseverance, and resilience. May Almighty Allah make this life and the hereafter worthwhile for us. I am extremely grateful to everyone including those I inadvertently omitted their names. Above all, I say Alhamdu lilahi.

Yaqoob A.M

ABSTRACT

Rural livelihoods have been the subject of empirical analysis in development studies because they play important roles in mitigating Food Insecurity (FI). In Nigeria, the incidence of FI is higher among the rural populace, particularly the peasant farming households, than urban households. Previous studies have linked aggregate measure of rural livelihoods to FI with little attention to contributions of specific components to FI. Hence, the influence of rural livelihoods on FI status of farming households in Southwestern Nigeria was investigated.

A five-stage sampling procedure was used. Osun and Ekiti States were purposively selected based on poverty incidence in Southwestern Nigeria. Iwo and Osogbo ADP zones were randomly selected from Osun, while Ikole and Ikere were selected from Ekiti. Eleven Local Government Areas were randomly selected from the two states. Forty six villages were randomly chosen proportionate to size, while 400 farming households were selected from the villages. Semi-structured questionnaire was used to obtain information on socio-economic characteristics (age, Being Married-BM, Household Size-HS, Farming Experience-FE, education), livelihoods' assets (Natural Asset-NA, Physical Asset-PA, Human Asset-HA, Financial Asset-FA and Social Asset-SA), income sources, food consumed and agro-ecological zones. Others included Dependency Ratio-DR, Access to National Grid-ANG and Access to Irrigation-AI. Households that pursued On-farm (ONF), On-farm with Off-farm (ONF-OF), On-farm with Non-farm (ONF-NF) and combined On-farm, Off-farm and Non-farm (ONF-OF-NF) livelihoods were classified based on their income sources. Households were classified as Core Food-Insecure (CFI), Moderately Food-Insecure (MFI) and Non Food-Insecure (NFI) based on food consumed. Data were analysed using descriptive statistics, principal component analysis, income portfolio analysis, multinomial logit model, food consumption scores and ordered probit model at $\alpha_{0.05}$

Age of household heads was 51.9 ± 11.4 years, while HS was 8 ± 2.9 persons. Access to NA-52.9%, PA-63.3%, HA-77.8% and SA-72.6% was high, while FA-37.3% was poorly endowed. On-farm (3.6%), ONF-OF (17.8%), ONF-NF (19.7%) and ONF-OF-NF (58.9%) were the choices of livelihoods pursued. The probability of specialising in ONF livelihood was reduced by DR (-0.0377). The probability of pursuing ONF-NF was increased by ANG (0.0744) and DR (0.0690), while BM (-0.0841) reduced it. Post Primary Education-PPE (-0.2502) and DR (-0.0544) reduced the probability of pursuing ONF-OF-NF livelihood, while BM (0.1584) increased it. Households that were CFI, MFI and NFI were 4.38%, 35.89% and 59.73%, respectively. The probability of being NFI was increased by age (0.0115), BM (0.1073), HS (0.0166), PPE (0.1090), AI (0.1376), rain forest zone (0.1417), and FA (0.1630), while extension services (-0.0040) and ANG (-0.1620) reduced it. Extension services (0.0030), FE (0.0052), and ANG (0.1202) increased the probability of being MFI, while age (-0.0085), BM (-0.0706), PPE (-0.0809), HS (-0.0123), AI (-0.1020) and rain-forest zone (-0.1051), reduced it. Extension services (0.0011), FE (0.0018), and ANG (0.0419) increased the probability of being CFI, while age (-0.0030), BM (-0.0277), PPE (-0.0282), HS (-0.0043), AI (-0.0356), rain-forest zone (-0.0366) and FA (-0.4210) reduced it.

On-farm rural livelihood relative to combined on-farm with off-farm and non-farm, reduced food insecurity among farming households in Southwestern Nigeria.

Keywords: Rural livelihoods, Food-insecurity, Livelihoods' assets, Food consumption scores
Word count: 488

TABLE OF CONTENTS

CHAPTER THREE: METHODOLOGY

CHAPTER FOUR: RESULTS AND DISCUSSION

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Access to Irrigation
ACF	Action Centre La Farm International
ADP	Agricultural Development Programme
ANG	Access to National Grid
BM	Being Married
CDC	Centre for Disease and Control
CBN	Central Bank of Nigeria
CFI	Core Food-Insecure
CMP	Conditional Mixed Process
CSI	Coping Strategy Index
DfID	Department for International Development
DR	Dependency Ratio
FA	Financial Asset
FE	Farming Experience
FI	Food Insecurity
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization
FCS	Food Consumption Scores
FIML	Full Information Maximum Likelihood
FSTG	Food Security Thematic Group
GCFSVA	Ghana Comprehensive Food Security and Vulnerability Analysis
GFSI	Global Food Insecurity Index
GHI	Global Hunger Index
GLSS	Ghana Living Standard Survey
HA	Human Asset
HDDS	Household Directory Diversity Score
HFIAS	Household Food Insecurity and Access Scale
HHS	Household Hunger Scale

HS	Household Size
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IV	Instrumental Variables
LGAs	Local Government Areas
MDER	Minimum Dietary Energy Requirement
MFI	Moderately Food Insecure
ML	Maximum Likelihood
MNL	Multinomial Logit
MT	Metric Tonnes
NA	Natural Asset
NAFPP	National Accelerated Food Production Programme
NFI	Non-Food Insecure
NBS	National Bureau of Statistics
NFCRP	National Food Crisis Response Programme
NLSS	Nigerian Living Standard Survey
NPC	National Population Commission
NSPFS	National Special Programme on Food Security
ONF	On-farm
ONF-OF	On-farm + Off-farm
ONF-NF	On-farm + Non-farm
ONF-OF-NF	On-farm + Off-farm + Non-farm
PA	Physical Asset
PE	Primary Education
PPE	Post Primary Education
PCA	Principal Component Analysis
PGT	Foster-Greer-Thorbecke
RRR	Relative Risk Ratio
SA	Social Asset
SL	Sustainable Livelihood
SLA	Sustainable Livelihoods Approach

TLU	Tropical Livestock Unit
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
USDA	United State Department of Agriculture
VEA	Village Extension Agents
VIF	Variance Inflation Factor
WB	World Bank
WFP	World Food Programme
W.H.O	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Food insecurity is a problem confronting global development efforts for a number of decades. Food insecurity is often an indication of poverty and it is the most widely used measure of food deprivation. Food insecurity implies that, sustained access to safe, sufficient and nutritious food is restricted by inadequate income or resources as at when needed (FAO, IFAD, UNICEF, WFP AND WHO, 2019). In 2018, the population of the undernourished people worldwide was about 821million with 29% living in sub-Saharan Africa, while over 2 billion suffer from one or more micronutrient deficiencies (CDC, 2020). Poverty, which is a permanent or temporary state of deprivation caused by inadequate entitlements including income, wealth and thus access to available food is pervasive in Nigeria (World Bank, 2019).

Food insecurity occurs when individuals or households are faced with limited physical, social or economic access to safe, sufficient and nutritious food for healthy life (Kakwani and Son, 2017). Food insecurity restricts people's ability to acquire nutritionally adequate and safe food in a way that is socially acceptable (USDA, 2019). The physical health and productive life impairment are a consequence of individual or household's inability to have secured access to nutritionally sufficient food (Jones *et al.*, 2013). Food insecurity is a threat to social-political order. The 2007-2008 food riot is a fallout from food price crisis, thus recognising the fundamental role of food access in social cohesion.

Mitigating food insecurity problem demands that, sufficient quantity of aggregate food supplies through production or food aid, household's access to physical food supplies through their own stock/home grown, or purchases from the market or gift or borrowing is guaranteed and that the utilisation domain requires that the available food is taken in a form and manner that takes into consideration the dietary and health implication for

individuals within the households and that households have access to safe, sufficient and nutritious food as at when needed (Napoli *et al.,* 2011). Thus, an individual is entitled to improved quality of life that takes into consideration the adequate health and wellbeing of individuals and this right is enshrined in Article 25 of the Universal Declaration of Human rights of 1948. Food insecurity status, which can either be transitory if an individual or household has temporary shortfall of food consumption requirements or chronic if a long term or permanent condition of inadequate food consumption requirement prevails. It often changes over time subject to seasonality or as a result of stochastic shocks including weather events, death or social conflict (FAO, IFAD, UNICEF, WFP and WHO, 2019).

A major factor with high potential to solve food insecurity issue is the livelihood of the people. It comprises of different assets and activities that enable individuals or households to achieve their means of living (ACF, 2010). Report shows that, the rural area of the developing world is characterised by widespread hunger and poverty, where family farming and smallholder agriculture including animal husbandry, fishing and non-farm participation are the common livelihoods. Thus, rural livelihoods comprise of mainly agriculture with a segment of the population diversifying into non-farm activities in order to pursue their livelihood goals (Davies *et al.,* 2010).

Rising from the problems associated with rural agriculture which include depleting soil fertility, poor infrastructure, weather and climatic vulnerability among others, rural households in developing countries including Nigeria are forced by necessity to deploy strategies such as agricultural intensification, livelihood diversification and migration in attempts to secure their livelihoods (Otaha, 2013; Jemal and Kim, 2014). Diversification is a broad component of rural livelihoods existing at varying levels of the rural economy. It could be viewed as adaptation technique or risk management for agrarian households. Rural households in Nigeria whose livelihoods depend largely on subsistence farming combine or diversify into one or more sources of non-farm income with the aim of achieving positive livelihood outcome (Kassie, 2017). Studies have shown that farming activities on the average account for only 40-60% of the livelihoods pursued in South Asia and sub-Saharan Africa (Hilson, 2016).

Livelihood and food insecurity are two concepts that are closely linked, while livelihood encompasses the capabilities, assets and activities required for a means of living, food insecurity is just one undesirable outcome resulting from inability of livelihood to ensure secured access to adequate and nutritious food. Thus, addressing the food insecurity problem also requires conscious effort to secure the livelihoods of individuals or households under consideration.

An important consideration in individual or household's choice of livelihoods is their access to various resources or assets and also the institutional contexts that influence their capacity to use these assets towards achieving their livelihood objectives (Kassie *et al.,* 2016). Assets through which people engage in different activities is central to achieving a sustainable livelihood. With more endowment of assets, individuals enjoy enhanced flexibility to leverage on different livelihood options through which their livelihoods are secured or their vulnerabilities are minimised. Asset can directly influence food insecurity through its effect on livelihood activities and indirectly when liquidated to secure access to food.

1.2 Statement of the Research Problem

About 70% of the population in developing countries engage in agriculture as the primary source of occupation (FAO, IFAD and WFP, 2015). Statistics show consistent increase in national production of major food crops in Nigeria for over five years (CBN, 2016). In 2016, the Central Bank of Nigeria also reported increase in crop and livestock production with about 3.5% and 5.99% respectively. According to Olomola (2015), the staple food production of rice, sorghum, cassava and maize increased by 1.3million MT, 13000MT, 600,000MT and 6.28million MT respectively between 2012 and 2014. Overall, the national food supplies rose by over 20 million MT between 2012 and 2015. In spite of these increases in national food production as well as the rising food imports bill averaged ₦1.4 trillion between 2011 and 2015 (NBS, 2015), the food insecurity situation in Nigeria is worsening with about 7.1 million people currently at the risk of being faced with chronic food poverty and in need of emergency safety nets and social protection (FAO, 2017). Consequently, the affected population suffers from the problem of undernutrition and inadequate access to nutritious and sufficient food (FAO, 2018).

Statistics show that, the annual population growth rates in Nigeria between 2011 and 2016 averaged 2.7%, while the annual growth rate of agriculture during the same period averaged 4.1% (Olomola and Nwafor, 2018), suggesting that the real issue with food insecurity in Nigeria are concerned with economic access and per capita real income of households. This is because about two-third of households in the south of the Sahara including Nigeria engage in vulnerable employment in Agriculture (FAO, IFAD and WFP, 2015). In the face of persistent and sharp increase in food prices, low demand for wage labor, unemployment, sickness or death of bread-winner, existence of adequate aggregate food supplies does not guarantee food security at the household level (Kakwani and Son, 2017).

Available evidence shows that the population of undernourished in Nigeria increased from 4.7 million (5.9% of the population) in 2008 to 12.9 million (7% of the population) in 2016 indicating an endemic increase in food insecurity (IFPRI-GHI, 2016; Olomola and Nwafor, 2018). When compared to urban households, food insecurity is more prevalent among the agrarian people particularly the peasant farming households in Nigeria (Fawehinmi and Adeniyi, 2014) This is because rural agriculture is characterised by drought, unpredicted rainfall pattern, land fragmentation, low level of productivity and high level of peasant farming (Jirstrom *et al.*, 2011).

Several efforts have been made in the past by successive administrations to address food insecurity through the creation of special programmes and projects. These include: National Accelerated Food Production Progamme, (NAFPP) (1973); National Special Programme on Food Security, (NSPFS) (2008); National Food Crisis Response Programme (NFCRP) (2009); Food Security Thematic Group (FSTG) (2009). Seven Points Agenda with emphasis on Food Security (2009), Agricultural Transformation Agenda (2011-2015) and more recently Agricultural Promotion Policy (2016-2020). These efforts were met with little success as Nigeria is ranked 103th out of 119 countries in the global hunger scores (GHI, 2018). Sabates-Wheeler *et al.* (2012); Asogwa and Umeh, (2014) attributed the problem of food insecurity to low productivity of the Nigerian agriculture resulting from inadequate technology that characterize the sector. While the need to increase national food supply through productivity initiatives is key

to tackling food insecurity problem, diversification of income sources has equally been recognized as a strategy for poverty reduction as well as reducing the extent of vulnerability (Khartum and Roy, 2012). The relevant questions that need to be answered are:

i. To what extent do farming households have access to livelihoods' assets?
ii. What choices of livelihoods were pursued by farming households in the study area?
iii. What factors determine the choice of rural livelihoods pursued by farming households in Southwestern Nigeria?
iv. What is the food insecurity status of farming households in the study area?
v. What influence do rural livelihoods have on food insecurity status of farming households in Southwestern Nigeria?

1.3 Objectives of the study

The main objective of this study was to determine the influence of rural livelihoods on food insecurity status of farming households in Southwestern, Nigeria. The specific objectives of the study were as follow:

i. Assess the extent of farming households' access to livelihood assets.
ii. Identify and profile the choice of rural livelihoods pursued by farming households in the study area.
iii. Identify factors determining the choice of rural livelihoods pursued.
iv. Identify and profile food insecurity status of farming households.
v. Determine the influence of rural livelihoods on food insecurity status of farming households in Southwestern Nigeria.

1.4 Justification of the study

A paradigm shift in recent development literature views food insecurity as a livelihoods' failure to ensure access to adequate food at the household rather than agricultural failure to produce sufficient food at the national level (Nwalie, 2017). Although, appropriate agricultural policies might show a reported increase in national food production, food

insecurity may be persisting at the household due to inefficient agricultural food system or unfavorable macroeconomic indices such as price fluctuation, unemployment, high foreign exchange rate and inflation. Hence, the need to examine the extent to which the choice of rural livelihoods affects household's economic access to food is critical to solving the food insecurity problem. Furthermore, data obtained through household and food consumption survey, upon which this study is based, are often the most preferred sources of food consumption estimates for most analysts, because they provide more reliable and accurate information than nationally aggregated data on Food Balance Sheet (Kakwani and Son, 2017).

Previous studies (Ayantoye *et. al.,* 2011; Oni *et. al.,* 2011; Asogwa and Umeh, 2012; Dzanya *et. al.,* 2015) on food insecurity adopted the cost of calorie index proposed by Greer and Thorbecke (1986) as applied by FAO (2003) to estimate food insecurity threshold. However, maintaining stable health condition also requires adequate intake of calories, protein, vitamins and minerals. Cost of calorie function which they derived exclusively from the inadequacy of calorie requirement does not take into consideration the issue of under-nutrition or malnutrition or quantities of the nutrients. Oni and Fashogbon, (2013); Asa and Achibong, (2016); Mamman *et.al.* (2016) used food poverty measure proposed by Foster, Greer and Thorbecke (1984) to estimate food insecurity line. But this measure provides estimates of monetary value of food rather than adequacy (or otherwise) of dietary requirements for healthy life. The exceptions to these studies are the studies conducted in Ghana by Mensah (2014) and collaborative 'Report of Food Security Sector Humanitarian Agencies (2015) conducted in the North East, Nigeria. There is a dearth of information or gap in knowledge that this study intended to fill using the Food Consumption Scores (FCS) to assess food insecurity status. In using this measure, the food quantity was not taken into consideration. But it was reported to be positively and significantly correlated with kilocalories consumed per capita per day, asset indices and total monthly household expenditure (Coates *et al.,* 2007; Wiesmann *et al.,* 2009).

The methodological debate on livelihood studies reveals that some studies (Korie, 2011; Awoniyi and Salman, 2011; Roy and Khartun, 2012) quantified rural livelihoods using

the aggregate indexing approach derived from the share of different income sources available to farm households. Although the aggregate indexing approach is widely favoured in the literature for its simplicity and objectivity, the possibility of identifying the specific component that provides higher expected income with lower risk of food insecurity is problematic as the sub-components are averaged into a single index score. More so, relying on estimates obtained from direct use of income or income share could be misleading due to the random nature of income which has the intrinsic ability to make significant fluctuations in perceived income sources over time. (Barrett *et al.*, 2001). Even if income is not stochastic, measuring income for some activities including farming particularly in developing countries is difficult.

In their studies, Oni and Fashogbon, (2013); David, (2013) quantified rural livelihoods using the main or single activity variable and adopted the sectorial classification commonly used in national accounting systems to link the household's main activity to corresponding outcome. However, rural livelihoods cannot be analysed based on a single activity component as rural households are often engaged in combinations of activities (Barrett *et al.,* 2001). Mensah (2014); Muhamed and Muhamed (2014) quantified rural livelihoods using a checklist of livelihood activities pursued and stratified households into 'diversified' (i.e. on-farm + non-farm activities) and non-diversified (on-farm activity only) using Barrett *et al.* (2001) sectorial classification. Although this approach is known for its computational simplicity, the authors failed to empirically account for relative contributions of other livelihood activities to food insecurity. For example, some activities with low entry barriers such as environmental gathering cannot be classified as on-farm or non-farm. Classifying them into non-farm activity could yield a misleading result in view of overwhelming empirical evidence of negative impact of non-farm income strategy on food insecurity.

This study deviates from the previous approaches as it adopted the concept of livelihood strategy to capture the various activities or combinations of livelihood activities pursued by farming households using the income portfolio analysis and activity variables to cluster farming households by mutually exclusive choices of rural livelihoods as the basis for proffering solution to food insecurity problem. Understanding asset endowment

at the disposal of rural households and also the choice of livelihoods pursued towards securing their livelihoods could provide useful insights for policy makers on the choice of appropriate and context-specific livelihood intervention programmes that can sustainably mitigate the problem of food insecurity.

1.5 Organization of the Study

The remaining sections of the study are structured as follow: Chapter two delves into a review of theories, literature and conceptual design of the research work, followed by chapter three with highlights of the methodology used for the study, including the sampling design and analytical techniques. In chapter four, results and discussion of the research findings were presented. The summaries of findings, conclusion of the study, recommendations and suggested areas for further study were presented in chapter five.

CHAPTER TWO
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

This chapter deals with the theory of entitlement, theory of random utility, sustainable livelihood approach, concepts of livelihoods' assets, livelihood strategies, and livelihood diversification. It also presents comprehensive review of the methodologies used in assessing food insecurity and in quantifying rural livelihoods, as well as multivariate methods and techniques used to aggregate indicator variables for livelihoods' assets.

2.1 Theoretical Framework

2.1.1 Theory of Entitlement

Prior to Sen.'s poverty and famine analysis, the debate on food insecurity was dominated by Malthus theory for years. Malthus proposed that an increase in human population in excess of available food supply would alienate the residuals either by famine or due to some occurrences that can equally be linked to inadequate food availability. Given the expected consequence of food deficit that is deemed to occur from persistent increase in population, a shift in paradigm to sustainable food production was advocated by Malthus such that the food needs of the population match-up with food supply. However, the popular view of Malthus (1798) was challenged by Sen. (1981), positing that the inability to have economic access to food notwithstanding the physical availability makes people suffer from food insecurity (Devereux, 2001). Sen. (1981) narrated the previous experience of famine condition in nations with adequate aggregate supply of food stressing that economic accessibility make significant contribution to achieving adequate food access. Sen. emphasized the importance of entitlement in achieving food access.

Entitlement refers to different combinations of commodity baskets that an individual can lawfully acquire utilising the entirety of rights and opportunities at his disposal (Sen.,

1989). It is the collection of income and resource bundles (assets and resources, including labor power) that a household may utilise to ensure its survival. Securing this livelihood requires that the entire well-being of the household, as well as their food needs are being taken into account. Sen.'s entitlement perspective revolves around two terms which are "endowment" and "entitlement to commodity bundles." According to Sen., a person's means of living is dependent on a set of entitlements which includes a bundle of commodities, that an individual may command and that 'endowments' constitute the resources available to individual to facilitate commodity exchanges (Devereux, 2001). Sen. (1981) divides all legal sources of food into four entitlement categories: production-based, trade-based, own-labor and inheritance and transfer entitlement. As a result, an individual or household with entitlement package that fails to include a combination of commodity with sufficient food, such individual will suffer from hunger and experience food insecurity (Sen., 1989). According to Sen., entitlement failure happens only when the endowment set, or the entitlement mapping or both are adversely affected.

The endowment set is the collection of all legitimately held resources by individuals consistent with standard practices and procedures. It consists of tangible assets such as machineries, transportation, buildings, and so on, as well as intangible assets such as skills, knowledge and membership of organisation. This resource usage might take the form of production, trade, or transfer to get final commodities and services. The entitlement mapping, also known as E-mapping, is the rate of transforming resources of the endowment set into commodity bundles of the entitlement set. However, the drawback of this theory is that, for a number of factors such as poor or incomplete information, established food habits, or indifference, the food intake of the people may fall below their entitlements. (Sen. 1981). Nonetheless, it is often used as a framework for analysing hunger and food insecurity at the micro level (Deveareux, 2001) and thus forms the theoretical foundation for this study.

This study was in part underpinned by theory of entitlement. The food insecurity status of individual households was a direct consequence of inadequate food basket in household's commodity bundles termed "entitlement set". This is caused by poor or loss of endowment set, referred to in this study as livelihoods' assets. The food insecurity

status or outcome of individual households could also be the failure in the allocation or mapping of assets to outcome (food) through a set of activities or combination of activities considered in this study as Rural livelihoods. It could as well be the combination of the two scenarios as emphasized by Sen.'s poverty and famine analysis.

2.1.2 Theory of Random Utility

The intrinsic motives driving household's choice of livelihoods are to maximise utility through predicted earnings from undertaking a specific livelihood (Dearcon and Krishnan, 1996). The random utility is a framework used to analyse a household's choice of livelihoods. According to the theory, utility is an intangible construct laden with sense of feelings by individuals or households but cannot be directly observed (Manski, 1977; Phaneuf and Smith, 2005). Further, it premised that this unobservable utility may be split into two parts: systematic or representational utility (V) and random or unexpected utility (ε_i). This random component emerges due to the unpredictability of the individuals' choices as well as the fact that the characteristics do not cover all of the preferences. Thus, the total utility derived by the i_{th} household from engaging in a particular livelihood can be explicitly stated as a linear combination of two components: (i) a deterministic part, V_{ia}, that accounts for the explained components and (ii) stochastic error term that accounts for unexplained components such as measurement errors.

$$U_{ia} = V_{ia} + \varepsilon_{ia} \quad \text{..... (2.1)}$$

Given that V_{ia} is a deterministic component and ε_{ia} constitutes the "white noise" component (Thurstone, 1927). The assumption is that, allocation of assets to each activity or group of activities is expected to maximise household's utility derived through the entitlement set. Assets would be allocated by a household such that the value of marginal product across the set of activities are equal or would be completely allocated to a single activity that has higher return. As a result, the likelihood that the utility of a livelihood set '*a*,' is greater than the maximum utility of alternative set *i* is expressed as follow:

$$P(a) = P\left[U_{ia} > \text{Max}\, U_{ji}\right] = P\left[V_{ia} + \varepsilon_i > \text{Max}\, V_{ji} + \varepsilon_j\right] \; j \neq a \ldots\ldots \quad (2.2)$$

The assumption is that, the utility function is a linear combination in parameters X_i characteristics of the farming household head, those of the alternative livelihood set 'a' viewed by i_{th} household and a random or unexpected component.

$$U_{ia} = \beta^{\iota} X_{ia} + \varepsilon_{ia} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.3)$$

Where β^{ι} is a vector of unknown parameters and X_{ia} is a vector of observed attributes of the household head as well as livelihoods' choice and ε_{ia} is the error term.

2.1.3 Sustainable Livelihood Approach (SLA)

The thinking among the development experts for more effective poverty reduction measures was responsible for the emergence of the livelihood approach. The Sustainable Livelihood Approach is a response to the failure of economic growth advanced by theory of modernisation with the premise to exit a significant number of people from poverty. However, Chambers and Conway (1992) and Scoones (1998) challenged this theory arguing that it could not effectively reduce poverty on the ground that the capability of the poor to benefit from the growth trajectories was not taken into consideration (Krantz, 2001). More so, it questioned the sectorial approach advanced by theory of basic needs in tackling multifaceted problems of rural development (Scoones, 2009).

It provides a realistic framework for supporting development at the rural level, to reduce poverty and also to ensure sustainable management of the environment (Scoones, 1998). Hence, SLA employs integrated approach to development emphasising on the resources and strategies that poor people use to make a living (Farrington *et al.*, 2002). The framework for asset vulnerability which is at the heart of the SLA has significant economic root in Sen.'s famine analysis (1981) and Chambers (1994a, b, c). Carney (1998) defines livelihood as the capabilities, the various resources and activity or set of activities that support the achievement of livelihood outcome(s). A livelihood is said to be "sustainable" if it can withstand and mitigate the effects of stresses and shocks and as well preserve or improve its capabilities and resource endowment in the present and distant time without jeopardising the natural resource base.

The concepts of livelihood assets, activities, strategies, and outcomes are commonly used in discussions on livelihoods. This wider context was deemed crucial since one of the goals of poverty reduction policies and initiatives was to assess the opportunities and constraints that influence the capabilities of the poor from pursuing a successful livelihood. As a result, terms such as claims and access were deemed crucial in the livelihood approach. For instance, the genuine possibility of gathering firewood in the forest; fetching water from the village dam for irrigation; obtain food from the forest or to have the perfect knowledge about the prices of agricultural goods or the opportunity for wage labour away from home (De Haan, 2000).

A framework known as the Sustainable Livelihood framework was used to explain the basics of Sustainable Livelihoods; several variants from different organisations have been found in the literature, all depicting the same principle. Livelihood sustainability, according to Chambers and Conway (1991), depends on how assets and capabilities are used, maintained, and developed in order to safeguard livelihoods. According to Pandey *et al.* (2012), there are three types of livelihood sustainability: social, economic, and environmental. Carney (1999) claims that achieving a sustainable livelihood is contingent on making sustainable use of available natural resources, which most rural people rely on for survival. According to Pandey *et al.* (2012), livelihood sustainability requires earnings from engaging in economic activities. According to the authors, rural livelihood sustainability is dynamic and built on social thrust. It can be accomplished in a variety of ways, the most typical one is the creation of varying combinations of livelihood activities (Ellis, 1999).

According to Scoones (2009), the SLA is plagued with some drawbacks that include its inability to factor in the process of economic globalization, political and governance issues, as well as structural changes that is taking place in the economy of the rural sector. Further, the concept is not applicable to the aggregate scale and macroeconomic analysis because its context was mainly on household focus (Norton and Foster, 2001). Even if criticisms regarding globalisation process and democratic governance are relevant, they are not within the purview of this study.

Thus, the Sustainable Livelihood framework is fundamental to all the conceptual models in studies involving rural livelihoods including the present study. This is because it is a bottom-up rural development, unlike the top-down intervention's approach supported by theories of modernisation and basic needs. It also favours the micro-level analysis of rural livelihoods. In practice, the concept has been used to address a broad number of development issues, including food insecurity (Devereux *et al.,* 2004). This is due to the importance of food as a basic necessity of life. Food insecurity is approached from a livelihood perspective that considers not just the availability and accessibility point of view, but it also captures the household's coping techniques (Young *et al.,* 2001).

2.1.4 Concept of Livelihood Assets

The portfolio of assets via which people make a living is referred to as livelihoods' assets. It encompasses both tangible and intangible assets (Scoones, 1998). They form a stock that can be saved, gathered, traded or assigned to activities to produce a stream of inflow, a means of subsistence, or other gains. A household may or may not own a particular asset. In as much as a household has access to it, it becomes a vital contributor to livelihood. Assets are productive when they are used as inputs in a production process, or nonproductive when used as household durables (Barrett and Reardon, 2000).

Assets or capital might be privately held or in the public domain. It is important for the poor to have access to them when they are needed. Access is the process that connects people from resources' endowment to a commodity bundles included in the entitlement set (Geiser *et al.,* 2011a). Asset is central to all strands of Sustainable Livelihood (SL) frameworks and livelihood activities. The assets available to individuals or households in rural areas constitute the foundation of rural livelihoods (DFID, 1999). People with more assets are likely to pursue diverse income sources in a bid to achieve their means of living. They also have the capacity to improve their resilience when faced with shocks and stresses. This is the case as individuals require diverse set of assets to pursue positive livelihood goals (Baffoe and Matsuda, 2017). Following Scoones (1998), the most recognised and generally acceptable assets within the Sustainable Livelihood approach are:

I. Natural Capital

This includes the nature-based resources (e.g. Land, water, wildlife, biodiversity and environmental resources). They are beneficial to people's livelihoods, especially for those who rely on natural resource-based activities for all or part of their income. In other words, it is described as the stocks of naturally and environmentally provided assets such as soil, atmosphere, forests, water, and wetlands. This capital is more commonly used in research involving rural setting. Land, on the other hand is generally regarded as productive capital in urban areas because it is tied to housing.

II. Physical Capital

It comprises of producer goods as well as the basic infrastructure required to support livelihoods, such as water, sanitation, electricity, transportation, communications, and housing, as well as buildings, roads, and production equipment and technologies. In other words, it refers to the stock of manufactured or public goods and other productively-inclined inputs at the disposal of individuals, firms and the state (World Bank, 2000).

III. Human Capital

It refers to the combination of skills, knowledge, labour availability and good health that together allows people to undertake various livelihood activities and fulfill their goals (DFID, 1999). Human capital also refers to people's stake in education, health, and nutrition that influence how people use their labour to modify the pattern of their inflow. Given the frequency of its valuation in the labour market, human capital is reasonably easy to quantify in monetary terms.

IV. Financial Capital

This includes the financial assets and cash or equivalents available to a household which enable them to pursue various activities. Regular remittances or pensions, savings, and access to credit are examples of financial assets. It is categorised into:

(a) **Accessible stocks:** It includes cash, bank deposits, or liquid resources that can simply be changed into cash- with no liabilities and not reliant on third parties e.g. jewelries and

livestock. (b) **Regular inflows:** It comprises labour income transfer from the state, pensions, and remittances that are usually reliant on others. Although two more assets- institutional knowledge and political capital- have recently been added to the asset categories and that also support SLA, they are not within the focus of this study.

According to Moser and Felton (2007), financial asset is sub-divided into three sub-categories namely labour security, transfer/rental income and productive durables.

i. Labour security: This refers to individual's ability to exploit their labour potential as an asset. It is an attempt to consider labour as an asset by using employment vulnerability as a measure of work status stability. The most difficult sub-category of financial capital to measure is labor security. However, the vulnerability ranking of work status can be adapted using the ILO framework. It categorises working for the state as the most secure type of job, followed by permanent employment status such as working in an organised and privately-owned employment entity. The third category in the vulnerability ranking is self-employment, while contract/tender work is the least secure job.

ii. Transfer/rental: This refers to unearned income sources such as remittances, government transfer, and rent. Rent is a return on capital, whereas remittances and government transfers are income transfers within society.

iii. Productive Durable G**oods:** Because they offer the source of current or projected income, productive durable goods are considered financial capital. Refrigerators and sewing machines are two examples. Thus, in making the choice of financial asset indicators for this study, a blend of approaches specific to the study context were considered in order to reduce the selection bias as much as possible.

v. Social Capital

This includes the social assets used by people to support livelihoods. It encompasses group membership, networking, access to larger institutions, and social trust. It includes membership of local level institutions such as religious, occupational, market and political system that generates social benefits. Given that social capital is non-physical and difficult to convert into monetary value, it is often considered difficult to quantify

by social scientists. However, the use of binary variables such as membership of organisations is considered good proxies for measuring social capital.

2.1.5. Concept of Rural Livelihood Strategies

A livelihood strategy is referred to as set of activities and various options or choices that can be combined to achieve livelihood objectives (Carney, 1998). These strategies are built based on multi-approach procedure and respond to differing needs based on the context of time, geography, and economic levels (Phongsiri, 2012). Livelihood strategies have been the subject of empirical analysis in development studies because they are made up of different combinations of activities that Scoones refers to as "livelihood portfolios". A portfolio might be strictly concentrated focusing on a single or less activities or it can be quite distinct, so identifying the determinant of one or more strategies is essential. The differences that exist between individuals and households' ownership of assets, levels of income, gender, social or political status make livelihood strategies to vary from time to time (Scoones, 1998).

Given a specific set of assets at a given time, household determines which activity it will engage in and how deeply it will engage in it. Activities are the courses of actions undertaken to generate specific outcome(s) (Winters *et al.*, 2001). They entail the use of a given asset or group of assets. For instance, agricultural or farm production may require financial resources to acquire factor inputs and social capital is required for labour participation. Wage employment in non-farm sector, on the other hand, may rely solely on human capital. The degree to which assets are employed determines the intensity of an activity. Agricultural intensification strategy has the propensity to commit substantial human and financial resources for input procurement, compared to strategy that depend on less intensive agricultural production. It may be noted that livelihood strategy'' rarely refers to a lone activity. It involves detailed, location-specific, multifaceted and frequently changing activities devised by rural people to fulfill their aspirations (Gaillard *et al.*, 2009).

2.1.6 Concepts of Livelihood, Rural Livelihoods and Livelihood Diversification

The concept of livelihood appeared in the literature two decades ago. Since then, it has received increasing attention among the researchers, development partners and donor organisations. The concept of livelihood is set to detail not only the account of activities or set of activities pursued by rural people, but also the assets that enable them achieve a successful livelihood, the contexts that are likely to support or inhibit their quest for improved living is a component they must consider, while managing their resources. The concept of livelihood has proved useful in understanding the complexity of rural livelihoods. Rural livelihoods comprise mainly of crop production and agricultural activities including collection and gathering of unprocessed food, livestock rearing, fishing, weaving and diversification into non-farm activities such as (trade, service and remittance).

Available reports show that subsistence agriculture provides a means of living for between 20-25% of the world's population. Most of these people are classified as smallholder farming households, or their activities reflect peasant livelihoods. Given the dominance of rural people in subsistence agriculture and other activities, a study of rural livelihoods is crucial for a variety of reasons: (i) Most rural poor rely directly or indirectly on peasant livelihoods; (ii) rural poor predominantly depends on peasant farming directly or indirectly; (iii) peasant agriculture is important to national and global economies in terms of contribution to food and livestock production, environmental effects and limited natural resources; (iv) potential market for consumer goods and services if rural people's welfare improves. Thus, analysis of rural livelihoods is therefore important for identification of income strategies pursued by farming households towards attaining their livelihood goals.

The pathway of an outcome through assets and activities and the influence of institutional contexts in shaping the use and returns to assets is a key component of the livelihood concept. According to Ellis (2000), livelihood is comprised of assets (natural, physical, human, financial, and social capital) and activities that generate the means for their survival and long-term well-being, as well as the context (policies, processes, and

institutions) that together determine their livelihoods. The concept of livelihood is crucial in understanding diverse activities undertaken and also the influence of assets in shaping the capacity to pursue certain activities, the unstable nature of decision making and the relationship between the combinations of assets and activities (Barrett and Reardon, 2000). Given how frequently the conditions, consumption and people's livelihoods change with time, the concept of livelihood is flexible (Drinkwater, 1998). It has also received widespread acceptance as a useful tool for gaining a better knowledge of the elements that affect people's way of life and their well-being, with specific focus on the rural poor (Wanmali, 1999). Rural households in developing nations rely on a variety of assets and undertake diverse activities to acquire the means of improving their overall well-being, including food; they also combine non-farm activities with agricultural production.

Scoones (1998) describes livelihood diversification as the creation of a broad income-earning suites to cover all forms of shocks or stress, or as a strategy that focuses on creating responses to a certain type of shock or stress through a carefully devised adaptation mechanism. Agricultural or non-agricultural livelihood diversification by farming households is possible. Agricultural diversification necessitates the production of different food crops or cash crops (e.g., cashew, cocoa), whereas non-agricultural diversification necessitates the participation in non-agricultural revenue streams such as non-farm wage employment, non-farm rural employment, rural-wage from non-farm sector, trading and earnings from distant relations to an agrarian family.

Livelihood diversification is a strategy through which households build varying suites of resources and activities with the aim of achieving their means of living and increase their overall well-being (Ellis, 2000). Ellis further argues that various activities from farm, non-farm, and off-farm sectors are pursued by people in order to smoothen their consumption behaviors. Livelihood diversification can also be referred to as a continuous system of preserving and evolving a broad range of activities and vocations to reduce the variability that is often associated with household income, minimize the effects of seasonality and it also offers alternative income source or supplementary earnings (Barrett *et al.,* 2001; Loisson, 2016). In development studies, the concept of

livelihood has become the subject of policy-based research simply because earnings from farming activities have been severely constrained by factors related to urbanisation (Khartum and Roy, 2016). The concept of diversification is often viewed as a mechanism for risk management through which individuals trade off some higher expected return for lower income stability attained by selecting varying combinations of assets and activities with poor remunerations or that are negatively correlated with income (Reardon *et al.*, 2000).

Two set of narratives prevail in the literature on motives for livelihood diversification in the literature. The first is the push factor (distress-push) perspective which includes (i) Existence of risk that comes in different forms such as seasonal changes and unpredictable climatic events (Ellis, 2000), (ii) difficulty in land accessibility caused by population explosion, land tenure system, market failure, inadequate infrastructure and its attendant problems of inaccessibility to market and increased cost of production (Malmberg and Tegenu, 2007) (iii) liquidity constraint in the face of credit market failure or insurance market failure (Reardon, 1997). These are unfavorable conditions that may force farm households to seek alternative sources of income within or outside the farm. They tend to dominate in agricultural setting characterized with high risk and low-potentials such as those affected by drought, flooding and the environmental degradation. Further from the push factor perspective, livelihood diversification arises when people from rural enclave undertake poor-yielding non-farm activities out of the need to guarantee their living, lower the risk of hunger and prevent slipping further into poverty. Given the poor status of assets that include land, capital, cattle, and credit, rural households are driven into low-return nonfarm activities, thus undermining their resilience to seasonal changes in weather condition and the risk of climatic events (Reardon and Taylor, 1996). Should the crop fail or animals lost, households are liable to reallocate labour resources to other economic sectors that may include formal non-farm occupation or non-farm rural wage, informal engagement in off-farm activities (e.g., scouting for wild animals, wage labour working from other peoples' farms), or non-agricultural/non-farm activities (e.g., weaving, brewing). Much as the poor likely to pursue distress push diversification due to their inability to manage risks, so too are

the risk-preference poor individuals with a clear evidence of differentiated wealth likely to pursue *ex ante* diversification.

The second set of narrative on people's motivations for livelihood diversification rests on pull factor (demand-pull diversification) perspective. These are favourable factors with positive outcome that induce farm family to participate in other income sources in order to improve their living conditions. They motivate farmers to diversify their income sources beyond farm activities by improving earnings from nonfarm sector. These sets of factors prevail in low risk and high-potential agro-ecological regions (Haggblade *et al.,* 2007). They include: (i) consideration for complementary role that integrates between crop and livestock activities (ii) specialisation as a result of improved technology; (iii) managerial acumen, skills and experience. In the light of the pull-factor perspective, rural households are motivated by the incentives to engage in high-earning activities from non-farm sector, with the aim of accumulating wealth and maximise returns from their assets (Loison and Loison, 2016). Therefore, individuals or households diversify for two main reasons bordering on necessity and choice conditions (Ellis, 2000). Given the persistent poor agricultural productivity, declining farm sizes as well as the population surge, sub-Saharan African's structural transformation of agricultural sector is not impressive, compared to Europe, America, or Asia, From the foregoing, the concept of livelihood diversification is widely acknowledged as a strategy for mitigating complex rural development problems including poverty, food insecurity and environmental degradation. However, its effectiveness in achieving the desired result particularly among the rural dwellers has been the subject of empirical debates among the scholars. Nevertheless, the concept as also adopted in this study has been adjudged to be an efficient indicator that can be used to assess the performance and sustainability of the rural livelihoods (Liu and Liu, 2016).

2.1.7 Definition of Terms

Livelihood Security: This is the ability of individuals or households to have sustained access to the entitlement set adequate for securing their overall well-being.

Livelihood outcomes: These are the people's aspirations that they strive to achieve; the products of undertaking various activities. Examples are income, food security etc.

Livelihood strategies: It includes the mix of activities undertaken by people to achieve their livelihood goals.

Farming Household: A household that consists of at least a member that is undertaking a holding is said to be a farming household (UN, 1984).

Livelihood Activities: These are sets of actions generated by households to achieve the means of living. They require the application of single asset or they may be combined. They are divided into four categories: production activities, reproduction activities, consumption activities and exchange activities.

Livelihood Portfolio: This is a term referred to as livelihood strategies by some scholars. It is the combinations of activities undertaken by people aimed at securing their means of living (Scoones, 1998).

Access: It refers to the availability, opportunity to use and actual use of a particular asset or resources by the household (Peters *et al*., 2008).

2.2. Methodological Review

This section comprehensively presents the review of the methods and approaches that have been previously applied in the literature with a view to identifying the most suitable and appropriate methods based on their relative advantages.

2.2.1 Review of Food Insecurity Assessment Tools

For over two decades, the global effort to achieve food security has realized the need to shift its attention from 'availability' to "accessibility" domain and subsequently to sustainable livelihoods, thus necessitating the increased attention to micro-level analysis of food (in) security. For micro-level assessment of food insecurity, there are two strands of literature with debates on making "individual" or "household" the unit of analysis. At one end is a strand of literature (Reutlinger, 1985; Gittinger *et al.*, 1990) that favours the use of "individual", while at the other end are the proponents (Frankenberger and Goldstein, 1991, Maxwell, 2001) of "household" level. According to the former, they argued that, assessing food insecurity based on "household" level was too simplistic, given that the decision-making with respect to household's food acquisition and allocation was not uniformly distributed and may therefore reveal a vague idea about the

actual food insecurity estimate of individual members (Maxwell, 2001). In contrast, the latter strand argued that, since the decisions on what to produce and consume occurs at the household level, the need for household level assessment is plausible (Assenso-Okyere *et al.*, 1997). Hence, this study considered the choice of household level because it is mostly preferred by the researchers owing to its cost effectiveness and relative computational simplicity (Haddad and Kanbur, 1990).

Furthermore, national or country level measures of food insecurity are clearly distinguished from those designed for household's level use. National or country level food insecurity measures (e.g. prevalence of undernourishment) often emphasise food availability. Even though Global Hunger Index (GHI) and Global food insecurity index (GFSI)) attempt to capture not just available national food supplies, their main focus was not on household-level behaviour as well as the factors driving the economic access to food because they are more concerned with national or regional food insecurity trend. Household-level food insecurity measures and upon which the study was based emphasise physical and economic access. They include: HDDS (Ruel, 2003), FCS (WFP, 2012); CSI; HHS; HFIAS; Expenditure on food, (FGT, 1984) and Cost of calorie function (Greer and Thorbecke, 1986).

i. Household Dietary Diversity Scores (HDDS)

Dietary diversity is one of the indicators for measuring access to food at the household level. It was developed by Food and Nutrition Technical Assistance Project (FANTA). It entails adding uniformly weighted response data on household's intake of twelve (12) food groups in the past 24 hours. Cereal grains, roots and tubers, vegetables, fruits, meats, eggs, fish, pulses and nuts, dairy products, fats and oil, sugar, and condiments are the food groups. The caregiver in a household responds to a question about the intake of any item from the food groups in the past 24 hours. A score ranging from 0 to 12 is obtained from the summation of these responses:

$$S_{HDDS} = \sum_{fg=i}^{n=12} food_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.4)$$

S_{HDDS} = Household Dietary Diversity Scores; $food_i$= i^{th} food or food group consumed and n = total number of foods or food groups consumed.

The household Dietary Diversity (HDDS) score is known for its relative simplicity, objectivity and measurability (FANTA, 2006). Although the scores show positive association with other measures of food insecurity, there is no standard cut off points defining food insecurity categories (Swindale and Bilinsky, 2006).

ii. Food Consumption Scores (FCS)

This indicator as developed by the World Food Programme attempts to estimate the incidence of food poverty in any geographical enclave and it was strongly motivated by its linkage with household food access. It's a variety of dietary diversity score that use a 7-day recall to combine data on dietary diversity and food frequency (WFP, 2009). The frequency of household's intake of eight food groups is reported by the respondent. The food groups are Staples- maize, rice, sorghum, cassava, potatoes, millets and other grains- Pulses, Vegetables, Fruit, Meat and Fish, Dairy products, Sugar, and Oil. The product of food group consumption frequency and the predetermined weight (based on energy, protein, and micronutrient densities) of the associated food group summed over possible number of food groups produce the *FCS* score as follow:

$$FCS_i = \sum_{fg_{h=1}}^{n=8} w_{fg}\, f_{fg} \quad \text{……} \quad (2.5)$$

Where FCS_i is the food consumption scores obtained for i_{th} household; w_{fg}= weight of h_{th} food group consumed (weight = 4 for meat, milk and fish; = 3 for pulses; = 2 for staples; = 1 for vegetables and fruits = 0.5 for sugar and oil (WFP, 2009) and f_{fg}= frequency of h_{th} food group consumed and n = number of food groups.

Although food consumption score does not take into consideration the quantity of food consumed, it has been shown to be positively and significantly correlated with calorie intake per capita per day, wealth indices and total monthly household expenditure (Coates *et al.*, 2007). Being a viable welfare outcome in its self, FCS continues to receive increasing attention from the nutritional literature suggesting the significance of

consuming a wide range of foods in order to improve dietary quality. Additionally, standardisation of cutoffs and weightings for the score makes it easier to compare the scores across contexts (Jones *et al.*, 2013).

iii. Coping Strategies Index (CSI)

This is a hybrid of participant-driven approach to food insecurity assessment. It involves interrelated questions about how people deal with food shortfall to provide a quantitative measure that may be used to target food assistance, track its effectiveness and forecast food insecurity change that is likely to occur in the future (Maxwell *et al.*, 2003). CSI is computed from the set of strategies deployed by households in times of food scarcity or that they may adopt in the future to deal with issues of food access. A list of universally accepted coping strategies blended with context-specific coping domains is suggested for use. A locally developed list can be produced via the focus group discussion with community stakeholders or representatives from the target population. During the survey, data on the relative frequency of the strategies used over the preceding month is expected to be factored in and blend with information on the actual strategies developed.

Given the differences that exist in the way individuals or households from diverse contextual backgrounds perceive or behave with respect to food poverty depth (Coates *et al.*, 2006); a second round of focus groups with the aim of assigning severity of the weights to the developed list of coping techniques is recommended. Having assign scores to frequency categories, the data is integrated to obtain an aggregate index score using data obtained from the household survey. However, rather than establishing a threshold value for defining food insecurity, CSI is an indicator developed to compare inter-household food (in)security estimates or targeting food aid or estimating the impact of food assistance, rather than establishing threshold value for defining food insecurity categories.

iv. Household Hunger Scale (HHS)

This is a behavioural measure of food access designed to consider more-severe behaviour. It includes the last 3 questions of the HFIAS with all describing the manifestations of chronic food insecurity: Has it ever occur a time when your family

went without food because you didn't have the means to get more? Have you or any member of your family go to bed starved due to non-availability of adequate food? Have you or a family member go all through day and night with no any food intake due to insufficient food? Furthermore, unlike the 4 questions recommended in the HFIAS, the new 3-item scale which consists of only 3 frequency responses-never, sometimes/rarely or often- was found to be both internally, externally and as well inter-culturally valid among the various tested scales including the full 9-item HFIAS and its variants. In spite of its validity as a cross cultural food insecurity assessment tool, it places more emphasis on hunger rather than food insecurity (jones *et al.,* 2013).

v. Household Food Insecurity Access Scale (HFIAS)

Different from approaches that employ indirect indicators (such as household income and expenditure) to quantify household's access to food, the experience-based approach uses the instrument of data collection to directly capture household behavior and lived experiences of household food insecurity (Barrett, 2002). It was created on account of household behavior indicating inadequate quality and quantity, as well as concern and anxiety about adequacy of household food access. To achieve this, a set of nine (9) general questions was created, each of which was assumed to reflect fundamental pillars of the household food security access component (Coates *et. al.*, 2006). A score ranging from 0 to 27 considered to represent a composite dimension of food insecurity was created as HFIAS. Some of these approaches may need the use of participatory adaptation strategies; nonetheless, they differ from the previously studied assessment tools because they involve direct measurement of food insecurity. HFIAS has been proved to be positively correlated with household's wealth, animal protein source, food consumption, maternal education (Knueppel *et al.,* 2010), dietary adequacy (Becquey *et al.,* 2010), household per capita income (Maes *et al.*, 2009), household assets and dietary diversity (Knueppel *et al.,* 2010; Faber, 2009). The main drawback lies in its subjective measurability such that there may be a shift in internal standards or values, thereby resulting in an altered perception of one's food insecurity situation and, as a result, a change in HFIAS scores (Jones *et al.,* 2013).

vi. Expenditure on Food

It's an indirect method as it provides money metric assessment of food access. Given that, people on the verge of poverty are more likely to spend a larger percentage of their earnings on food, estimating the share of total household expenditure on food has become a useful indicator (Smith *et al.,* 2006). The FGT (1984) measure of poverty, which uses per capita household expenditure on food to estimate food insecurity is commonly implemented with minor modifications (FAO, 2006).The formular for calculating the food insecurity index is given as follow:

$$F_i = \frac{\text{Per capita expenditure for the ith household}}{\frac{2}{3}\,\text{mean per capita food expenditure for all households}} \quad \ldots\ldots\ldots (2.6)$$

The household is deemed food secure if F_i exceeds or equal to one ($F \geq 1$); however, if the value of F_i is below one ($F_i < 1$), then it is considered food-poor. In practice, however, expenditure on food actually measures food acquisition rather than actual food consumption. Food purchased for household consumption may be wasted, rotten, or even shared out as a gift in some cases. As a result, the assumption of acquisition-consumption equality has the tendency to either inflate or decrease estimates of food security (Pinstrup-Anderson, 2009).

vii. Cost of Calorie

FAO's definition of chronic undernourishment is closely related with hunger. A person is considered hungry by the FAO if his calorie intake falls below a cutoff calorie need, known as the minimal dietary energy requirement (MDER). It is easy to determine whether or not an individual is undernourished, provided the distribution of calorie intake and the MDER are known. Household consumption and expenditure surveys, which include data on all foods acquired by households, including food purchased, food consumed from their own production and food received in kind, are the most direct method of determining calorie intake distribution. Food calorie conversion factors are available for almost every country on the planet, and they can be used to convert these food quantities to calories. The food energy intake of each sample household can be

estimated from the product of food quantities and the calorie conversion factors adjusted for adult equivalent and using the consumption factors for different age–sex configurations. The food insecurity line, which is the calorie level below which people are considered food insecure can be calculated as follows:

$$\ln X = \alpha + \beta C \quad \text{..... (2.7)}$$

Where X is the expenditure on food, C is the actual calorie consumption per adult equivalent in a household; α is the constant parameter and β is the associated unknown parameter. The cost of the least calorie intake required can be calculated using the FAO-recommended and periodically reviewed minimum daily calorie requirement available for all countries in the world as:

$$Z = e^{\alpha+\beta L} \quad \text{..... (2.8)}$$

Z is the cost of buying the minimum calorie intake requirement (i.e., the food insecurity line); a and b are parameter estimates and L is the recommended minimum daily calorie intake level. Based on the calculated Z, per capita households' food expenditure adjusted per adult equivalent is often used to determine the food insecurity status. The household is said to be food insecure if per capita food expenditure adjusted per adult equivalent is lower than the food insecurity line, Z; otherwise, it is said to be food secure. When dealing with large amounts of numerical data, the risk of misreporting is very high using this method (Hoddinott, 1999). Furthermore, this method considers only the calorie requirements of individuals without taking into consideration the issue of malnutrition or undernutrition (Kakwani and Son, 2017).

In spite of the development of several indicators capturing varying dimensions of food security over the past decades, no single measure can be used across contexts and time and which can as well capture the multi-dimensionality of food security concept (Coates and Maxwell, 2012).

In view of the foregoing, this study considered the choice of Food Consumption Score (FCS) based on the following: Firstly, it uses data on dietary diversity considered to capture different foods or food groups intake-a measure of adequacy of micro and macro

nutrients requirement. Secondly, unlike experiential and behavioural measures of food insecurity, Food Consumption Score (FCS) has standardized cut-off values defining food insecurity categories. Lastly, even though food consumption score pays no attention to the quantity of food or food group consumed, it was shown to be positively and significantly correlated with other measures of food insecurity and also the welfare outcomes.

2.2.2. Methods for Measuring and Aggregating Livelihood Assets

The objective of this section was to develop a single index from numerous variables indicative of five classes of livelihoods' assets using the multivariate methods adopted by Sharma (1996). Consider a household endowed with capital such that it can be valued in the form of S of types of capital, C^i, where i $\in [1, 2, \ldots \ldots S]$. Each of these capital C^i is comprised of J number of indicators $a^{i,s} \ldots\ldots a^{i,J}$. For individual a's, it can be quantified on a binary, ordinal, or categorical scale by assigning a weight, w to each indicator and add the weighted indicator variables to produce an index of C^i as follows:

$$C^i_{n,} = \sum_{j=1}^{J} w_t^{i,j} a_n^{i,j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.9)}$$

Where n= number of observation; i = form of capital; j = asset type

To achieve the weighted sum of $a^{i,j}_{n,}$ assets, various methods were identified as follow:

i. Prices

The most appealing method to weigh these assets involves using their face values such that $w_t^{i,j} = p_t^{i,j}$ where $w_t^{i,j}$ is the weight and $p_t^{i,j}$ is the price of asset (i, j).The aggregate score of total assets endowment or owned by the household equals the weighted sum or total monetary value of the livelihood assets given as:

$$\textbf{Asset score} = \sum_{j=1}^{J} w_t^{i,j} a_{n,t}^{i,j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.10)}$$

Where **j** is j^th^ category of livelihood asset, **w** is the price weight of each asset **'a'** of a particular j^th^ category. This method is computationally simplistic as it does not require a complex process of data mining. However, its limitation lies in its inability to value intangible assets such human or social asset by their prices (Moser and Felton, 2007).

ii. Unit values

This involves adding together the list of assets owned. This can be achieved using w = $1/g_n$ for each asset. Following Morris *et al.* (2000), asset score or index can be calculated thus:

Asset score = $\sum f_{gi} W_g$ ……... (2.11)

Where g is the list of assets, n is the number of households who owned a particular item in the list of assets, w is a weight equal to the reciprocal of the proportion of the sampled households who owned one or more of that item (W_g) and f is the number of units of assets g owned by i^{th} household (f_{gi}).

The summation of the product is obtained for all possible assets. Although, this method has the virtue of simplicity, some assets cannot be measured using a cardinal variable e.g. human capital and/or social capital (Moser and Felton, 2007).

iii. Principal Components Analysis (PCA)

Following Filmer and Pritchett (2001), development economists have used Principle Components Analysis (PCA) to construct a multivariate index that is indicative of several asset indicators that are either continuous or measured on a binary or ordinal scale. (Savitri, 2003). However, because this is primarily a descriptive technique, adding a few number of variables with nominal category is not likely to have any significant impact. (Savitri, 2003). When compared to the previous methods of simple summation, PCA is computationally more simplistic and easy to understand owing to the accuracy with which the weights are estimated. The idea behind this method is that for each capital Ci, there is a latent (unobservable) variable C existing in different forms and also involves the ownership of various asset $a^{i,1}$……$a^{i,J}$.

Given the i^{th} household with access to asset $a^{i,1}$ if $C > w^{i1}$. This indicates that the eigenvectors of the covariance matrix or the principal components of the data set are obtained from the estimation method of maximum likelihood. As a result, the first eigenvector is often selected as it gives the highest variation about the original data set. It is also the vector that provides the best fit with the least deviation from the observational unit to a line going through the various axes (Moser and Felton, 2007).

In principal component analysis, a new set of variables are created as linear combinations of the original set. The linear combination that accounts for the highest variation is called the first Eigen vector or the first principal component. PCA offers a more appealing method for combining variables than simple summation of the previous approaches. Firstly, and in technical terms, it is similar to a circular movement of the dimensional axes such that it minimises the variance from the observational units. Secondly, the coefficients of PCA have a logical sense of interpretation ((Moser and Felton, 2007). Formular to compute PCA-based household asset index is given as:

$$\mathrm{PCA_j} = \sum \mathrm{Fi}\ (\mathrm{Xji} - \mathrm{X})/\mathrm{Si} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2.12)$$

Where $\mathrm{PCA_j}$ is the value of the $\mathrm{j^{th}}$ household's assets index obtained using the PCA technique, $\mathrm{F_i}$ = weight for the $\mathrm{i^{th}}$ variable in the PCA model, $\mathrm{X_{ji}}$ = $\mathrm{j^{th}}$ household value for the $\mathrm{i^{th}}$ variable, $\mathrm{X_i}$ and $\mathrm{S_i}$ are the mean and standard deviation respectively for the $\mathrm{i^{th}}$ variable.

The foregoing suggests that, the aggregation method that is suitable and appropriate for combining variables indicative of tangible and intangible assets is principal component analysis thus informing the choice of aggregation method used in this study.

2.2.3 Classification of Income Sources and Livelihood activities

Identifying rural households by the choice of livelihoods begins with adequate knowledge and understanding about the grouping of income generating activities. Barrett *et al.* (2001); Loison and Loison (2016), categorised the constituents of rural livelihoods by sector (e.g. farm or non-farm activities), by function (e.g. wage employment or self-employment) or by location (e.g. local or migratory).

i. Sectorial Composition: The three major classifications commonly used in national accounting systems are: primary (agricultural, mining, and other extractive industries), secondary (manufacturing and processing), and tertiary (trade and services). This can be further divided into primary and non-primary income sources. The production or collection of unprocessed foods, cattle, timber, or sea products from

natural resources generate farm/agricultural income (Barrett *et al.*, 2001). Furthermore, non-agricultural or nonfarm income includes all non-agricultural income sources from processing, transport, and trading of unprocessed agricultural, forest and fish products (Barrett *et al.*, 2001). However, there are variations in the use of terminologies. According to Dercon (1998), off-farm is often used interchangeably with non-farm. Given the diversity of non-farm activities such that they are numerous and far from being exhaustive, the literature agrees on broad classification of livelihood activities to include on-farm, off-farm and non-farm activities (Ellis, 1998; Barrett *et al.*, 2001).

ii. F**unctional composition:** Recognising the importance of assigning activities by functional category, the main distinction here is between "self-employment" and "wage employment," In practice, however, assigning a set of rural activities into functional category is often difficult. In Africa, roles and responsibilities among rural household members are often difficult to define for the following reasons: Firstly, because many smallholder farming households employ one family member as a farm manager and another as an employee, the main question is how to assign duties among household members. When viewed from household's income, it is self-employment; from the individual's perspective, it is wage employment. In practice, however, the wages earned by individual household members are not necessarily in cash. As a result, the convenient method is to capture the activities of both as self-employed and allocate their shares of earnings from the enterprise total gain. Secondly, in the rural economy of developing nations, there may be some ambiguity in the assignment of self -employed and wage-employed activities. Some activities may be obvious as self-employment, while others are clearly wage employment. There are some activities that are difficult to categorise as "wage employment" or "self-employment". For example, activities that are obviously self-employed such as owning a firm and producing goods, the buyer of which cannot give orders in the business and must accept the product as given. In Africa, however, rural firms consisting of 1-2 people (Chuta and Liedholm, 1990), engage in small scale secondary production such as interior decorations often receive the purchase orders and detailed descriptions of goods from the clients and get the product branded to suit their requisition order. This is a typical example of agency contract. In a non-employment contract, on the other hand, an individual or organisation who engages the service of a

consultancy firm often details the full specification or job description to the consultancy firm as the case may be. In this case, the client who engages the service of consultancy firm gives in detail the terms of reference to the firm without taking part in the decision making of the firm. Therefore, in rural African context, distinguishing between self-employment and wage employment is often a difficult exercise.

iii. Spatial Composition: The two broad categories under the location-specific activity are “local”, and migratory. The two sub-categories under “local” are: (a) at home (b) away- from home, such as: (i) definitely rural, (ii) neighboring rural community, and (iii) adjoining city. On the other hand, it can be far away from dwelling" or "migratory" in nature, such as (a) inter-zone rural (e.g., away from own zone rural), (b) inter zone urban (e.g., to a far-away metropolitan community), and (c) foreign. This classification has several inherent advantages, including the ability to determine household’s reliance on rural economy and its transition, including the interdependence between farm and non-farm sectors as well as rural and urban linkages in the country. In practice, however, categorising a given activity into any of the above categories is highly problematic. For example, the use of "local," which is normally case-specific, is arbitrary. Although different scholars offer a number of explanations to explain the concept, the common practice is to use the administrative niche in which the people’s residence is located, such as zone or districts as this is found easy to understand and unambiguous for local leaders. For instance, it is possible for a household to be rural-based, yet its livelihood can overlap between rural and urban. However, controversies do exist in the way scholars use terminology like "rural non-farm income," such that it might be referred to as non-farm income earned by rural households anywhere, or it can refer to non-farm income received just in rural areas. The concept is more difficult when urban dwellers make earnings from rural enclave, a practice that is commonly applied in Latin America (Reardon and Berdgue, 1999). However, the residence of the income earner is used in many national surveys, as against the location of the activity.

In Africa, it is often experienced for migration to be seasonal such that assignment of a given activity to “local” or “migratory” is problematic. For instance, an activity could share the features of being “local” and “migratory”. For example, a livestock merchant

that embarks on a long journey away from the local areas to buy new stock and then comes back to make their sales. Such interaction can also occur between the remote rural area and the neighboring community as in the case of the itinerant merchant. As a result, assigning activities to a certain income functional category can give rise to methodological concerns.

In view of the foregoing considerations in respect of the classification and assignment of rural activities by sector, function or location and given the relative strength and drawback associated with each of them, it is obvious that sectorial classification upon which this study was underpinned is computationally simplistic and is less ambiguous for use in survey design.

2.2.4 Approaches and Methods for Quantifying Rural Livelihoods

In rural area, people pursue their livelihoods via the three major strategies (Barrett *et al.,* 2001). They include agricultural intensification, migration and livelihood diversification and. While the first two are important categories of rural livelihood strategies, the latter one is an important strategy existing at varying levels of the economy (Start, 2001). Given that diversification is a broad category of livelihood strategy, this study aimed at quantifying rural livelihoods from the diversification point of view.

In general, literature identifies and quantifies livelihoods pursued by rural people in Sub-Saharan Africa based on the main activity, income or income share and asset (Ellis, 2000). The use of household income or income share is mostly favoured even though each of these methods tends to complement one another (Nghiem, 2010). The first approach in quantifying rural livelihoods considers the use of main activity and it involves asking households to choose the livelihood activity that contributes the most in the household's income portfolio. These activities as previously classified as "agriculture or non-agriculture", "wage or self-employment" "local or migratory" are linked to the corresponding outcome using the functional relationship involving econometrics model (e.g. logit, probit, tobit, Heckman 2-stage models etc. However, the possibility of underestimating the income strategies of rural households is high because individuals or households with varying combination of income sources are forced to

select arbitrarily from predetermined list. However, the concern arising from the arbitrary selection of the main activity was modified by Barrett *et al.* (2005) and Stifel (2010) using welfare indicators such as income or expenditure as a proxy. Subsequently, a test of First order stochastic dominance is used to determine the dominant livelihood activity or strategy in each welfare group. However, the main problem in using this method is how to determine which livelihood activity is the most commonly used by households that fall within similar welfare groups.

The second approach deviates from the use of main activity or number of activities undertaken. The approach considers the diverse nature of rural income sources or activities pursued using the concept of diversification. Recognizing its importance in addressing food and income poverty among rural households, livelihood diversification has been used to evaluate the success of rural livelihoods (Kassie, 2017). The time households spend on nonfarm activities was used to quantify the degree of diversification (Nghiem, 2010). Other indices such as Simpson, Entropy, and Modified Entropy index are also used as proxies for measuring the extent of diversification (Khatun and Roy, 2012). However, the aggregate indexing approach that makes use of the household's income share from different sources of income pursued is a one-dimensional approach that does not empirically reveal the relative contributions of specific components of the aggregated index for informed policy decision.

The third approach as proposed by Brown *et al.* (2006) is an asset based. It requires the use of statistical techniques to cluster observations into natural categories. This method employs data on income shares, productive assets, and occupational activities to determine the most appealing and uniformly grouped households. It groups households based on their asset allocation to a variety of livelihood and income-generating activities and then tests differences in their livelihood outcomes using the resulting strategy-specific income distribution. This approach could be problematic and it is not widely used in the literature because measuring assets of rural households in Africa might be difficult as they hardly keep records of such assets (Barrett *et al.,* 2001). Stifel (2010) also proposed a method that is similar to asset-based. It takes into account a household's labor allocation decisions among a variety of livelihood activities in order to classify

households into similar income groups based on their chosen livelihood strategy. Although capturing a household's labour allocation is reasonably easy to measure for hired activities (e.g. wage labor), it is complex and time demanding for self-employed activities (Nielson, 2000).

The fourth approach following Aboud *et al.* (2001) blends all the previous approaches. It identifies four unique rural livelihoods using the concept of livelihood strategies. The returns and distribution of each choice of livelihoods are clearly varied. The 'full-time farmer' strategy refers to rural households who rely only on their own agricultural production for income. For some others, farm with wage labour in other people's farms are combined. In the third choice, farmer combines agricultural and non-agricultural returns. The fourth choice aggregate all the three basic elements of income classification involving farm, off-farm, and non-farm activities. This approach identifies a causal link to outcomes via assets and activities using econometric model including assets, livelihoods' choice and outcome variable of interest. This approach was favoured in this study because it considers the peculiarity of rural livelihoods with respect to diversity of rural households' income sources and dynamic nature of their choices. Thus, the approach enables the study to identify the rural livelihoods' choice that reduces food insecurity as well as those that increase their vulnerability to food poverty. Further, using the activity variable(s), the approach is purged from the stochastic influence of income or income share which has the potential to introduce considerable variation in apparent income sources from time to time.

In addition, the approach follows a parametric procedure. The non-parametric tests, on the other hand have the important properties that make little or no propositions about the distribution of population parameters, however, two notable drawbacks are documented. Firstly, they are generally less statistically robust as they have limited ability to make prediction or inference from the larger population compared to parametric procedures. Secondly, there is a difficulty in interpreting the results of non-parametric tests as they are often based on value rankings as against the use of actual data (Rosner, 2000).

2.2.5 Empirical Review

In this section, the objective was to review the empirical studies with specific focus on study theme which includes the determinants of the choice of rural livelihoods and the influence of rural livelihoods on food insecurity status of farming households in Southwestern Nigeria.

1. **Studies on Livelihoods and Diversification Strategies**

Rahut and Scharf (2012) investigated the correlates of diversification strategies using multinomial logit model. From the result, it was found that, the rural poor are primarily farm workers who pursue non-farm activities that are poorly remunerative, whereas, the relatively wealthy in the rural area also participate in highly remunerative non-farm activities. It was also discovered from the study that, household's formal education, size of farm holdings and geographic location, all play crucial role in the ability to find more lucrative employment in non-farm activities. A household with higher members was linked to higher likelihood of diversification into high-yielding non-farm activities. Sisay (2010) used data from rural Ethiopia to show that the poor depend more on off-farm activities, while the better-off earn more from agriculture. The findings show that household's demography and human capacity measured in formal education positively and significantly influence diversification. In a study on livelihood diversification and gender in Malawi, Simtowe (2010) found that households headed with females have higher propensity to diversify their livelihoods than their male-headed counterparts.

Adugna and Wagayehu (2015) found that male-headed households, higher level of education, household size, agro-ecological location, frequency of extension contacts, membership of social organizations, dependency ratio, and remittances positively and significantly influence participation in combined ONF-OF, combined ONF-NF as well as combined ONF-OF-NF strategies. Obi and Njoku (2014) found that on-farm is a viable livelihood for rural inhabitants in Southeastern Nigeria. Their findings revealed that age, years in formal education, and monthly income are all significant determinants of livelihood activities. Oluwatayo (2009) investigated factors determining livelihood diversification strategies using Tobit model. It was revealed from the study result that, male-headed, small-sized households, not poor, formally educated with access to

microcredit are not engaged in livelihood diversification, compared to households headed by female, lack of formal education, demographic size, poor socio-economic status and those without access to credit.

While Lay and Schuler (2008) argued that asset-endowed households are able to achieve positive outcome from diversification, Simtowe (2010); Asmah (2011) and Ng'anga *et al.* (2011) revealed that, land, access to credit, irrigation infrastructure, agricultural farm tools, ownership of tractor and other machinery are listed assets that significantly influence diversification, while larger area of farm land are often associated with concentration in agricultural activities. Eneyew (2012) also found negative influence of farm area on non-farm diversification. In their study, Khatun and Roy (2012) found that diversification among rural households in West Bengal is determined by years of farming experience, households size, investment in human capital, years of formal education, productive assets and access to credit source. It was also found that poor endowment of asset, lack of credit facilities, low level of information dissemination and capacity building supports, high level of risk aversion, infrastructure deficit and loss of confidence in non-farm sector are the determinants of household's decision to diversify.

2. Studies on Rural Livelihoods, Diversification and Food Insecurity

In an empirical investigation conducted by Mensah (2014) using cross sectional data sets of one hundred and Ninety six farm households, obtained from WFP-GCFSVA survey (2012), the result revealed that livelihood diversification, welfare score, farm size and level of education are positive and significantly influence household's food security using the food consumption scores. In a study conducted in Nairobi focusing on urban farmers, Njogu (2009), found that households that engaged in farm diversification to complement their wage income benefited from improved access to food. Considering the rate of urbanisation and its attendant welfare and food security challenges in developing nations, urban-practised agriculture can be an effective instrument for raising household incomes and ensuring food security (Redwood, 2009). Oni and Fashogbon (2013) investigated the influence of livelihood diversification on food poverty using a nationwide primary data set of the Nigerian Living Standard Survey (NLSS). The result

of Heteroscedastic Ordered Probit (HOP) model reveals that male-headed households who are predominantly farmers are more food-insecured, when compared to their female-headed counterparts. It was also found that married household heads who are relatively aged, large household size, lower level of formal education, relocation to any other zones from Guinea savanna zone and lack of credit access are positively and significantly influence food poverty.

Similar study conducted on the analysis of rural households' livelihoods and outcome in the water-stress areas of the Amhara region of Ethiopia, using a cross sectional data primarily collected from two hundred and ten households, Arega *et al.* (2013) found that most (93%) of the rural households rely only on small scale rain-fed agriculture (on-farm livelihood), while about one-quarter pursued some non-farm activities with meagre contribution to their total income per annum. The OLS estimates also show that possession of livestock, fruits and trees production, access to credit, living in savanna region and engagement in activities that are non-farm positively and significantly influence annual incomes of households and by extension, their livelihood outcomes. In a study conducted in Caicara of Coastal Brazil, Sisay (2010) used a panel data set to examine off-farm activities and income among 1343 households in rural Ethiopia. The results show that the better-off households earn largely from farming activities, while the non-poor engage in highly rewarding off-farm activities, implying that off-farm income can be used as poverty reduction strategy.

Olugbire *et al.* (2011) determined the contribution of non-farm employment to household income and poverty, they assessed the outcomes differentials between households who participated and those that did not participate in the non-farm sector using a propensity score matching model. When compared to self-employed households, findings from the study reveals that non-farm wage work significantly increases income. Non-farm wage work has a greater impact on wellbeing than self-employment. The study concluded that the non-farm wage-employment benefits the non-poor than the poor. Using fuzzy set and Logit regression analysis, Awoniyi and Salman (2011) examined the level of non-farm income diversification, its impact on farming households' well-being and the factors that influence it. The male-headed, formally

educated, wealth status, age of the respondents and farm area significantly influence non-farm participation. The findings from the poverty analysis revealed that more than half (53.9%) of the sampled population that did not participate in non-farm sector were poor, unlike those that actively participated (48.3%).The authors concluded that the agrarian family that did not participate have higher probability of being poor, compared to those that participated in nonfarm activities.

In a study conducted by Slam and Yew (2013), the findings revealed that harnessing natural asset provides economic benefits to vulnerable households which help in securing their livelihoods including enhanced income and improved food intake. The study also found that natural assets improve economic well-being, such as water for fishing, land for commercial farming, and economic trees (mango, orange) that provide economic benefit or income to help fulfill household's food and non-food basic needs. Kamaruddin and Baharuddin (2015) found that owning a physical asset has effects on livelihood outcomes, particularly, it increases income, allowing vulnerable households to meet their food and other social demands. Positive and significant impact of human asset on food security was found by Lim *et al.* (2015) because it increases household resilience and reduces the probability of falling deeper into food insecurity. According to Eneyew (2013), financial assets contribute to household well-being by increasing access to good health, improved food intake, and improved food security outcomes.

Zerai and Gebreeziabher (2011) used probit and Heckman selection models to investigate food security impact of non-farm employment in Eastern Tigray, Ethiopia. The results of the study revealed that rural nonfarm participation enhances household’s food security. Using pooled data from GLSS of 1991/1992 and 2005/2006 and endogenous witching regression, Asmah (2011) analyzed the relative importance of several selected proxies of agricultural sector reforms and the welfare effect of rural livelihood diversification. Findings from the study revealed that, households that participate in non-farm sector outperformed those that did not participate with respect to asset-specific variables, market and institutions. Human capital variables including health, education, and household age composition, influence the duo of household well-being and decisions to diversify into non-farm activities. Babatunde and Qaim (2010)

found that earnings from non-farm activities influences dietary energy and micronutrient intake in a research study conducted in Kwara State, Nigeria. In a study of gender analysis by Canagarajah *et al.* (2001), the results show that, diversification has impact on female-headed households in Ghana as it was able to lift them out of severe food and income poverty.

Contrary to the conclusions of the previously cited authors, Brown *et al.* (2006) and Stifel (2010) found that non-farm activities in developing nations have not benefited many households. According to the authors, the inability of non-farm employment in emerging economies to achieve the desired result has been linked to some constraints. They include formal credit, market access, such as distance and information, household's demography, such as education, age, experience, gender and household asset endowments, such as land, labour, and financial capital. In his empirical study on food security correlates among farming households in the forest zone of Ghana's central region, Kuwornu *et al.* (n.d.) reported similar findings. The study revealed that, earnings, credit access, dependency ratio, and households' own grown food significantly influence food security, while non-farm activities had no significant influence. In a research study involving Southwestern Nigeria, Awotide *et al.* (2010) found that non-farm diversification had no significant influence on food insecurity.

From the preceding review, it was evident that, livelihood assets in all its forms were reported to have significant positive impact on food security outcome. However, the impact of non-farm livelihood diversification on food security outcome are mixed with negative impact of non-farm diversification on food insecurity are reported by some studies, while non-significant effect was reported by some other authors. The latter concluded that, the non-farm diversification benefits the non-poor than the poor. They blamed the inability of many households to benefit from non-farm diversification on lack of formal credit, market access in terms of distance and information and asset endowment. This study seeks to contribute to the literature determining the influence of rural livelihoods on food insecurity status of farming households in southwestern Nigeria.

2.3 Conceptual Framework

The conceptual framework for this study was depicted in Figure 2.1. The framework identified five groups of livelihoods' assets namely natural, physical, human, social and financial assets. Given a particular set of assets, farming households engage in a particular livelihood or a set of livelihoods consisting of any two or more combination of activities considered as on-farm, off-farm and non-farm activities. On the other hand, a household head may choose to exclusively pursue on-farm livelihoods or activities that are strictly agricultural, over his diversification into either off-farm or non-farm or combined off-farm-non-farm activities if he enjoys a higher return. Activities map into outcome. Outcomes are the results of activities undertaken by the households. Household activities can result in a single or numerous outcomes. However, in some cases, rather than being derived from a specific economic activity, outcomes are directly related to a household asset (e.g. social asset). As a result, outcomes are the products of a single activity, a series of activities, or the direct use of asset.

If there is adverse change in assets or in the entitlement mapping caused by drought, flooding, crop failure, loss of animal or capital, there would be production and/or income shock leading to insecure access to food (food insecurity). However, the institutional context within which a household carry out its activities influences the kind of activity or set of activities it will pursue and the degree of involvement in the activities. The institutional context can be classified into four categories: natural, market, state and civil society forces. Each of these factors has an influence on the household's activity and investment choices. Each of these factors that establishes the context in which the household operates is interdependent. For example, the efficiency or otherwise of state policy influences the functional role of markets in rural areas.

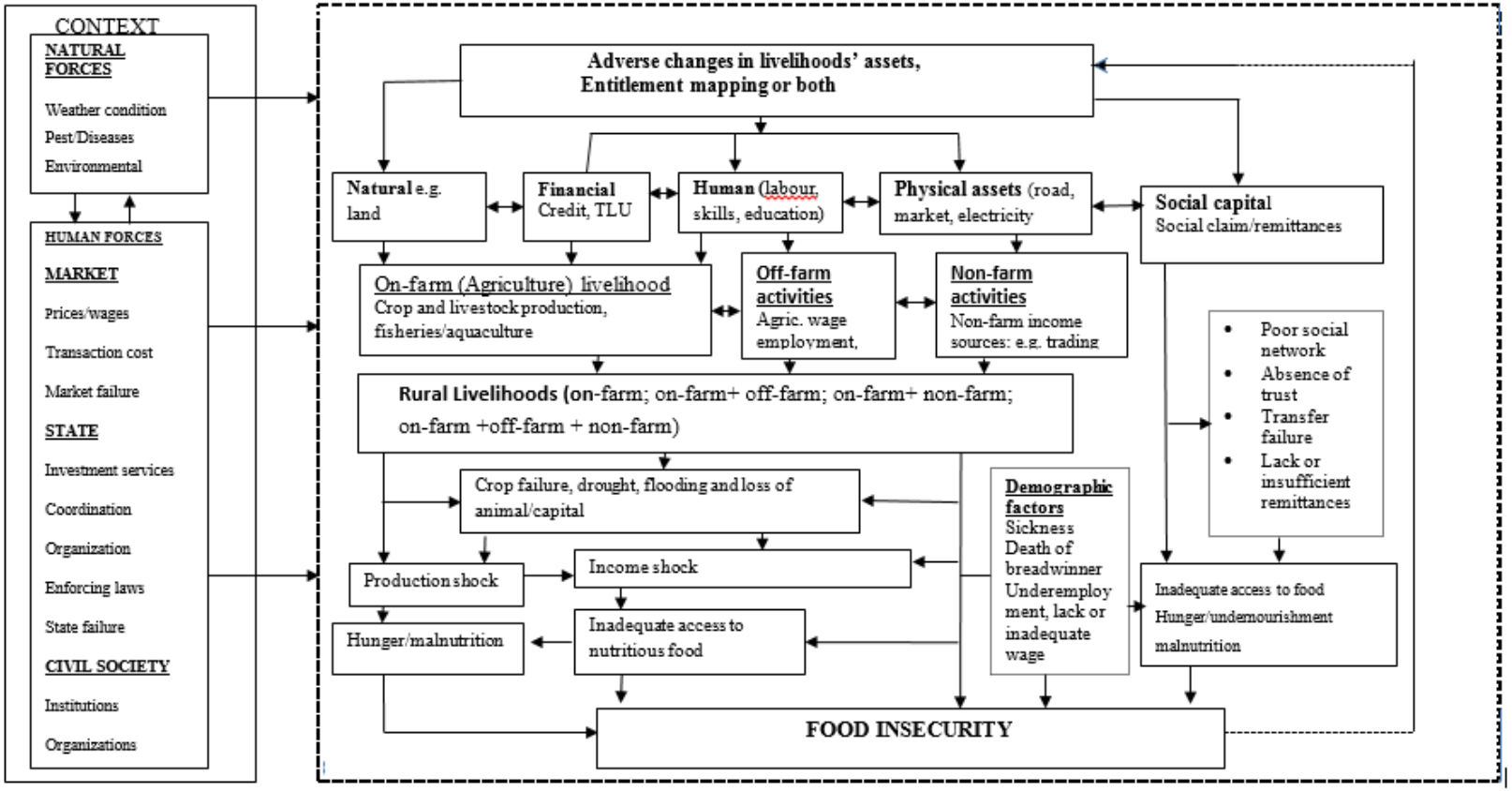

Figure 2.1: Framework for Rural livelihoods
Source: Adapted from Winters *et al.* (2001) modified by Author (2019)

CHAPTER THREE

METHODOLOGY

In this chapter, the methodological framework appropriate for achieving the objectives of this study was presented. It also presents the description of the study area, the sources and types of data, sampling procedure and the analytical tools.

3.1 Study Area

This study was conducted in Southwestern Nigeria. It is one of the six geo-political zones in the country. The South-west consists of six states namely Lagos, Ogun, Oyo, Osun, Ondo and Ekiti State. The zone lies between latitude 600 211ˡ and 800 371ˡ North (Faleyimu *et al.,* 2010) and longitude 200 311ˡ and 600 001ˡ East. It shares border with Kogi and Kwara states in the northern part and with Atlantic Ocean in the southern part, Edo and Delta states in the eastern part, while in the western part by the Republic of Benin.

The Southwest has a land area of about 114,271 square kilometres with total population of 27,581,992 (NPC, 2006). The zone houses the Yoruba ethnic group. The zone has a distinct feature of tropical climate marked with dry season between November and March and a wet season between April and October. The average distribution of annual rainfall is 1480mm and a mean monthly temperature range of 18^0C-24^0 C and 30^0C-35^0C during the rainy and dry seasons respectively. The southwest monsoon wind from the Atlantic Ocean is connected with the wet season, while the northeast trade wind from the Sahara desert is related to the dry season. The vegetation cover of the southwestern zone differ in species composition and structure, with the lowland rainforest, derived savannah and mangrove species dominating the zone. The lowland in the forest stretches inland to Ogun and part of Ondo state, while secondary forest is towards the northern boundary where the derived savannah exists (Agboola, 1979; Agboola, *et al*., 2019). The crops such as rice, maize, sorghum, cowpea, groundnut, yam, potato, cassava, and soya

bean are predominantly grown in the area. The people of the zone also practice fishing, poultry, livestock husbandry and non-farm activities such as trading and wage employment.

3.2 Source and Type of Data

The primary source of data collection was used in the study, while the instrument used for data collection was semi-structured questionnaire with oral interview. Eleven field staff, consisting of Village Extension Agents (VEAs) in Osun and Ekiti States Agricultural Development Programme were recruited as enumerators and trained to administer the questionnaire. Data were collected from a total of forty-six (46) selected farm villages in both states between July and October, 2019. Data on household socio-economic characteristics, institutional variables, agricultural and non-agricultural sources of income, expenditure on farm inputs and access to different types of assets were collected. Also, data on agro-ecological locations, membership of local level institutions, food groups consumed and their relative frequencies were also captured by the survey.

In this study, the heads of households were interviewed because the decisions on what to produce and consume particularly in a typical rural household of Africa depend largely on the household head. This is because it saves time and financial resources to interview a household head than to interview every member of a household. More so, it is a difficult exercise as it often requires making repeated visits to a particular household. In interviewing the head of the household, the assumption is that, the household head has adequate knowledge and information about the entire household. This is necessary to achieve the objectives of the study through the survey instrument. It is worthy of mentioning that, the data collected were strictly household level and not exclusive to the household head. The survey instrument (questionnaire) used for data collection in this study was presented in the appendix XII.

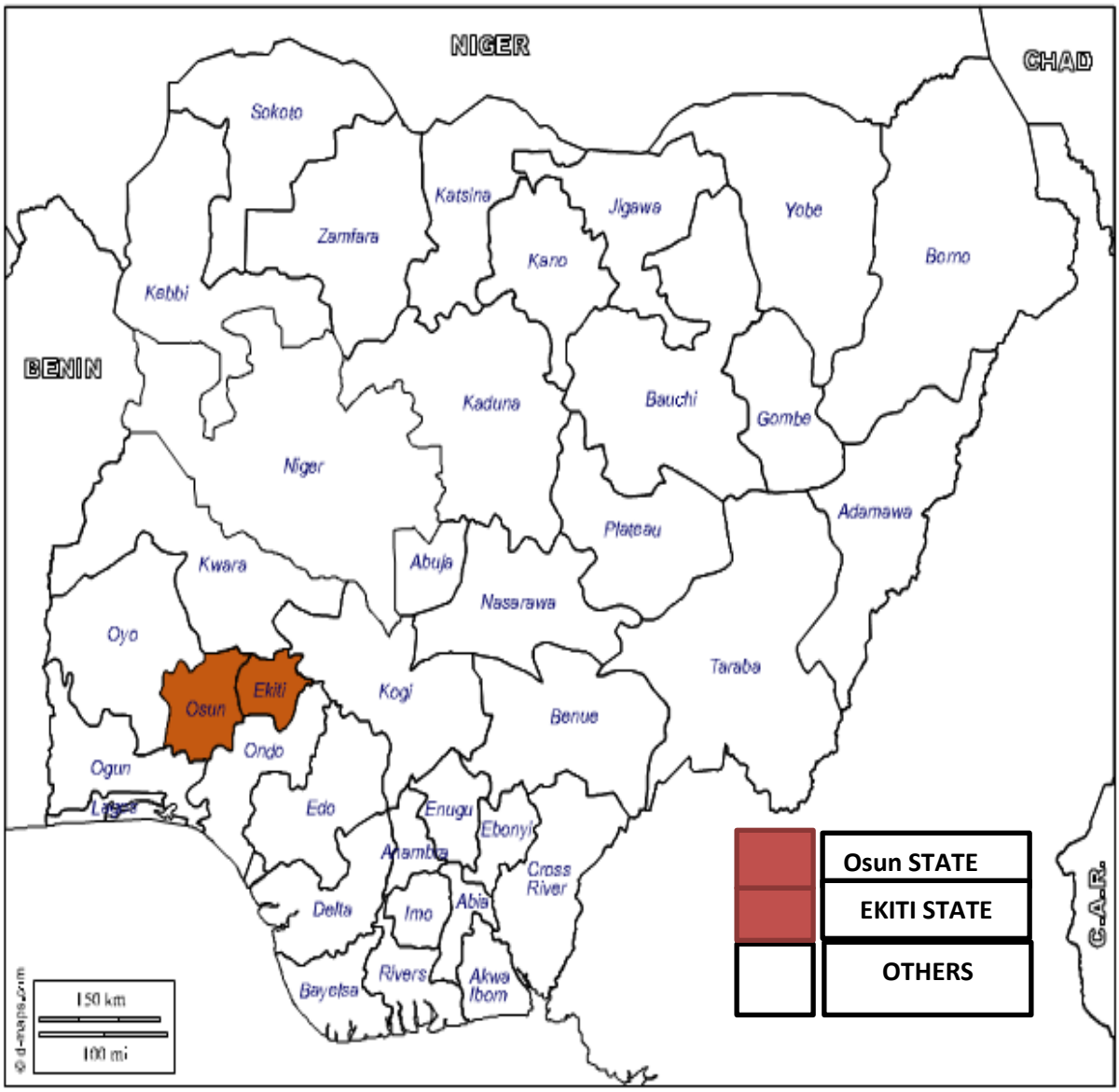

Figure 3.1: Map of Nigeria Showing the Study Area

3.3 Sampling Procedure

Five-stage sampling procedure was used for this study. In the first stage, Osun and Ekiti states were purposively selected from the six states of the Southwestern Nigeria because the two states have the highest poverty incidence and by extension food insecurity (NBS, 2016). In the second stage, two ADP zones were randomly selected from each of the two states making a total of four ADP zones selected. ADP is known to coordinate agricultural activities in Nigeria. ADP is administratively structured into zones, blocks and cells. Zone has at least four or five blocks, while cell consists of numerous villages that are situated in the block. The third stage involved random selection of seven and four blocks respectively from the selected ADP zones of Osun and Ekiti states, making a total of eleven blocks (11 LGAs) in the selected two states. The number of blocks (LGAs) selected was proportionate to the size of the ADP zone. The proportionate factor used is given as follows:

$$n_i = \frac{N_i}{N} * 11 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.13)$$

Where n_i = the number of blocks (LGAs) to be selected from zone i

N_i= the number of blocks (LGAs) in i_{th} zone

N = total number of blocks (LGAs) in the all the selected ADP zones

11 = desired number of blocks (LGAs) for the survey.

The fourth stage involved random selection of forty-six (46) villages proportionate to the size of the blocks (LGAs) in each zone. The proportionate factor used is given as follows:

$$h_i = \frac{H_i}{H} * 46 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.14)$$

Where h_i = the number of villages to be sampled

H_i= the number of villages in a particular block (LGA)

H = total number of villages in all the randomly selected blocks (LGAs)

46 = desired number of villages for the survey.

In the last stage, four hundred (400) farming households were randomly chosen from the two states proportionate to the size of the selected villages. The proportionate factor used was given as follows:

$$m_i = \frac{M_i}{M} \times 400 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.15)$$

Where m_i = the number of farming households to be selected from i_{th}village

M_i= total number of households in i_{th} village

M = total number of households in all the selected 46 villages

400 = desired number of households for the survey

However, only three hundred and sixty-five (365) copies of questionnaire were used in the analysis. Twelve copies (12) were rejected due to incomplete information, loss and inconsistency. The remaining twenty three (23) were the total number of unretrieved copies in all the sampled villages. Table 3.1 shows the states, zones, Local Government Areas (LGAs) and villages considered for the study.

Table 3.1: Distribution of Respondents by States, Zones, LGAs and Villages

State	ADP zone	LGAs/Blocks	Name of village	Sampled Household
Osun	Oshogbo	Ifedayo	Aworo	9
			Ilupeju	8
			Akesin	9
		Olorunda	Idi-amu	11
			Okemole	10
			Oba-Ile	9
			Ajegunle	10
		Ede North	Olusokun	10
			Alusekere	8
			Elere	9
			Abugunde	8
		Ifelodun	Iba	9
			Isogun	8
			Oluode	8
			Seke	11
		Irepodun	Jagun	7
			Kaura	10
			Fosun	9
			Oguntunde	8
			Gbere	9
	Iwo	Ejigbo	Ike	9
			Olori	8
			Owu	8
		Ola-oluwa	Olorin	9
			Ikonifin	10
			Asamu	11
			Ajagba	11
Ekiti	Ikere	Gboyin	Ijan	8
			Agbado	7
			Aisegba	8
		Ikere	Oke-osun	9
			Oke-jegbende	8
			Ijao	9
			Odo-oja	9
			Are-araromi	8
	Ikole	Oye	Aiyegbaju	9
			Omu-ijelu	7
			Ilupeju	9
			Oye	8
			Ire	7
			Itapa	7
		Ekiti East	Ilasa	8
			Isinbode	9
			Eda	7
			Ikun/Araromi	8

Source: Author's computation from field Survey, 2019.

3.4 Methods of Data Analysis

Different analytical techniques were presented in this section in order to operationalise the study objectives. These include the descriptive statistics, principal component analysis, income portfolio analysis, multinomial logit model, food consumption scores, instrumental variable (IV) ordered model probit and also ordered probit model.

3.4.1 Descriptive Statistics

This was used to analyse the household's profile of the sampled respondents. These include the use of table of frequency distribution, measure of central tendency, measure of dispersion, graph and charts. The data was disaggregated by each state and then pooled together in order to explore the distribution of attributes by each state of the sampled population.

3.4.2 Principal Component Analysis (PCA)

Objective I, which is determining the extent of farming households' access to livelihood assets, was addressed using data reduction technique of principal component analysis. Following Moser and Felton (2007); Alinovi *et al.* (2008); and the works of Jakobsen (2009); Jemal and Kim (2015), Principal Component Analysis (PCA) was used to derive a composite score from the combination of various binary assets variables as well as assets variables measured on interval and ordinal scales. The eigenvectors of the covariance matrix resulting from maximum likelihood estimation produces the principal components of the data set. The first principal component was used to create the asset score because it contributes the maximum variation to the original data sets.

The novelty in using this procedure is that the livelihoods' asset was considered a latent variable that cannot be observed in the survey. The manifestation of this latent variable was observed only through access to five different categories of livelihoods' assets that include Natural, Physical, Human, Financial and Social assets that are also latent. The PCA-based model of livelihoods' assets is specified as follows,

$$A.S_{l_i} = \alpha^{\iota}NA_i + \beta^{\iota}PA_i + \gamma^{\iota}FA_i + \delta^{\iota}HA_i + \lambda^{\iota}SA_i \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.16)$$

$A.S_{l_i}$= Asset score for i^{th} household, NA_i = Natural asset; PA_i= Physical asset; FA_i= Financial asset; HA_i= Human asset; $S.A_i$= Social capital; $\alpha, \beta, \gamma, \delta,$ and λ are the eigenvectors of the covariance matrix for Natural, Physical, Financial, Human and Social assets respectively. In using the PCA, the idea was to take these j^{th} asset indicator variables for each category of asset and find their combinations to produce indices Z_1, Z_2 …….Z_j, that are not correlated and whose variances decrease from first to the last. The Z_i produced was the principal components given by:

$Z_j = b_{j1}S_1+b_{j2}S_2+b_{j3}S_3+\ldots+b_{jj}S_J$ ....……..... (3.17)

Where $b_j^1 = [b_{1j} \ldots b_{jj}]$ are vectors of the scoring factors or weights and S_1……S_j are vectors of indicator variables for j^{th} category of asset. Following Scoones, (1998), the indicator variables used for constructing composite score for each of the asset category were given as follow:

$N.A_i$: Access to Natural asset

N_1 = Farm size (ha)
N_2 = Access and use of forest resources/products (1= yes, 0 otherwise)
N_3 = Irrigation practice (1= yes, 0 otherwise)

$P.A_i$: Access to Physical asset

P_1 = House ownership (1=yes, 0 otherwise)
P_2 = Ownership of vehicle (1=yes, 0 otherwise)
P_3 = Access to the tarmac road (1=yes, 0 otherwise)
P_4 = Access to the national grid (1=yes, 0 otherwise)
P_5 = Distance to the market (km)

$F.A_i$: Access to Financial asset

F_1 = Remittances received (₦)
F_2 = Microcredit received (₦)
F_3 = Number of livestock owned (Tropical livestock units, TLU)
F_4 = Ownership of jewelries (1=yes, 0 otherwise)

$H.A_i$: Access to Human asset

H_1 = Labor availability (economically non-active/active household members)
H_2 = Distance to the nearest health care centers (km)
H_3 = Health status (Normal =1, 0 otherwise)
H_3 = Years of formal education of household head

$S.A_i$: Access to and/or ownership of Social assets

S_1 = Membership of social organization (1=yes, 0 otherwise)
S_2 = Decision making in social organization (1= yes, 0 otherwise)
S_2 = Share of income from remittances (₦)

A 2-stage factor analysis was used to estimate a composite score of livelihoods' assets for each household. In the first stage, a composite asset score was estimated separately for each category of livelihoods' assets using the iteration technique of principal factor. In the second stage, an aggregate score of livelihoods' assets was computed from the previously (first stage) estimated interacting variables. Formular to compute PCA-based asset score was given as follows:

$$A.S_{lj} = \frac{\sum F_i(X_{ji} - X)}{S_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.18)$$

Where $A.S_j$ is the value of the j_{th}household's asset obtained using the PCA technique, F_i = scoring factor of the weight for the i_{th} variable in the PCA model, X_{ji} = j^{th} household value for the i_{th} variable, X and S_i are the mean and standard deviation respectively for the i_{th} variable.

In the first stage, the mean value of PCA-based composite asset score for each category of asset was used to classify households into three different levels of access to livelihoods' assets given as 'high, moderate or low' level. Households with scores above two-third (2/3) of mean asset score were ranked "high", while those with scores above the one-third (1/3) but less or equal two-third (2/3) of the mean asset score were ranked "moderate". Those with scores less than or equal to one-third (1/3) of the mean asset score were ranked low. However, in the second stage of the analysis, this classification was collapsed into only two categories (Low/High) due to the convergence in the data set. Households with composite score that exceeds or equal to the population mean score were ranked "high" while those with score less than the population mean were ranked "low" in terms of access to livelihood assets.

3.4.3 Income Portfolio Analysis

Objective II, which is identification of the choice of rural livelihoods pursued by farming households was addressed using the "income portfolio analysis". This involved identifying people by income proportion received from various sectors of the rural economy classified by Ellis (1998) and Barrett *et al.* (2001), as follow:

A. Farm income: This is the income type obtained from the use of land inherited, purchased, rented or accessed by share tenancy for agricultural activities including crop, livestock, fishery and forestry.
B. Off-farm income: This is the type of income or wage earned from the use of own labour hired in other farms within the context of Agriculture.
C. Non-farm income: This includes earnings from non-agricultural sectors such as non-farm employment, transfer income, rents received, rural wage and earnings from distant relations to an agrarian household (Ellis, 2000).

From the foregoing classification and following the works of Adugna and Wagayehu (2015); Kassie *et al.* (2017), farming households were identified and grouped into four mutually exclusive livelihoods' choices as: on-farm (agriculture only); on-farm-off-farm, on-farm-non-farm and on-farm-off-farm-non-farm choice of rural livelihoods (Aboud *et al.,* 2001).

3.4.4 Multinomial Logit Model

Objective III, which is identifying factors determining the choice of rural livelihoods, was analysed using the multinomial logit model. Multinomial logit is suitable for qualitative response modeling given that the response variable is unordered or nominal in character (Greene, 2012). Following Greene (2003) and as further adopted by Rahji (2005) and Gani (2015), the probability that the i^{th} household with x characteristics chooses the j^{th} choice of rural livelihoods was modeled as follows:

$$P_{ij} = \frac{\exp(M_i\beta_j)}{\sum_{j=0}^{J}\exp(M_i\beta_j)} \quad \text{For } j = 0\ldots.. J \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.19)$$

Given that j = 0, J such that $\sum_{j=0}^{J} P_{ij} = 1$ for any other I, where P_{ij} = probability representing the i^{th} respondent's chance of adopting any of the J categories; M =determinants of choice probability; β_j = covariate effects specific to j^{th} response category. The choice of this model was rooted in the assumption of optimal allocation of asset endowment by the i_{th} household to pursue a livelihood that maximises its utility (Brown *et al.,* 2006). The baseline and reference group that was used in this study was "on-farm with off-farm" livelihood against which other livelihoods' choices were

compared. Let $P_r\ (Y_{ij} = Q/M)$ be the probability of observing outcomeY_{it}, given M.The probability model for Y_{ij} can be constructed as:

$$P_r\ (Y_{ij} = Q/M) = \frac{\exp\ (\beta_o+\beta_1 M_{2i}+\cdots+\beta_k M_{ri})}{\sum_{J=0}^{k}\exp(\beta_o+\beta_{ij}M_{2i}+\cdots\ldots\ldots\ldots+\beta_{kj}M_{si})} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.20)$$

for $J = 0,1,2,.K.$

$$Pr_{ij} = \frac{\exp\ (\beta_j M_i)}{1+\sum_{j=0}^{k}\exp\ (\beta_j M_i)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.21)$$

For j = 1, 2, 3 and i =1, 2 . . . , 15

$$Pr_{i0} = \frac{1}{1+\sum_{j=0}^{k}\exp\ (\beta_j M_i)} \text{ For j= 0} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.22)$$

In equation (3.21), Pr_{ij} is the probability of choosing the j^{th} livelihoods, while Pr_{i0} in equation (3.22) is the probability of choosing the reference category. In practice, estimating this model requires that the coefficients of the reference category are normalized to zero (Greene, 1993). This is because the summation of probabilities for all the choices must be equal to unity (Greene, 1993). As a result, only (4-1) separate sets of parameters can only be determined. The estimated equation was given by the natural logarithims of the odds ratio of equation (3.21) (Greene, 1993) as:

$$\ln\left(\frac{P_{ij}}{P_{i0}}\right) = \beta_{ij}M_i \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.23)$$

For $i = 1, 2, \ldots, 15.$ and j=1, 2, 3.

The Relative Risk Ratio (RRR) or odds ratio$\left({}^{P_{ij}}/_{P_{i0}}\right)$ was given by the relative probability of Y= j in comparism to the base category Y= 0. The β_{ij} parameter estimates determine the influence of a unit increase in the relevant explanatory variables on the log odds ratio of a given choice of livelihoods compared to base category. However, the coefficients of the reference group can be calculated using Hill's (1983) formula:

$\gamma_v = -(\gamma_1+\gamma_2+\ldots\ldots+\gamma_{v-1})$ ..... (3.24)

$\beta_2 = -(\beta_1+\beta_3+\beta_4)$ ..... (3.25)

Equation (3.25) implies that, the negative of the sum of the parameters for groups 1, 3, and 4 is the coefficient of the reference group for each explanatory variable in the reference group. This study modeled the choice of rural livelihoods as $Y_{ij}= f(M_i)$ where

Y_{ij} assumes a value from 0, 1, 2 and 3, if a household I chooses a particular livelihood. The multinomial logit model in its explicit functional form was specified as follow:

$$Y_1 = \alpha_1 + \beta_1 M_1 + \beta_2 M_2 + \ldots\ldots\ldots + \beta_{15} M_{15} + \varepsilon_t \quad \ldots\ldots\ldots (3.26)$$

$$Y_2 = \alpha_2 + \beta_2 M_1 + \beta_{3,} M_2 + \ldots\ldots\ldots + \beta_{15} M_{15} + \varepsilon_t \quad \ldots\ldots\ldots (3.27)$$

$$Y_3 = \alpha_3 + \beta_3 M_1 + \beta_4 M_2 + \ldots\ldots\ldots + \beta_{15} M_{15} + \varepsilon_t \quad \ldots\ldots\ldots (3.28)$$

Where $M_1 \ldots\ldots M_n$ denote the vector of the independent variables, with n = 1……..15. $\beta_1 \ldots\ldots \beta_n$ denote the parameter coefficients. ε_i is an error term with normal distribution, and $\alpha_1, \alpha_2,$ and α_3 show the constant term. The explanatory variables following the works of (David, 2013; Adugna and Wagayehu, 2015; and Gebru *et al.*, 2018) that were expected to influence the j^{th} choice of rural livelihoods are as follow:

Demographic and Socio-economic Factors

M_1	=	Age of household head (years)
M_2	=	Sex of household head (1= male, 0 otherwise)
M_3	=	Marital status (1= married 0 otherwise)
M_4	=	Household head completed Primary education (1=yes, 0 otherwise)
M_5	=	Post primary education of household head (1=yes, 0 otherwise)
M_6	=	Dependency ratio (non-working /working members of the household)

Economic (Production/Exchange) Factors

M_7	=	Microcredit use (1= yes, 0 otherwise)
M_8	=	Land area in use (ha)
M_9	=	Irrigation Practice (1=yes, 0 otherwise)

Institutional Influence Factors

M_{10}	=	Frequency of contacts with extension agent in a year
M_{11}		Distance to the nearest market from dwelling (km)
M_{12}	=	Access and utilization of electricity/national grid (1= yes, 0 otherwise)
M_{13}	=	Membership of social organization (1= yes, 0 otherwise).

Vulnerability/Resilience Factors

M_{14}	=	Livestock ownership (Tropical Livestock Unit)
M_{15}	=	Access to remittances (1=yes, 0 otherwise)

3.4.5 Marginal Effects and Quasi Elasticity of the Multinomial Logit Model

According to Greene, (1993), there is a difficulty in interpreting the coefficients of the multinomial logit model. However, differentiating equations (3.21) and (3.22) gives the marginal effects or partial derivatives ($\frac{\delta P_j}{\delta X_i}$) of the regressors on the probability of adopting the j^{th} livelihoods as follow:

$$\frac{\delta P_j}{\delta X_i} = P_j\left(\beta_j - \sum_k P_k\beta_k\right) \quad \text{..... (3.29)}$$

Where j =1, 2 ...J. and k =1, 2 ... J.

The marginal effects or partial derivatives for this study were obtained using Stata 15. Subsequently, quasi elasticities were obtained from the marginal effects using $\eta Ji = \overline{X}$ ($\text{“}\delta P_j/\text{”}\delta X_i$) where $\overline{X}$ is the mean value of X_i. The method of deriving the quasi elasticities implicitly indicates that, the sign and magnitude of the marginal effects do not have to be related to the sign of the coefficients used to obtain them (Greene, 1993).The quasi elasticities show the percentage point change in the probability of adopting the j^{th} livelihood P_j upon a one percent change in the relevant regressor, M_i. By virtue of simplicity of interpretation, quasi elasticities are found to be preferable to the coefficients and partial derivatives (Rahji, 2005). The signs and values of quasi elasticities can also change when evaluated at different points (Basant, 1997).

3.4.6 Likelihood Ratio Test

Hypothesis:

$H_0 = \beta_1 = \beta_2 = \beta_3 = \ldots = \beta_k = 0$; $H_1 = \beta_1 \neq \beta_2 \neq \beta_3 \neq \ldots \neq \beta_k \neq 0$

$$X^2_{stat} = -2[LLR - LLF] \quad \text{..... (3.30)}$$

Where LLF = log likelihood for the full model; LLR = log likelihood for the restricted model. LLF is obtained from the estimated multinomial logit model with constant parameter, while LLR (L_0) is obtained from the estimated model with only constant parameter and is computed as follows:

$$L_{(0)} = \sum_{j=0}^{J} n_j \ln P_j \quad \text{..... (3.31)}$$

$$L_{(0)} = n_o \ln P_o + n_1 \ln P_1 + n_2 \ln P_2 + n_3 \ln P_3 \quad \text{..... (3.32)}$$

Decision rule**:** acceptH_1, if $X^2_{stat} > X^2_{tab(0.01,48)}$

$$X^2_{stat} > X^2_{tab(0.05,48)}$$

3.4.7 Food Consumption Scores (FCS)

Objective IV, which is profiling food insecurity status of farming household was addressed using "Food Consumption Scores". Following the works of Mensah (2014) and collaborative "Report of Food Security Sector Humanitarian Agencies (2015), Food Consumption Scores (FCS) was used because it is shown to be a valid proxy for measuring adequacy or otherwise of dietary requirements using data on household's consumption of different food groups (FANTA, 2006).

Food Consumption Scores (FCS) was estimated by asking the individual responsible for food preparation in a household about the frequency of consumption of each of the eight (8) food groups using 7-day recall. The food groups are: staples-maize, rice, sorghum, yam, cassava, potatoes and millet), pulses -legumes, nuts and seeds- vegetables, fruits, meat and fish, dairy products, sugar and oil. The frequency of each of the food group consumed was multiplied by a predefined weight and the resulting values are summed to obtain the food consumption score as follow:

$$FCS_i = \sum_{fg_{h=1}}^{n=8} w_{fg}\, f_{fg} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.33)$$

Where FCS_i is the food consumption score obtained for i_{th} household; w_{fg}= weight of h_{th} food group consumed, f_{fg}= frequency of h_{th} food group consumed and n = total number of food groups.

Based on these scores, three different cut-off categories representing food insecurity status of individual households were obtained as follow: "poor" conceptualized as core food insecure ($y^* \leq 21$), "borderline" conceptualized as moderately food insecure ($21 < y^* \leq 35$) and "acceptable" conceptualized as non-food insecure or food secure ($y^* > 35$) with respect to frequency of food groups (dietary diversity) consumed. Table 3.3 presents the food groups classification by their food items as well as their associated weights based on nutrients density.

Table 3.2: Classification of Food Groups by Food Items

S/N	Food groups	Food items	Weight
1.	Staples:	Cereal: rice, maize, pasta, wheat, sorghum, millet, bread/cake, Root and tubers: yam, cassava, cocoyam, potato, and/or tubers	2
2.	Pulses:	Legumes/nuts/seeds: beans, cowpea, peanuts, groundnuts, Bean cake, soy, pigeon pea, lentils, melon, and/or other pulses	3
3.	Vegetables:	Orange vegetables (rich in vitamin A): carrot, red pepper, okra, Pumpkin, green leafy vegetables: Amaranths, cassava leaves, Onion, tomatoes, cucumber, lettuce and/or other green leafy vegetables	1
4.	Fruits:	Mango, pawpaw, apple, orange/tangerine, Pineapple, watermelon, and/or other fruits.	1
5.	Meats & Fish:	Goat, beef, chicken, pork, organ meats (liver, kidney, heart), fish, dry fish, smoked fish and/or sea food.	4
6.	Dairy products	Fresh milk, yoghurt, cheese, other/or dairy products	4
7.	Sugar:	Sugar, honey, cakes, candy, cookies, pastries and other sweets	0.5
8.	Fat/Oil	Vegetable oil, palm oil, Shea-butter, margarine, other fats/oil	0.5

World Food Programme, (2007)

3.4.8 Instrumental Variable (IV) Ordered Probit Model

Objective V, which is determining the influence of rural livelihoods on food insecurity status was addressed using the instrumental variable (IV) ordered probit model proposed by Amemiya (1978) and Newey (1987) and adopted by Maitra and Rao, (2014). The choice of this model was premised on its suitability for estimating bicausal or jointly dependent relationship among economic variables (Greene, 2012). Furthermore, the ordered probit regression is suitable for estimating model with ordinal outcome. Thus, Y which is a proxy variable for the latent Y^* is a linear function of selected covariates, x_I, plus a normally distributed error term.

$Y_i^* = x_i\beta + \varepsilon_i$ ………………………………………………………….. (3.34)

For i_{th} rural household, where $\mu_0 = 0$ and u_j=1 denotes the two food insecurity categories through which the three observed Y values were determined as follows:

$$Y_i^* = Y_i = \begin{cases} 0 & \text{if } y_i^* \leq \mu_0, \text{ (None} - \text{food insecure)} \\ 1 & \text{if } \mu_0 < y_i^* \leq \mu_1 \text{ (moderately food} - \text{insecure)} \\ 2 & \text{if } \mu_1 < y_i^* \leq \mu_2 \text{ (Core} - \text{food insecure)} \end{cases}$$

The predicted probabilities of each ordinal outcome such that $0 < U_1 < U_2$ were given as:

$P[Y_i^* = 0] = \emptyset\ (U_0 - x_i\beta)$ ………………………………………………… (3.35)

$P[Y_i^* = 1] = \emptyset\ (U_1 - x_i\beta)$ - $(U_0 - x_i\beta)$ ………………………………… .. (3.36)

$P[Y_i^* = 2] = \emptyset\ (U_2 - x_i\beta) - (U_1 - x_i\beta) = 1- \emptyset\ (U_2 - x_i\beta)$……………….. (3.37)

In these equations, "$\emptyset$" are positive values denoting the probability density function of a standard normal distribution. The implication is that, for core food-insecure (lowest) category, the sign taken by the marginal effect is opposite that of parameter β , while the sign of the marginal effects for non-food insecure (highest) category is consistent with that of β Parameter. For moderately food-insecure (middle) category, the sign of the marginal effect can either be positive or negative depending on the sign taken by the difference of the terms in the bracket. The full specification of the ordered probit model is given as follow:

$Y_i^* = Y_i = \beta_1X_1 + \beta_2X_2 +. + \beta_{14}X_{14} + \beta_{15}X_{15} + \beta_{16}X_{16} + \beta_{17}X_{17} + \beta_{18}X_{18} + \varepsilon_{1i}$ (38) Model 1

$$Y_i^* = Y_i = \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_{13} X_{13i} + \beta_{14} X_{14} + \varepsilon_{1i} \quad \text{..... (3.39) Model 2}$$

Where Y^* is a row vector of latent, unobservable food consumption scores that determine the observed, Y_i ordinal outcomes of 2, 1 and 0 for core-food insecure ($y^* \leq 21$), moderately food insecure ($21 < y^* \leq 35$) and none-food insecure ($y^* > 35$) respectively; X's denote the vector of explanatory variables; β is the associated vector of unknown parameters and ε is an independently distributed error term ($\varepsilon_i \sim$ iid: $0, \sigma^2$). The explanatory variables following the works of Asmelash, (2014); Yishak *et al.* (2014); Maitra and Rao (2014); Mensah (2014) and Gani (2015) are:

Demographic and Socio-economic Factors

X_{1i}	=	Age of the household head (years)
X_{2i}	=	Sex of the household head (1=male, 0 otherwise)
X_{3i}	=	Marital status of the household head, (1= married; 0 otherwise)
X_{4i}	=	Post primary education (1= post primary education, 0 otherwise)
X_{5i}	=	Household size
X_{6i}	=	Dependent ratio (non-working /working members of household)

Economic (Production/Exchange) Factors

X_{7i}	=	Farming experience of Household head (years)
X_{8i}	=	Primary occupation of Household head (1= farming, 0 otherwise)
X_{9i}	=	Irrigation Practice (1= yes, 0 otherwise)
X_{10i}	=	Agro-ecological zone (1= Rain forest, 0 otherwise)
X_{11i}	=	Rural livelihoods (1= on-farm, 2= on- farm + off-farm, 3= on-farm+ non-farm, 4= on-farm +off-farm+ non-farm).

Institutional/Resilience Influence Factors

X_{12i}	=	Frequency of contacts with extension agents in a year
X_{13i}	=	Access and utilization of electricity/ National Grid
X_{14i}	=	Aggregate Asset score (PCA-based)
X_{15i}	=	Natural Asset score (PCA-based)
X_{16i}	=	Physical Asset score (PCA-based)
X_{17i}	=	Human Asset score (PCA-based)
X_{18i}	=	Financial Asset score (PCA-based)
X_{19i}	=	Social Asset score (PCA-based)

3.4.9 Endogeneity Issue in Food Insecurity Model

Given that the dependent variable Y^* and independent variable X_{14i} in equation (3.39) were assumed to be jointly determined such that asset variable, X_{14i} can also be influenced by food insecurity, Y^*, there will be endogeneity problem, (i.e. $E(\varepsilon_i X_{14i} \neq 0$;

$E(\varepsilon_{1i}\ \varepsilon_{2j} \neq 0$ for $i \neq j)$ (Greene, 2012). This implies that, ordered probit model will not produce consistent estimates of β_i parameters using maximum likelihood (ML) method. However, to obtain consistent estimates of β_i parameters from the maximum likelihood procedure, a vector z_i containing the relevant instrumental variables such that $E(\varepsilon_i z_i) = 0$ and $E(\varepsilon_{1i}\ \varepsilon_{2j} = 0$ for $i \neq j)$, was required. The full specification of the simultaneous equation model, taking into consideration the assumption that underlies the endogeneity of X_{14i}(asset score) is given as:

$$Y_1 = \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_{13} X_{13i} + \beta_{14} X_{14i} + \varepsilon_{1i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.40)$$

$$X_{14} = \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_{14} X_{14i} + \beta_{15} X_{15i} + \beta_{16} X_{16i} + \varepsilon_{2j} \ldots\ldots\ldots \quad (3.41)$$

Where Y_1 and X_{14} are endogenous variables representing food insecurity status and asset score respectively. With the exception of these two endogenous variables (Y_1 and X_{14}), other variables specified in the simultaneous equations model were strictly exogenous. The structural equation was given by Equation (3.40), while the equation (3.41) is the reduced form and it basically expresses the variation in strictly exogenous variables only, including a vector z_i consisting of instrumental variables, X_{15i}(per capita expenditure on farm inputs), X_{16i}(ownership of livestock) and X_{17i}(access to credit) that were excluded from the structural equation. This was done to produce the unique estimates for the coefficients of the structural and reduce-form equations. This is what is usually referred to as the identification issue in simultaneous equation model.

Given a system of simultaneous equation and its specification, the procedure for estimating the β_i parameters can either be sequential or simultaneous. However, there is difficulty in making use of Full Information Maximum Likelihood (FIML) estimation technique because it requires rigorous computational procedure and is time-demanding especially when it comes to ordered choice model. However, Stata user-written "cmp" (Roodman, 2009) has the routine to conveniently estimate this model.

3.4.9.1 Anthrho Statistics (ρ)

The IV-Ordered probit model was analysed using FIML estimation technique such that the significance of the reported "anthrho" statistics could be directly tested. The "anthrho" statistic measures the correlation of error terms from both models (Kawstsu and Largey, 2009). If the null hypothesis of no endogeneity could not be rejected as stated below, then the single equation ordered probit model could be consistently estimated.

H_0: ρ = 0: There is no endogeneity

H_1: ρ ≠ 0: There is endogeneity

3.4.9.2 Hausman Specification Error Test

Given the existence of likely linear dependence between the variable, (X_{14i}) i.e. asset score and stochastic error term (ε_{1i}) in food insecurity equation (3.39), Hausman specification error test was used to confirm the significance of the coefficients of the error terms in structural and simultaneous equations under the following hypothesis:

H_0: $E(\varepsilon_{1i}\varepsilon_{2j} = 0$ for $i \neq j)$: There is no endogeneity

H_1 : $E(\varepsilon_{1i}\varepsilon_{2j} \neq 0$ for $i \neq j)$: There is endogeneity

3.4.10 Variance Inflation Factor

Given the suspicion of likely correlation among the independent variables specified in the ordered probit models, Variance Inflation Factor (VIF) was operationalised in order to determine the magnitude of the correlation. The VIF is a metric for determining how inflated the standard error is. The rule of thumb states that, the variable with VIF above 10 indicates serious concern for multicollinearity (Greene, 2003).

H_0: VIF > 10; There is multicollinearity

H_1: VIF ≤ 10; There is no multicollinearity

Description of variables that influence food insecurity status

In specifying model, the choice of variables considered in this study was informed by economic theories, previous empirical studies as well as the considerations for econometric properties. However, some variables important for model specification

were not explicitly specified to avert multicollinearity problem. The expected influence of these variables on food insecurity status has been captured in the computation of PCA-based asset score for the aggregate and individual asset type. Such variables included access to credit, remittances and membership of organisation.

X_1 (Age): The age of the respondent is a count variable measured in years. The influence of age on food insecurity status was expected to be positive.

X_2 (Sex): This is a discrete variable, given 1 for male-headed and 0 otherwise. Given that poverty is gender sensitive with a bias for feminisation of poverty and food insecurity (Mallick and Rafi, 2010). Food insecurity status was hypothesised to be positively influenced by female-headed households.

X_3 (Marital status): This is a discrete variable where 1= if married and 0 otherwise. Marital status determines per capita income of farming households and thus access to food. The influence of marital status was expected to be positive on food insecurity status.

X_4(Post primary education): This is a discrete variable where 1=household heads with post primary educational attainment and 0 otherwise. The increase in formal educational attainment above the primary school level is found to be associated with improved farm productivity and minimising the risk of falling further into food poverty depth due to the benefit of comparative advantage derived from using improved technologies (Garrett and Ruel, 1999). The influence of post primary educational attainment on food insecurity status was expected to be negative.

X_5(Household size): This is a count variable that represents all household members living under the same roof and are feeding from the pooled resources. The influence of household size on food insecurity status was expected to be positive.

X_6 (Dependency ratio): This is a count variable. It is described as the ratio of non-working household's members to members that are actively engaged in productive employment. The high dependency ratio resulting from the larger share of non-working members of the household implies greater economic burden; hence, the lower earning

capacity with a direct consequence of food insecurity (Tawodzera, 2001). The influence of dependency ratio on food insecurity status was expected to be positive.

X_7(Farming experience): This is a count variable used to measure the number of years household heads engaged in farming activity. The influence of farming experience on food insecurity status was expected to be negative.

X_8 (Primary occupation): It is a discrete variable where 1= household head primarily engaged in farming and 0 otherwise. Given that poverty and hunger are more rural than urban and prevalent among the households in vulnerable employment in agriculture (FAO *et al.,* 2015). This study hypothesised that, being primarily engaged in farming was expected to positively influence by food insecurity status.

X_9 (Irrigation practice): This is a discrete variable where 1= if at least a member of the household practises irrigation system.), 0 otherwise. It was used as a proxy variable for what Jemal and Abafita, (2014) and Gani, (2015) considered as "rainfall index" in their studies. Given that agriculture in developing countries including Nigeria is predominantly rain-fed, the attendant incidence of prolonged drought, pest infestation and flooding tend to have negative influence on farm productivity, income level and food insecurity status.. Access to irrigation was expected to negatively influence food insecurity status.

X_{10} (Agro-ecological zone): This is a discrete variable where 1= if resident in rain-forest agro-ecological zone and 0 otherwise. Rain-forest zone is characterized with favourable agro-climatic conditions such as temperature, rainfall and relative humidity among others, compared with savanna or derived savanna agro-ecological zone. Rain-forest agro-ecological zone was expected to negatively influence food insecurity status.

X_{11} (Rural Livelihoods): This is a categorical variable describing four mutually exclusive livelihood choices where 1= ONF; 2= ONF-OF; 3= ONF-NF and 4= ONF-OF-NF livelihoods. However, the influence of (4-1) categories could be determined to avoid dummy variable trap (Gujarati, 2009). Rural livelihoods' choice was hypothesised to either positively or negatively influence food insecurity status.

X_{12}(Frequency of contact with extension agent): This is a continuous variable representing the frequency of extension visits in a year. It enhances the capacity of farmers to adopt improved production technologies such as improved farm inputs and access to market information that are likely to positively influence farm productivity, income and access to food. (Asogwa *et al.,* 2012). The influence of extension visits on food insecurity status was expected to be negative.

X_{13}(Access and use of electricity (national grid)): This is a discrete variable where 1= if household had access and actually use electricity (national grid) and 0 otherwise. The influence of access and actual use of electricity (national grid) on food insecurity status was expected to be negative.

X_{14} (Asset Score): This is a continuous variable derived from PCA-based data reduction technique. Possession of assets tends to minimise the risk of being poor or food-insecure by enhancing their capabilities to smoothen their consumption (Barrette, 2002). The study hypothesised that PCA-based asset score negatively influences food insecurity status.

X_{15}(Natural-Asset score): It is a latent and continuous variable derived from the principal component analysis. This variable may be directly or indirectly linked with the household's capacity to secure access to food. Natural asset was hypothesised to negatively influence food insecurity: The following were used as proxy indicator variables for construction of PCA-based natural asset score.
(i). Land Area: It is a count variable measured in hectares. It is the area of land in use for production activities. (ii) Access to forest resource/product: It is a discrete variable where 1= access to forest resource/product, 0 otherwise. (iii) Access to irrigation facilities: It is a discrete variable where 1= access to irrigation facilities and 0 otherwise.

X_{16} (Physical-Asset score): It is a latent and continuous variable derived from the principal component analysis. The influence of physical-asset score on food insecurity status was expected to be negative. The following observed variables were considered to measure the facets of physical asset. (i). House ownership: It is a discrete variable where 1 = if the household owned a house and 0 otherwise (ii). Ownership of vehicle: It

is a discrete variable where 1= if the household head owned a vehicle and 0 otherwise (iii). Access to tarmac road: This is a discrete variable where 1= access to tarred road and 0 otherwise (iv) Access to national grid: It is a discrete variable where 1= access to electricity and 0 otherwise (v) Proximity to the market: It is a count variable measuring the distance in kilometer from household's dwelling.

X_{17}(Financial Asset (FA) score): This is a latent and continuous variable derived from the principal component analysis. The influence of FA score on food insecurity status was expected to be negative. The following asset indicator variables were considered so as to capture the broad category of financial assets. (i). Remittances: This is a count variable measuring the unearned income such as cash gifts and/or donations from friends and family members to a household (ii). Microcredit received: It is a count variable valued by loan amount benefited in the last 12 months (iii). Livestock ownership: This is a count variable using "tropical livestock unit" as its proxy measure. Tropical Livestock Unit (TLU) is a standard unit that corresponds to 1 cattle with 250kg weight (FAO, 2003) (iv). Ownership of jewelries: It is a discrete variable where 1= ownership of jewelry and 0 otherwise.

X_{18}(Human-Asset score): This is a latent and continuous variable derived from the multivariate technique of principal component analysis. Human-Asset score was expected to negatively contribute to food insecurity status. The study considered the following variables as indicators of human capital. (i). Labour availability: This is a count variable measured by the dependency ratio. Dependency ratio is the ratio of economically inactive (below 15 and above 65 years) to economically active members (ii). Distance to the nearest health care facility: It is a count variable measured in kilometres. It measures the proximity from the dwelling to the nearest health care facility (iii). Health status: This is a discrete variable where 1=if any household's member was ill in the last seven days and 0 otherwise; (iv) Years of formal education: This is a continuous variable that captures the years spent in formal education.

X_{19} (Social-Asset score): This is a latent and continuous variable derived from the principal component analysis. The influence of social-asset score on food insecurity status was hypothesised to be negative. The following were considered as proxy variables for measuring household's access to social capital. (i). Membership of

organization: It is a binary variable where 1= if household head or any member of a household belonged to at least a social organisation and 0 otherwise; (ii). Decision making in social organisation: This is also a binary variable where 1= if household head or any member of a household participated in decision making of the organisation and 0 otherwise; (ii). Share of income from remittances: This is a count variable representing the remittance share of income to a household.

Table 3.3: A priori Relationship between the Explanatory Variables and Choice of Rural Livelihoods

Code	Variable	Expected Sign	Empirical Evidence
X_1	Age	+/-	Cornelius, 2011; Mensah, 2014; Kassie *et al.*, 2017
X_2	Marital status	+/-	Awoniyi and Salman, (2015); Gani, 2015
X_3	Gender	+/-	Njuguna, 2011; Gebru *et al.*, (2018);
X_4	Primary education	+/-	Adugna and Wagayehu, (2015); Lorato, (2019)
X_5	Post pry education	+/-	Gani, (2015); Kassie *et al.*, (2017);
X_6	Dependency ratio	+	Njuguna, (2011); Khatum and Roy, (2012); Adepoju and Obayelu, (2013);
X_7	Access to credit	+/-	David, (2013); Combary, (2015);
X_8	Access to remittances	+/-	Adugna and Wagayehu, (2015); Gebru *et al*, 2018
X_9	Extension contact	-	Kassie *et al.*, (2017);
X_{10}	Livestock ownership	+	Adepoju and Obayelu, (2013); Lorato, (2019)
X_{11}	Market distance	-	Bongole, (2016); Gebru *et al.*, (2018)
X_{12}	National grid	+	Cornelius, (2011)
X_{13}	Farm size	-	Ntwenya *et al.*(2015); Eshettu and Mekonne, (2015);
X_{14}	Access to irrigation	+/-	Khartun and Roy, (2012)
X_{15}	Organisation membership	+	David, (2016); Onunka and Olumba, (2017)

Table 3.4: A priori Relationship between the Explanatory Variables and Food Insecurity Status

Code	Variable	Expected Sign	Empirical evidence
X_1	Age	+	Asogwa and Umeh, (2012); Jemal and Kim, (2014)
X_2	Gender	-	Fekadu and Mequanent, (2010); Adepoju and Adejare, (2013)
X_3	Marital Status	+	Oni and Fashogbon, (2013)
X_4	Post pry education	-	Mensah, (2014); Maitra and Rao, (2014)
X_6	Dependent ratio	+	Mensah, (2014); Fekadu and Mequanent, (2010); Jemal and Kim, (2014)
X_8	Primary occupation	+	Adepoju and Adejare, (2013)
X_9	Access to irrigation	-	Jemal and Kim, 2012; Gani, 2015
X_{10}	Agro-ecological zone	-	Oni and Fashogbon, (2013); Jemal and Kim,
X_{11}	Livelihoods choice Extension contact	+/-	Asmelash, (2014); Yishak *et al.*, (2014)
X_{12}	Access to national	-	Asogwa and Umeh, (2012)
X_{13}	grid	-	Gani, (2015)
X_{14}	Assets score	-	Maitra and Rao, (2014); Ibrahim *et al.*, (2018)

3.5 Limitations to the Study

Given the dynamics of food insecurity over time among rural households and the significance of the survey data in validating the previous research findings, a major limitation of this study lies in its cross-sectional focus. Hence, it was impossible for this study to estimate the proportion of the sampled population that were transitorily and chronically food insecure over time and to identify the underlying factors that were likely to influence these transitions. Further, the data used was based on primary source collected from farming households, majority of whom hardly keep records of their farm operations. Consequently, response errors were imminent as most of the information (e.g. data on income sources, food consumption, expenditure on farm inputs etc.) were elicited based on the memory recall of the respondents. However, these errors were minimised to a great extent through the assistance of the experienced and adequately trained extension workers. In addition, given that the study was based on household level analysis, quantification and aggregation of data obtained on interval scale including income sources, income shares and frequency of food groups intake were potential sources of error for the study. Despite its focus on household level, the study found it computationally intensive, time consuming and as also constitutes huge financial burden to interview all members of households and report them accordingly. The practice was to collect household level data interviewing the household head who often makes decision for the household.

More so, the insecurity problem which is ravaging some parts of the northern Nigeria also restricted the study from selecting the zone mostly affected by poverty and hunger. Nevertheless, the distribution of poverty and hunger scores was reportedly uneven across the states of geo-political zones.

CHAPTER FOUR

RESULTS AND DISCUSSION

This section presents the results of descriptive and inferential statistics used to achieve the objectives of the study. It also discusses the results with the aim of validating the previous empirical findings or critique them based on sound economic intuition.

4.1 Distribution of Households based on Socio-Economic Characteristics

The household profile are concerned with the description of the demographic and socio-economic conditions of the households in order to provide background information on the subjects and cases being investigated. The data so analysed and upon which the cases were being discussed, was disaggregated into the component states before it was pooled together so as to adequately explore the spatial differences in the distribution of the selected attributes. They included the age of the household head, gender, marital status, household size, educational attainment, farming experience, farm size, credit use, organisational membership, primary occupation, agro-ecological zone and income level.

Table 4.1 shows the distribution of the households based on the socio-economic factors. The result of the pooled data revealed that 81.37% of the study households were male-headed, while about 18.63% were female headed. In terms of age, it was revealed that 7.40% of the household heads were at least 35 years of age, 26.85% were between 36 and 45 years of age, 32.87% aged between 46 and 55 years, 19.73% were between 56 and 65 years and 13.15% aged above 65 years. The average age of the study households was about 52 years suggesting that majority of the household heads were in the age range of active labour force. The household heads who were less than or equal 35 years of age constitute the smallest age group. About 90.68% of the household heads were married, while 3.8%, 4.6% and 0.8% were single, widowed and divorced respectively. In terms of the household's size, 61.1% of the farming households had 6-10 household size, while

12.8% had 11-15 members, 3.8% had 1-5 members, while the least percentage of the respondents (2.9%) had household size of above 15 members. The mean household size was 8 members indicating a relatively large household size in the study area. In terms of formal educational attainment, there was high literacy among the study households as majority (90.9%) were formally educated, while only 9.1% had no formal education. The mean year of formal education was approximately 10 years. The high literacy level among the households suggests the ease of adopting innovations and improved production technologies.

Farming was the primary occupation for most (78.6%) of the study households, while 21.3% were primarily engaged in non-farm activities implying that, a greater number of the respondents predominantly engaged in farming as the major source of living. It was also revealed that, more than half (58.3%) of the study households had above 10 years of farming experience. The high level of experience was likely to benefit the households in terms of improved productivity and earning capacity.

For credit use, the result shows that, majority (74.5%) of the households used microcredit. Access and utilisation of credit was likely to guarantee improved economic conditions for large number of households. For membership of social organisation, the results further show that majority (74.5%) of farming households belonged to at least one local level institution, while about one-quarter (25.5%) did not belong to any social organisation. This implies that, membership of social organisation was likely to yield some positive externalities in the form of labour assistance and other social claims for large number of study households. It also has the potential to reduce their transaction cost through an effective mechanism for disseminating information among group members.

Considering the mean monthly income of the households, the results from Table 4.1 show that just one-quarter (25.5%) of the study households earned above N60,000 monthly. while more than one-third (35.6%) earned at most N30,000 monthly. The mean monthly income in the study area was N57, 422.30.

Table 4.1: Distribution of Households by Socio-economic Characteristics

Characteristics	Osun (n=226)		Ekiti (n=139)		Pooled (365)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Gender of Household head						
Male	166	26.55	131	94.24	297	81.37
Female	60	73.45	8	5.76	68	18.63
Age of Household head						
≤35	20	8.85	7	5.04	27	7.40
36-45	72	31.86	26	18.70	98	26.85
46-55	79	34.96	41	29.50	20	32.87
56-65	40	17.70	32	23.02	72	19.73
>65	15	6.64	33	23.74	48	13.15
Mean	48.74	(10.67)	55.22	(12.03)	51.92	(11.38)
Marital status						
Married	206	91.15	125	89.93	331	90.68
Single	6	2.65	7	5.04	14	3.84
Widowed	12	5.31	5	3.60	17	4.66
Divorced	2	0.89	2	1.44	3	0.82
Household size						
1-5	65	28.76	22	15.83	87	3.84
6-10	135	59.73	88	63.31	223	61.10
11-15	22	9.74	25	17.99	47	12.88
>15	4	1.77	4	2.88	8	2.99
Mean	7	2.88	8	3.09	8	3
Education of Household head						
No formal education	30	13.27	3	2.16	33	9.04
Primary	67	29.65	27	19.42	94	25.75
Secondary	77	34.07	46	33.09	123	33.75
Tertiary	52	23.01	63	45.32	115	31.51
Primary Occupation						
Farming	149	65.93	138	99.28	287	78.63
Non-farming	77	34.07	1	0.72	78	21.37
Farming Experience						
≤10	98	43.36	54	38.85	152	41.64
11-20	77	34.07	37	26.62	114	31.23
>20	51	22.57	48	34.53	99	27.13
Mean	15.58	(9.53)	18.66	(1.87)	16.76	(10.57)
Credit use						
No	53	23.45	40	28.78	93	25.50
Yes	173	76.55	99	71.22	272	74.52
Organisation membership						
No	53	23.45	40	28.78	93	25.50
Yes	173	76.55	99	71.22	272	74.52
Monthly income of Household						
≤30,000	20	8.85	38	27.34	58	15.89
30,001-60,000	45	19.91	48	34.53	93	25.50
>60,000	161	71.24	53	38.53	214	58.63
Mean	69,287.86	(68,286.0)	38,130.1	(32,363.1)	57,422.30	(59,236.46)

Source: Author's computation from field survey, 2019. Values in parenthesis are standard deviation

4.2. Distribution of Households by Access to Livelihood Assets

Table 4.2 presents the distribution of households by access to livelihood assets. The results of the pooled data revealed that 52.8%, 32.6% and 14.5% had high, moderate and low levels of access to natural asset respectively. This implies that, above average of study households relied on natural asset involving land, water, forestry and bio-diverse resources for their livelihoods. Uma *et al.* (2021) reported that, inclusive access to natural resources enables people to grow their own foods and to raise income. In other words, inadequate tenure rights to natural resources, coupled with extreme weather events and environmental degradation often result in poverty and hunger For physical asset involving house ownership, ownership of vehicle, access to electricity, access to tarmac road and access to the market, 63.2% of farming households were highly endowed, while about 13.1% and 23.6% had moderate and low levels of access to physical asset respectively implying that most of the respondents were highly endowed with physical asset.

In terms of human asset involving labour availability, health status of study households, years of formal education, access and actual utilisation of health facilities, it was revealed that, 77.8% of study households were highly endowed, while about 13.2% and 9.0% were moderately and poorly (low) endowed with human asset respectively. This indicates that most of the study households were highly endowed with human assets. Possession of human assets among the study households was likely to strengthen their productive capacity required to improve their overall well-being including access to adequate food. However, for financial asset involving access to credit, remittances received, ownership of livestock and jewelries, the results show that about 60% of study households were poorly (low) endowed with financial assets, while 2.7% and 37.3% were moderately and highly endowed respectively. The implication is that, the ability of most households to achieve a successful livelihood might be affected.

For social assets involving membership and decision making of households in social organisation and also the share of household income from remittance, the results show that majority (72.6%) of the study households were highly endowed with social asset. The high endowment status among the study households suggests that they were likely to benefit from social trust and networks of friends and relatives to fall back on in times

of stress and shocks. Lim *et al*. (2015) reported that social asset enhances human resilience that has the capability to reduce the risk of falling further into income and food poverty. From the aggregate point of view, the results from Table 4.3 show that majority (66.58%) of study households were poorly endowed with aggregate livelihood assets compared to 33.42% with high level of access to aggregate livelihood assets suggesting that majority of the households lacked the capabilities to pursue a successful livelihood. This finding underscores the imperative of access to financial asset in farm investment decision as well as the intensity of involvement in farm and agricultural activities.

Table 4.2: Distribution of Households by Access to Livelihood Assets (Disaggregated)

Assets categories	Osun (n=226)		Ekiti (n=139)		Pooled (N=365)		Endowment Status
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
Natural	46	20.35	7	5.04	53	14.52	Low
	53	23.45	66	47.48	119	32.60	Moderate
	127	56.19	66	47.48	193	52.88	High
Physical	48	21.24	38	27.34	86	23.56	Low
	36	15.93	12	8.63	48	13.15	Moderate
	142	62.83	89	64.03	231	63.29	High
Human	30	13.27	3	2.16	33	9.04	Low
	23	10.18	25	17.99	48	13.15	Moderate
	173	76.55	111	79.86	284	77.81	High
Financial	144	63.72	75	53.96	219	60.00	Low
	5	2.21	5	3.60	10	2.74	Moderate
	77	34.07	59	42.45	136	37.26	High
Social	46	20.35	30	21.58	76	20.82	Low
	17	7.52	7	5.04	24	6.58	Moderate
	163	72.20	102	73.38	265	72.60	High

Source: Author's computation from field survey, 2019

Table 4.3: Distribution of Households by Access to Livelihood assets (Aggregated)

Asset score interval	Osun n=226)		Ekiti (n=139)		Pooled (n=365)		Endowment status
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
<16,229.09	153	67.70	90	64.75	243	66.58	Low
≥ 16,229.9	30	32.30	49	35.25	122	33.42	High
Mean asset score	16,229.09						
Standard deviation	26,264.55						

Source: Author's computation from field survey, 2019.

4.3. Profile of Households by Income Sources and Livelihood Activities

This section presents the percentage mean monthly income share by different sources as well as the distribution of the households by the choice of rural livelihoods pursued.

Table 4.4 shows the mean income (monthly) share by different sources of livelihood activities undertaken. The results reveal that the share of on-farm (Agriculture) from the total income earned across diverse activities was 55.96% with crop production sub-sector accounting for the largest share (39.76%). This was to be expected, given that most rural households rely on crop farming as their primary source of income. This result is consistent with Bongole (2016), who reported that 52.51% of households' income was derived from crop production. Further, livestock husbandry including cattle, sheep, goat, pig, ducks, turkey poultry and fisheries/aquaculture accounting for 14.71% and 1.49% respectively. When compared to crop production sub-sector, the livestock income share was low, suggesting the inability of most households to accumulate savings and invest in animal husbandry that has the potential to improve the adaptive capacity against seasonal or climate-induced shocks on income and food supplies. The second largest (27.86%) share of total income was non-farm with the trading sub-sector accounting for the largest share (12.53%). This is consistent with Hilson (2016) who reported that non-farm income contributed between 25-40% to total income in the south of the Sahara. However, the off-farm income share contributed the least to total income with about 16.18%. This was expected as off-farm income strategy is often considered the last resort and coping strategy for resource-poor rural households.

Table 4.5 presents the distribution of households by the choice of rural livelihoods. The results of the pooled data revealed that four mutually exclusive rural livelihoods were identified in the survey. They included the following:

Y_1= Those that pursued on-farm (Agriculture) only.

Y_2= Those that pursued on-farm + off-farm.

Y_3= Those that pursued on-farm + non-farm.

Y_4= Those that pursued on-farm + off-farm+ non-farm.

Table 4.4: Distribution of Households Based on Percentage Mean Monthly Income Share by Sources

Income composition (n=365)	**Osun (n=226)**	**Ekiti (n=139)**	**Pooled**
	% mean	% mean	% mean
Crop	36.17	45.96	39.76
Livestock	16.94	10.89	14.71
Fisheries/aquaculture	1.33	1.76	1.49
On-farm (Agriculture) sub-total	54.44	58.61	55.96
Agricultural wage	6.05	1.68	4.44
Gathering	6.40	3.49	5.33
Hire/Rent	1.67	4.57	6.41
Off-farm sub-total	14.12	19.74	16.18
Trading	14.76	8.72	12.53
Rural craft/artisans	5.46	0.84	3.76
Salaried job	10.11	2.72	7.39
Remittances	1.02	8.98	3.95
Transfer	0.14	0.39	0.23
Non-farm sub-total	31.49	21.65	27.86
Mean monthly income	₦ 69,287.86	₦ 38,130.1	₦ 57,422.30
Standard deviation	₦ 68,286.01	₦ 32,363.11	₦ 59,236.46

Source: Author's computation from field survey, 2019

As presented in Table 4.5, the least-pursued choice of rural livelihoods in the study area was “on-farm” (Agriculture) consisting of 3.56% of the respondents. The inability of most respondents to commercialise production systems through investment in improved technologies required for competitive advantage might be responsible for crowding-out majority of the respondents from this livelihoods choice. About 17.8% and 9.7% pursued ONF-OF and ONF-NF rural livelihoods’ choices respectively, while majority (58.9%) of the respondents pursued the most-diversified choice of rural livelihoods involving the combination ONF-OF-NF activities.

4.4 Profile of Household’s Choice of Rural Livelihoods across the Selected Socio-economic Characteristics

The analysis of inter-relationship between the choice of rural livelihoods pursued and socio-economic characteristics was presented in this section. This was done to show the link between rural livelihoods’ choice and the selected characteristics.

As presented in Table 4.6, the results show that significant difference exists between gender and the choice of rural livelihoods undertaken by farming households. Households headed by female were found to pursue the most-diversified of rural livelihoods involving the combination of on-farm-off-farm-non-farm farm activities (66.2%), compared to 58.4% of the male-headed households suggesting that, female-headed households were restricted by cultural factors to have the control or ownership of land for farming activities. Hence, they diversified into off-farm and/or non-farm activities in order to complement the farm income. Significant difference was also found between the educational attainment and the choice of rural livelihoods as the highest percentage (81.8%) of the most livelihood-diversified households was found among household heads with no formal education, while the lowest percentage (53.9%) was found among the household-heads with tertiary educational achievement.

Table 4.5: Distribution of Households by Rural Livelihoods' Choices

Livelihood activities	Livelihoods' choice	Osun (n=226)		Ekiti (n=139)		Pooled (n=365)	
		Freq.	Percent	Freq.	Percent	Freq.	Percent
Production of food and cash crops; Livestock and fisheries/aquaculture	On-farm (Agriculture)	7	3.10	6	4.32	13	3.56
Production of food and cash crops, Livestock and fisheries/aquaculture; Agricultural wage labour, Environmental gathering and rent	On-farm + Off-farm	19	8.41	46	33.09	65	17.81
Production of food and cash crops, Livestock and fisheries/aquaculture; Salaried job (Private & Government), Trading, Craft & Artisans, Transfers, Remittances and pension	On-farm + Non-farm	50	22.12	22	15.83	72	19.73
Production of food and cash crops, Livestock and fisheries/aquaculture; Agricultural wage labour, Environmental Gathering and rent of farm land; Salaried job (Private & Government); Trading, Craft & Artisans, Transfers, Remittances and pension	On-farm + Off-farm + Non-farm	150	66.37	65	46.76	215	58.90

Source: Author's computation from field survey, 2019

Table 4.6: Rural Livelihoods' Profile across the Selected Socio-economic Characteristics

Characteristics	ONF (%)	ONF-OF (%)	ONF-NF (%)	ONF-OF-NF (%)
Sex of HH				
Male	4.37	20.20	18.18	58.38
Female	1.4	5.88	26.47	66.18
χ^2		10.37***		
Educational Level of Household Head				
No formal	3.03	3.03	12.12	81.82
Primary	3.19	21.28	19.15	56.38
Secondary	2.44	18.69	19.51	59.35
Tertiary	6.09	17.39	22.61	53.91
χ^2		12.11*		
Farm size (hectare**)**				
0-2.0	2.52	18.57	23.21	55.70
2.1-3.0	14.82	22.22	14.81	48.15
>3.0	3.96	13.86	12.87	69.31
χ^2		17.79***		
Credit Use				
Yes	4.09	9.84	19.67	66.39
No	3.70	21.40	19.75	55.14
χ^2		7.97**		
Agro-ecological zone				
Rain forest	7.36	36.76	10.29	45.59
Others	3.03	13.13	21.89	61.95
χ^2		26.61***		
Monthly Household Income (₦)				
≤30,000	7.02	50.88	12.28	29.82
30,000-60,000	4.26	15.96	28.72	51.06
>60,000	2.81	9.34	17.76	70.09
χ^2		66.19***		

Source: Author's computation from field survey, 2019. ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. ONF= On-farm; ONF-OF= On-farm+ off-farm; ONF-NF= On-farm+ non-farm; ONF-OF-NF= On-farm+ off-farm + non-farm.

Higher level of education implies enhanced human capital, increased productivity as well as the improved well-being that avail farming households the incentives to specialise in on-farm livelihood. Further, significant difference exists between farm size and the choice of rural livelihoods. The results from Table 4.6 reveal that the highest percentage of the households who specialised in on-farm livelihoods was found among holders of farm size between 2.1 and 3.0 hectares (14.8%), followed by those above 3 hectares (3.9%). The least percentage of the respondents with specialisation in on-farm livelihood choice was found among those with farm size of at most 2 hectares (2.5%). This finding is consistent with Combary (2015) who found that households who pursued the most-diversified of rural livelihoods had small farm size per capita. Significant difference was also found between credit utillisation and the choice of rural livelihoods. With microcredit use, households were found to be more-specialised in on-farm rural livelihood (4.1%), compared with 3.7% of the respondents who had no access to credit.

Significant difference was found between the agro-ecological zone and the choice of rural livelihoods pursued by the households. The results from Table 4.6 show that households who resided in rain-forest agro-ecological zone pursued the most-diversified (45.6%) livelihoods and were more specialised (7.4%) in on-farm, compared with households who resided in savanna/derived savanna agro-ecological zone with 62% pursued the most-diversified livelihood and less-specialised (3.0%) in on-farm livelihood. Ntwenya *et al.* (2015) reported similar finding. Makita (2016) reported that the motives to specialise in on-farm livelihood prevail in a region with favourable conditions for agricultural production including the low risk of prolonged drought, land degradation, flooding and extreme weather events. The results from Table 4.6 further show that there was a significant relationship between the income class of the respondents and the choice of rural livelihoods. It was revealed that, the choice of on-farm livelihood was least (7.02%) pursued by households in the lowest income class with average monthly income of ₦30,000 or less, while the choice of ONF-OF-NF was mostly (70.09%) pursued by households in the highest income category with average monthly income of above ₦60,000. This finding may, however sound counter intuitive with majority of households in the highest income category expected to specialise in

agricultural activities (on-farm livelihoods) and take the advantage of improved technology for achieving the optimum productivity. The probable reason is that, estimating farm income especially in rural areas of developing countries is often unreliable such that it could be overestimated if the farmer perceived the opportunity of benefiting from certain intervention or underestimated if the perception of being taxed is suspected.

4.5. Determinants of Rural Livelihoods' Choices among Farming Households

The results as presented in Tables 4.7 and 4.8 reveal that, the overall fitness of the model as shown by the log likelihood estimate of 297.044 and Chi-square value of 178.26 was statistically significant indicating a good fit for the model. The LR statistics presented in Table 4.9 and indicated by (χ^2) value of 178.26 was statistically significant at both 1% and 5% levels confirming that the estimated coefficients are all significantly different from zero. Table 4.7 reveal that eleven (11) out of the sixteen (16) independent variables specified were significant at 1% ($p<0.01$), 5% (0.05) and 10% (0.1) levels representing about 70% of the total independent variables. They included gender of the respondents, age, being married, dependency ratio, post primary education, farm size, Tropical Livestock Unit (TLU), access to irrigation, distance to the market, remittances and access to national grid (electricity).

1. On-farm (ONF) livelihood: The factors influencing farming household's choice of on-farm livelihoods were age of the household head, dependency ratio, farm size and distance to the market. The odds of pursuing on-farm livelihoods relative to the base category were reduced by 95.2% with increase in age of the household heads. It could be deduced that, the relatively older farming household heads were fewer in on-farm than in the base category. The possible reason is that the relatively younger household heads tend to be more productive, hence they derived superior return from specialising in on-farm livelihoods choice than a choice to diversify into off-farm activities with poor remuneration. This finding is consistent with Adugna and Wagayehu, (2015) and Gebru *et al.* (2018). In line with prior expectation, the odds of pursuing on-farm livelihood relative to the base category by the respondents were reduced by 67.6% with increase in dependency ratio. It could be inferred that, an increase in the dependency ratio suggests

that the ability of farming households to meet the subsistence needs of his family decreases. Consequently, the fall in real income per capita resulting from high dependency ratio might force the household head to diversify into off-farm activities by way of *ex post* coping strategies. This finding is consistent with Adepoju and Obayelu (2013).

In line with the *a priori* expectation, the odds of pursuing on-farm livelihoods relative to the reference category were increased by 60.6% with increase in farm size. Studies have shown that households with larger farm sizes are found to derive their livelihoods exclusively from agriculture (Wanyama *et al.,* 2010; Babatunde, 2013). This finding implies that rural household tends to specialise in on-farm, when there was incentive to increase their farm size. Shariff (2002) also found that per-capita farm size was negatively associated with poorly remunerative farm wage employment as well as occupations with low productivity. This finding is in agreement with Adugna and Wagayehu (2015). In line with *a prio*ri expectation, the odds of pursuing on-farm relative to the reference category were reduced by 79.1% with a unit increase in market distance. This implies that, the inability of farming households to have access to inputs and output market at little or no transaction cost affect farm investment decision and the intensity of on-farm activities and this might likely drive the pursuit of additional income in off-farm activities with the aim of smoothening their consumption.

2. On-farm with non-farm (ONF-NF): Irrigation practice, access and actual use of electricity (national grid) and remittances were positive and significantly influence the choice of ONF-NF rural livelihoods, while sex of the household head and farm size were negative and significantly influence the choice of ONF-NF livelihoods.

The odds of male headed households to pursue combined ONF-NF activities relative to the reference category were reduced by 36.2% implying that households headed with male were unlikely to pursue ONF-NF livelihood. In other-words, households headed with females had the propensity to combine on-farm with non-farm activities. The possible reason is that rural women in developing countries are often more restricted by cultural factors to have the control and ownership of land for farming activities. Hence, they tend to combine petty trading with their smallholding farm plot in order to reduce

their vulnerability to poverty and food insecurity. This finding is in dissonance with Lorato (2019) but consistent with Gani (2015).

Consistent with *a priori* expectation, the choice of combined ONF-NF was negatively and significantly influenced by farm size. The odds of pursuing ONF-NF relative to the base category were reduced by 88.1% with increase in farm size. This finding is consistent with Adugna and Wagayehu (2015) and Bongole (2016) but inconsistent with Gebru *et al.* (2018). The use of irrigation farming increases the odds of pursuing the choice of ONF-NF livelihoods relative to the base category by 5.2%. This finding is in line with Gebru *et al.* (2018). Studies have also shown that, on average, irrigated crop yields are 2.3 times higher than those from the rain-fed production (Dowgert, 2010). As a result, the increase in output and income enable farming households the opportunity to diversify *ex ante* into non-farm activities. In line with *a priori* expectation, the odds of pursuing the choice of ONF-NF livelihoods relative to the base category increases by 62.2% with increase in the earnings from remittances. This implies that income from remittance plays critical role in smoothing household consumption, increase savings and thus gain access to diverse opportunities in non-farm livelihood activities. Gebru *et al.* (2018) reported similar findings.

In line with *a priori* expectation, access and actual use of the electricity (national grid) by the households increases the odds of pursuing ONF-NF livelihood relative to the base category by 95.3%. This implies that access and actual use of the electricity (national grid) has significant contribution to household income through employment in rural non-farm wage, reduction in transaction cost as well as reduced vulnerability to income shock and food insecurity.

3. On-farm, off-farm and non-farm (ONF-OF-NF): 3 out of the 6 independent variables including sex of household head, post primary education, and Tropical Livestock Unit (TLU) were negative and significant, while the remaining three including marital status, remittances and access to national grid were positive and significantly influence the choice of ONF-OF-NF livelihoods.

The odds of male headed households to pursue the most-diversified of rural livelihoods involving the combination of ONF-OF-NF activities relative to the base category

reduces by 35.7%. In other words, the probability of female headed households to pursue the most-diversified of rural livelihoods increases implying that women particularly in developing countries are often faced with higher risk of falling deeper into poverty and food insecurity, compared to their male-headed counterparts (FAO, 2015). Hence, they tend to diversify into broad range of income sources with the aim of smoothening their consumption.

The highly remunerative rural non-farm employment often requires formal education, with the minimum qualification of completed secondary education. Contrary to the *a priori* expectation, the odds of household heads with post primary educational attainment to pursue the most- diversified of rural livelihoods (ONF-OF-NF) relative to the base category were reduced by 80%. The possible reason is that farming households with post primary educational attainment may have realised the poor remuneration pursuing multiple livelihood activities involving the combination of ONF-OF-NF activities due to poor competitive advantage. As a result, they tend to specialise in agriculture, where enhanced productivity is guaranteed with improved technologies necessary for competitive advantage. This finding is in line with Adugna and Wagayehu (2015) but contradicts Gebru *et al.* (2018) and Lorato (2019).

In line with *a priori expectation*, the odds-ratio revealed that, the likelihood to pursue combined ONF-OF-NF livelihoods relative to the base category by the households were reduced by 94.3% with increase in the tropical livestock unit (TLU). The implication is that, there was no incentive by the households to combine multiple activities involving on-farm, off-farm and non-farm activities. This is because livestock ownership offers financial support for the households which enable them to maximize returns from on-farm and off-farm activities. This finding is consistent with Adepoju and Obayelu (2013), Gebru *et al.* (2018) and Lorato, (2019).

Consistent with *a priori* expectation, the odds of married households and earnings from remittance to pursue the choice of ONF-OF-NF livelihoods relative to the base category were increased by 27.4% and 76.8% respectively. This implies that, married household heads tend to pursue multiple income sources in response to the rising household expenditure profile that occurs when the size of the household increases. On the other hand, earnings from remittances enabled the respondents to engage in new business

opportunities so as to maintain or enhance their livelihoods. This finding is consistent with Gani (2015). In line with *a priori* expectation, the odds of farming household heads with access and actual utilization of electricity (national grid) to pursue ONF-OF-NF relative to the base category were increased by 5.7%. This implies that access to national grid availed the respondents a number of opportunities in rural non-farm sector such as rural wage and formal employment.

4.5.1 Marginal Effects and Quasi Elasticity

Table 4.10 presents the marginal effects and quasi elasticities of the significant variables in Table 4.7. Owing to the ease of interpretation, quasi elasticities are superior to the odds ratio and the partial derivatives (Basant, 1997). As shown in the Table 4.10, the quasi elasticity of marital status, post primary education and dependency ratio were inelastic being 0.1584, 0.2502, and 0.0544 respectively for the choice of combined ONF-OF-NF livelihood. The quasi elasticities of marital status, access to the national grid (i.e. electricity), and dependency ratio were inelastic being 0.0841, 0.0744, and 0.0690 respectively for the choice of combined ONF-NF livelihood. The quasi elasticity of dependency ratio was also inelastic being 0.0377 for the choice of on-farm (ONF) livelihood. The interpretation is that, if a given or a set of independent variables are elastic, it implies that, for one percent change in these variables, a more than proportionate change in the probability of adopting j^{th} choice of rural livelihoods is observed. However, for the inelastic variable(s), it implies that the probability of adopting the j^{th} choice of rural livelihoods is not largely influenced by a slight change in these variables as one present change in the independent variable leads to a less than proportionate change in the likelihood of adopting the j^{th} choice of rural livelihoods.

Table 4.7: Result of the Estimated Multinomial Logit Model for Factors Influencing the Choice of Rural Livelihoods

Variable	ONF	ONF-NF	ONF-OF-NF	ONF-OF (Base category)
Age	-0.0493	-0.0133	-0.0102	0.0278
	(-1.40)	(-0.63)	(-0.54)	
Sex	-0.0642	-1.0153	-1.0305	2.1100
	(-0.05)	(-1.43)*	(-1.53)*	
Marital Status	0.8128	0.3223	1.1859	-0.6954
	(0.62)	(0.45)	(1.69)*	
Dep. Ratio	-0.3921	0.0585	-0.0839	0.4175
	(-2.02)**	(0.78)	(-1.20)	
Primary education	-0.2659	-0.2779	-0.2652	0.8090
	(-0.32)	(-0.58)	(-0.62)	
Post pry. Education	-1.0846	-1.0846	-2.5228	5.2313
	(-0.66)	(-1.30)	(-2.21)**	
Farm size	0.0638	-0.1268	-0.0671	0.1301
	(0.55)	(-1.32)	(-0.82)	
Extension contact	0.0133	0.0226	0.0258	-0.0617
	(0.42)	(1.04)	(1.36)	
Livestock own.	-0.0287	-0.0179	-0.0583	0.1049
	(-0.34)	(-0.64)	(-1.58)	
Irrigation access	0.5691	1.1157	0.8262	-2.5110
	(0.54)	(1.58)	(1.24)	
Credit access	0.2242	0.5728	0.4917	-1.2887
	(0.27)	(1.12)	(1.04)	
Remittances	-12.4626	3.9440	4.3143	4.2043
	(-0.01)	(3.61)***	(4.09)***	
National grid	0.1778	1.5999	1.1175	-2.8952
	(0.22)	(3.33)***	(2.70)***	
Distance to market	-0.2348	-0.0346	-0.0312	0.3006
	(-1.23)	(-0.30)	(-0.30)	
Social membership	0.4036	-0.2159	0.2195	-0.4072
	(0.42)	(-0.43)	(0.46)	
Constant	2.8317	4.1821	5.5987	-12.6125
	(0.91)	(2.05)**	(2.96)**	
Model Summary				
Observation:	365			
LR $Chi^2(48)$:	178.26			
Prob.>Chi^2:	0.0000			
Pseudo R^2:	0.2308			
Log likelihood:	-297.044			

Source: Author's computation from field survey, 2019. Number in parenthesis are Z-values, ***, ** and * indicate 1%, 5% and 10% levels of significance respectively.

Table 4.8.: RRR Calculated from the Estimated Multinomial Logit Model for Factors Influencing the Choice of Rural Livelihoods

Variables	ONF	ONF-NF	ONF-OF-NF
Age	0.9520	0.9870	0.9840
	(-1.72)*	(-0.63)	(-0.54)
Sex	0.9380	(0.362)	(0.357)
	(-0.05)	(-1.74)*	(-1.56)*
Marital status	2.2540	1.3800	3.2740
	(0.62)	(0.45)	(1.69)*
Dependency ratio	0.6760	1.0600	0.919
	(-2.02)**	(0.78)	(-1.20)
PE	0.7670	0.7570	0.7670
	(-0.32)	(-0.58)	(-0.62)
PPE	0.3880	0.1970	0.0800
	(-0.66)	(-1.30)	(-2.21)*
Farm size	1.0660	0.8810	0.9350
	(1.75)*	(-1.64)*	(-0.82)
Extension contact	1.0130	1.0230	1.0260
	(0.42)	(1.04)	(1.36)
Livestock ownership	0.9720	0.9820	0.9430
	(-0.34)	(-0.64)	(-1.58)*
Irrigation access	1.7670	3.0520	2.2850
	(0.54)	(1.58)*	(1.24)
Credit access	1.251	1.773	1.6350
	(0.27)	(1.12)	(1.04)
Remittances	3.8700	51.6220	74.7680
	(-0.01)	(3.61)***	(4.09)***
Access to National grid	1.1940	4.9530	3.0570
	(0.22)	(3.33)***	(2.70)***
Distance to market	0.7910	0.9660	0.9690
	(-1.70)*	(-0.30)	(-0.30)
Org. membership	1.4970	0.8060	1.2450
	(0.42)	(-0.43)	(0.46)
Constant	16.9740	65.5060	270.0680
	(0.91)	(2.05)***	(2.96)***
Model Summary			
Observation:	365	LR CHI^2 (48):	178.26
Pseudo R^2 :	0.2308	Prob. > CHI^2 :	0.0000
Log likelihood:	-297.044		

Source: Author's computation from field survey, 2019. Number in parentheses are Z-values, ***, ** and * indicate 1%, 5% and 10% levels of significance respectively.

Table 4.9: Result of Likelihood Ratio Test

Chi^2 statistics	$Chi^2_{tab}(0.01, 48)$	$Chi^2_{tab}(0.05, 48)$	Decision rule
178.26	76.154	67.505	H_1 is accepted

Source: Author's calculation from field survey, 2019.

Table 4.10: Marginal Effects and Quasi Elasticities Obtained from the Estimated MNL Model

Variables	ONF 13	ONF-OF 65	ONF-NF 72	ONF-OF-NF 215
Age	-0.0013	0.0014	-0.0005	0.0004
	(-0.0667)	(0.0718)	(-0.0256)	(0.0205)
Sex	0.0209	0.0888	-0.0312	-0.0785
	(-0.0667)	(0.0722)*	(0.0254)	(0.0639)
Marital Status	0.0033	-0.0854	-0.0927	0.1747
	(0.0030)	(-0.0774)	(-0.0841)*	(0.1584)**
Post pry education	0.0178	0.2019	0.0554	-0.2751
	(0.0162)	(0.1836)**	(0.0504)	(-0.2502)**
National grid	-0.0219	-0.1110	0.1069	0.0261
	(-0.0152)	(-0.0772)**	(0.0744)**	(0.0182)
Dependency ratio	-0.0111	0.0067	0.0203	-0.0160
	(-0.0377)*	(0.0228)	(0.0690)***	(-0.0544)*
Farm size	0.0038	0.0069	-0.0113	0.0006
	(0.0104)	(0.0189)	(-0.0310)	(0.0050)
Livestock	0.0001	0.0041	0.0042	-0.0086
	(0.0002)	(0.0093)*	(0.0096)	(0.0196)
Irrigation access	-0.0022	-0.0841	0.0668	0.0195
	(-0.0002)	(0.0106)	(0.0084)	(0.0025)
Remittances	-0.4821	-0.2513	0.1524	0.5811
	(-0.1268)	(-0.0661)	(0.0401)	(0.1528)
Market Distance	-0.0066	0.0048	-0.0003	0.0020
	(-0.0165)	(0.0120)	(-0.0096)	(0.0050)

Source: Author's computation from field survey, 2019. Values in parenthesis are the quasi elasticities, ***, ** and * indicate 1%, 5% and 10% levels of significance respectively.

4.6. Distribution of Households by Food Insecurity

The distribution of the respondents based on frequency of food groups consumed viz.-a-viz. the staples, pulses, vegetables, fruits, meat and fish, dairy products, sugar and fat/oil was presented in this section. It also presents the distribution of the respondents by food insecurity status and as well profile the food insecurity status based on selected socio-economic characteristics.

4.6.1 Distribution of Households based on Average Days of Food Group Consumed

The distribution of the respondents based on mean days of food groups consumed using 7 days reference period was shown in Figures 4.1 and 4.2. While the result of the disaggregated data was shown in Figure 4.1 for the purpose of comparism between the selected states, Figure 4.2 presents the result of the pooled data for the purpose of discussion.

The results of the pooled data as shown in Figure 4.2 shows the food group intake by the households and the average number of days eaten in the last 7 days. The most frequently consumed food group was fat/oil with an average of 5 days in a week, followed by vegetables, “3.5” days and staples, “2.9” days. Fat/oil was the most frequently consumed food group. Consumption of dairy products was at the most twice a week, “1.6”. However, consumption of at least three or four out of eight food groups were recommended as the minimum number of food-groups intake required per person (FAO, 2007). Consumption of meat and fish was 2.6 days on the average, while that of sugar was 2.5 days. The figure also revealed that the least and inadequately consumed food groups in the study area were pulses (e.g. legumes, seed and nuts). This is consistent with Mensah (2014) who reported that the mean days of farm household’s consumption of “Pulses” “Fruits” and animal protein sources was less than 3 days.

4.6.2 Distribution of Households by Food Insecurity Status

The study used specific type of dietary diversity measure known as Food Consumption Scores (FCS) as a proxy in order to assess the adequacy or otherwise of food availability, accessibility and utilisation domain in achieving food security. Based on this, households whose food consumption scores fell within the cut-offs of $y^* \leq 21$, $21 < y^* \leq 35$ and $y^* > 35$ were classified as core food-insecure (poor), moderately food-insecure (borderline) and non-food insecure (acceptable).

Table 4.11 presents the distribution of the respondents by food insecurity categories. The results of the pooled data show that a considerable number of the studied population were food insecure with 4.38% and 35.89% being core and moderately food insecure respectively, while about 59.73% of the respondents were non-food insecure (food secure).

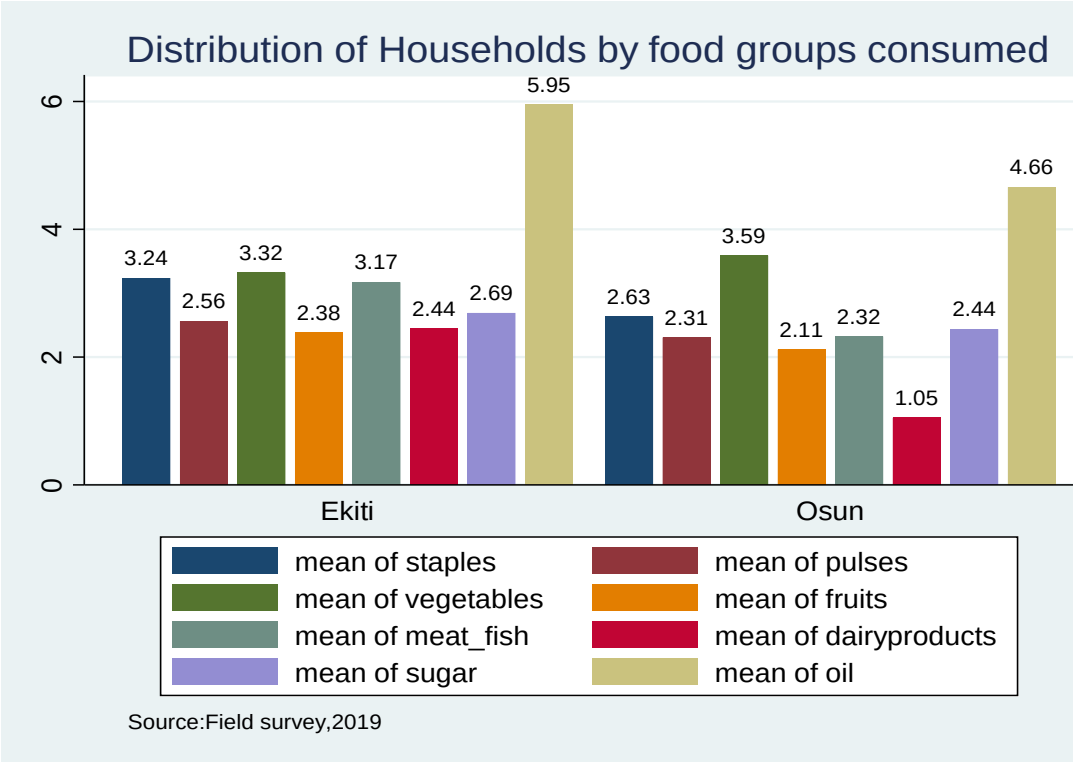

Figure 4.1: Food Groups Consumption in the last 7-days by the Household (Disaggregated)

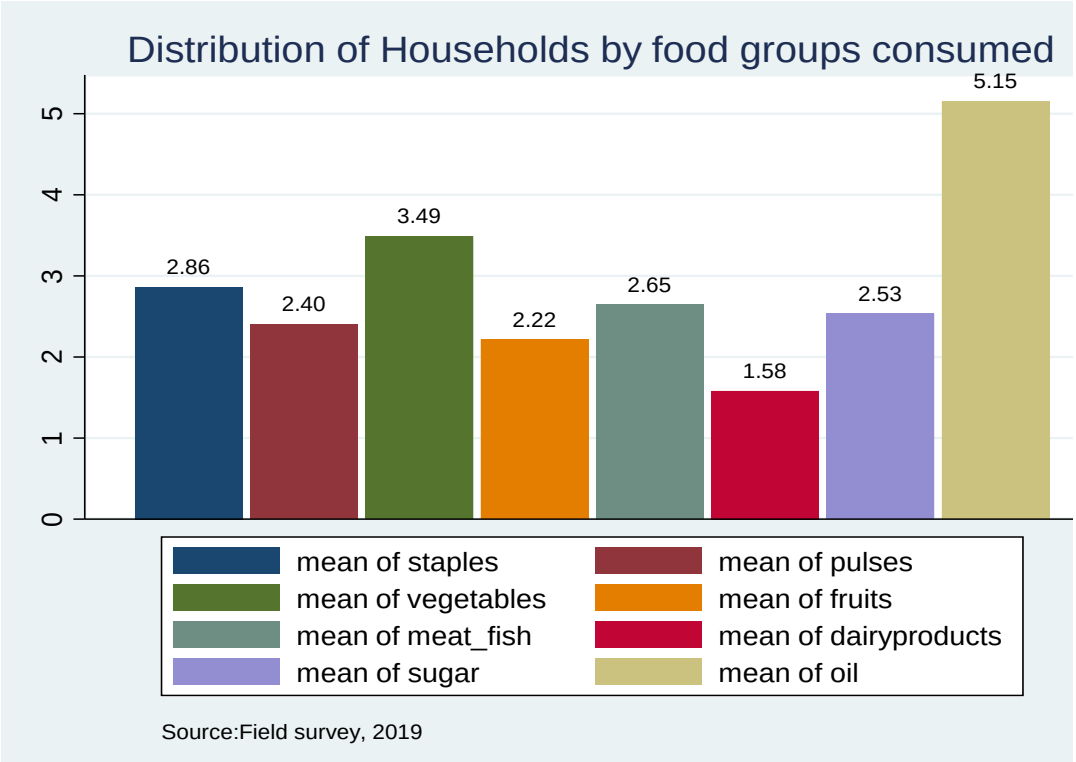

Figure 4.2: Food Groups Consumption in the last 7-days by the Household (Pooled)

4.6.3 Distribution of Households by Food Insecurity Profile

The classification of households into core, moderate and non-food insecure categories was done in order to link the gap in food insecurity to household's profile as shown in Table 4.12.

From Table 4.12, it shows that, the percentage of the food insecure were found to be higher among households headed by female with 7.4% and 42.7% being core and moderately food insecure respectively, compared with male-headed households with 3.7% and 34.3% being core and moderately food insecure respectively. FAO, (2015) corroborated this finding, reporting that in rural Nigeria, food insecurity is more prevalent among the women and children, thus implying widespread malnutrition among the vulnerable group. In terms of age, the result from Table 4.12 revealed that the relatively younger household heads of 45 years of age or less were the age group with the highest percentage of food insecure with about 10.4% and 40.8% being core and moderately food insecure respectively, followed by the household heads with age range of 46-65 years with 1.6% and 38.0% being core and moderately food insecure. This finding suggests that the inability of the relatively younger households to have tenure right for critical production input such as land coupled with low farming experience could be responsible for this finding. The lowest percentage of the food insecure were also found among households who were older than 65 years of age with 14.6% experiencing moderate food insecurity and no one experienced core-food insecurity.

Table 4.11.: Categorisation of Households by Food Insecurity Status

Food Consumption Scores (FCS)	Osun (n=226)	Ekiti (n=139)	Pooled (N=365)	Food insecurity Status
	Freq. (%)	Freq. (%)	Freq. (%)	
$y^* \leq 21$	15 (6.64)	1 (0.72)	16 (4.38	CFI
$21 < y^* \leq 35$	117 (51.77)	14 (10.00)	131 (35.89)	MFI
$y^* > 35$	94 (41.59)	124 (89.21)	18 (59.73)	NFI

Source: Author's computation from field survey, 2019. CFI= Core Food Insecure, MFI=Moderately Food Insecure and NFI=Non-Food Insecure.

Table 4.12: Food Insecurity Profile of Farming Households in Rural Southwestern Nigeria

Variables	Osun (n=226)			Ekiti (n=139)			Pooled (N=365)		
	CFI	MFI	NFI	CFI	MFI	NFI	CFI	MFI	NFI
Sex									
Male	6.02	53.61	40.36	0.76	9.92	89.31	3.70	34.34	61.95
Female	8.33	46.67	45.00	0.00	12.5	87.5	7.35	42.65	50.00
Age									
0-45	13.04	52.17	34.78	3.03	9.09	87.88	10.4	40.8	48.80
46-65	2.52	52.94	44.54	0.00	13.70	86.30	1.56	38.02	60.42
>65	0.00	40.00	60.00	0.00	3.03	96.67	0.00	14.58	85.42
Marital status									
Married	6.80	53.88	39.32	0.80	10.40	88.80	4.53	37.46	58.01
Not married	5.00	30.00	65.00	0.00	7.14	92.86	2.94	20.59	76.47
Household size									
1-5	10.77	53.85	35.38	0.00	3.14	86.36	8.05	43.68	48.28
6-10	5.93	55.56	38.52	1.14	7.95	90.91	8.83	80.39	10.78
> 10	0.00	26.92	73.08	0.00	13.79	86.21	0.00	75.00	25.00
Education									
Non-formal	3.33	40.00	56.67	0.00	33.33	66.67	3.03	39.39	57.58
Primary	13.43	53.73	32.84	0.00	14.81	81.19	9.57	42.56	47.87
Post Primary	3.88	53.49	42.63	0.92	8.26	90.83	2.52	32.77	64.71
Farm size									
0-2.0	6.67	53.33	40.00	0.85	5.98	93.16	3.80	29.96	66.24
2.1-3.0	15.79	52.63	31.58	0.00	50.00	50.00	11.11	51.85	37.04
>3.0	4.60	49.43	45.99	0.00	21.43	78.57	3.96	45.54	50.50
Credit									
No	10.64	57.45	31.91	0.98	7.84	91.18	6.58	36.63	56.79
Yes	0.00	42.35	57.65	0.00	6.22	83.78	0.00	34.43	65.57
Primary occupation									
Farming	7.38	50.34	42.28	0.72	10.14	89.13	4.18	31.01	64.81
Others	5.19	54.55	40.26	0.00	0.00	100.00	5.13	53.84	41.03
Experience									
≤10	8.16	47.96	43.88	1.85	1.85	9.26	88.89	5.72	34.21
11-20	5.19	55.84	38.96	0.00	2.70	97.30	28.57	38.60	57.89
>20	5.88	52.94	41.18	0.00	16.67	83.33	3.03	35.35	61.62
Social membership									
No	2.13	57.45	40.42	0.00	15.63	84.38	1.27	40.51	58.23
Yes	7.82	50.28	41.90	0.94	8.41	90.65	5.24	34.62	60.14
Agro-ecological zones									
Rain forest	0.00	40.00	60.00	1.59	6.35	92.06	1.47	8.82	89.71
Others	6.79	52.04	41.17	0.00	13.16	86.84	5.05	42.09	52.86

Source: Author's computation from field survey, 2019.

The possible reason is that, older household heads of above 65 years were more likely to have the least dependence ratio as most of their children would have grown up and likely to be found in the active productive age with the ability to adequately cater for the needs of their parents.

In terms of marital status, the result from Table 4.12 reveal that the married households were more food insecure with 4.5% and 37.5% being core and moderate food insecurity, compared to their counterparts that were not married with 2.9% and 20.6% being core and moderate food insecurity respectively. Households that were primarily engaged in farming activities, with household size of at most 5 members were less food insecure, compared to their counterparts that were primarily engaged in non-farm activities with household size of above 5 members. This implies that, the inability of the farming households to adequately mobilise resources such as finance for participation in highly remunerative non-farm activities and thus achieve a secured livelihood could be responsible for this finding.

In terms of educational attainment, the results reveal that household heads who had post primary educational attainment were the least food insecure with 2.5% and 32.8% being core and moderately food insecure respectively, followed by those with no formal education with 3.0% and 39.4% being core and moderately food insecure respectively. The highest percentage of food insecurity was found among households who had primary educational attainment with 9.6% and 42.6% being core and moderately food insecure respectively. Bawadi *et al.* (2012); Osunmakinde (2016) reported similar findings.

It was also revealed from Table 4.12 that the prevalence of food insecurity was higher among households without microcredit use, and those that belonged to at least a social organization, compared to their counterparts who had access to at least a source of credit and those that belonged to at least a social organisation. These findings are consistent with Keynesian capital and growth theories and also underscore the critical role that access to credit plays in driving the expenditure decision, aggregate demand and as well as in determining the overall level of output, income and access to food. The severity of

food insecurity was higher among household heads that resided in savannah or derived savanna agro-ecological zone than their counterparts who resided in rain forest agro-ecological zone. This implies that the higher the household's membership density in social organisations, the lower the risk of being food insecure and vice versal *ceteris paribus.*

However, in terms of the size of farm holdings, the results from Table 4.12 reveal that the least percentage of the food insecure was found among households with at most 2 hectares of farm size with about 3.8% and 29.9% being core and moderately food insecure respectively, followed by those with farm size of above 3 hectares with 3.9% and 45.5% being core and moderately food insecure respectively. The highest percentage of the food insecure was found among households with farm size between 2.1 and 3 hectares with 11.1% and 51.9% being core and moderately food insecure respectively. The inability of farming households with farm size between 2.1 and 3 hectares to operate on production frontier (resulting from technical inefficiency) could be largely responsible for this lag.

It could be deduced from Table 4.12 that, the rise in years of farming experience (keeping other factors constant) is associated with improved farm productivity, enhanced income and reduced vulnerability to food insecurity. Households who had above 20 years of farming experience were the least food insecure, followed by those with at most 10 years of experience. The highest severity of food insecurity was found among households whose farming experience ranged between 11 and 20 years with 28.6% and 38.6% experiencing core and moderate food insecurity respectively. The inability of this set of households to operate along the production frontier or to efficiently allocate their resources could be responsible for this finding.

4.6.4 Distribution of Households by Food Insecurity Status and Rural Livelihoods

Table 4.13 presents the profile of farming households based on their livelihoods- assets and livelihoods' choice. The results reveal that households who were ranked "low" in terms of access to livelihoods' assets were more food insecure with 5.8% and 40.3% being and moderately food insecure respectively, compared to their counterparts that

were ranked high in terms of access to livelihoods' assets with 1.6% and 27.1% being core and moderately food insecure respectively. This implies that with assets, individuals and households have the capacity to build their resilience to mitigate various adversities when faced with shocks and stresses (Kassie *et al.*, 2016). Barrette (2002) also found that, for individuals, the poor state of asset constitutes a fundamental threat to food security as it increases the risk of falling further into income and food poverty by severely impedes its capabilities to achieve successful livelihood.

With regards to the choice of rural livelihoods pursued, the results from Table 4.13 show that the lowest percentage of the food insecure was found among households that derived their livelihoods exclusively from agriculture (on-farm livelihood), with 21.4% experiencing moderate food insecurity and none being core food insecure, followed by those who diversified from on-farm into off-farm activities with 29.1% experiencing moderate food insecurity and no one experiencing core food insecurity.

Table 4.13: Food Insecurity Profile based on Rural Livelihoods

Variable	Osun(n=226) Food insecurity status			Ekiti (n=139) Food insecurity status			Pooled (365) Food Insecurity status		
Asset status	CFI	MFI	NFI	CFI	MFI	NFI	CFI	MFI	NFI
Low	8.50	57.51	33.99	1.11	11.11	87.78	5.76	40.33	53.91
High	2.74	39.73	57.53	0.00	8.16	91.84	1.64	27.05	71.31
Livelihood choices									
ONF	0.00	14.29	85.71	0.00	28.57	71.52	0.00	21.43	78.57
ONF-OF	0.00	78.94	21.05	0.00	8.89	91.11	0.00	29.68	39.06
ONF-NF	8.00	34.00	58.00	0.00	9.09	90.91	5.56	26.39	68.06
ONF-OF-NF	7.33	56.00	36.67	1.54	9.23	89.23	5.58	41.86	52.56

Author's computation from field survey, 2019. ONF= On-farm, ONF-OF= On-farm + off-farm, ONF-NF= On-farm+ non-farm, ONF-OF-NF= On-farm+ off-farm + non + farm.

The highest incidence of food insecurity was experienced by those that pursued combined ONF-OF-NF activities with 5.6% and 41.9% were core and moderately food insecure respectively, followed by those who diversified into non-farm activities (ONF-NF). This is consistent with Yishak *et al.* (2014) who reported that, the highest share of the food secure (non-food insecure) was found among household heads who derived their livelihoods exclusively from on-farm activities.

Furthermore, on-farm with off-farm (ONF-OF) livelihood, even though, considered as life-line rather than lucrative alternative livelihoods (Babatunde *et al.*, 2010) offers more stable but lower income opportunities for rural households than on-farm with non-farm (ONF-NF) livelihood. Sahal and Bahal (2012) corroborated this finding noting that a large number of rural populace particularly the poor resource-based peasant farmers who are deprived of essentials assets may be forced to undertake poor earning and occasionally vulnerable non-farm activities in order to earn their means of living. While it is evident that ONF-NF has the potential to minimise poverty and the risk undernourishment, lack of financial inclusion or favorable institutional framework could as well reduce its effectiveness in achieving the desired outcomes. The foregoing suggests that livelihood diversification in the study area was survival-led or distress driven.

4.7 Endogeneity of Asset Score in Food Insecurity Model

As pointed out in section 3.4.9 of this study, the aim of this section was to analyse the simultaneous equation of food insecurity using IV-Ordered probit and 2-stage least estimation techniques. The procedure involved the use of instrumental variables that were likely to influence asset variable (asset score) without directly affecting household food insecurity. Three instrumental variables including per capita expenditure on agricultural inputs, livestock ownership and access to credit were selected. The selection of instruments for "asset" variable followed the work of Alinovi (2010) on decomposition of resilience framework. This was done to purge the "asset score" from the stochastic influence of error term.

Table 4.14 presents the result of IV-ordered probit estimation. The results show that the overall fitness of the model, as shown by the log likelihood estimate of 4332.905 and

Chi^2 value of 464.67 was statistically significant thus implying a good fit of data. Furthermore, the coefficient of anthrho (ρ) statistics is 0.0705 and not significant, implying the acceptance of null hypothesis of exogeneity (no endogeneity) of the asset variable. However, in the absence of direct method for conducting post estimation test involving identification and validity of the instruments in models such as IV-Ordered probit, further attempt was made to analyse the food insecurity, (y^*) model using the 2-stage least square estimation (with instrumental variable) procedure. The 2-stage least-square estimation of over-identified equation also enables this study to check the consistency or otherwise of IV-ordered probit result.

Table 4.15 presents the result of 2-stage least square estimation of food insecurity model. From the result, it was revealed that, the overall fitness of the model as shown by the Chi^2 value of 133.21 was statistically significant indicating a good fit. Furthermore, Tables 4.16 and 4.17 present the post estimation results of the 2-statge least square. The result from Table 4.16 revealed that the critical values of Sargon and Basmann statistics indicated by Chi^2 values of 3.7500 and 3.5917 respectively were not significant implying that the null hypothesis of no correlation between the instruments and the error term was accepted indicating that the selected instruments were valid. Furthermore, Table 4.17 presents the results of Durbin-Hu-Hausman test. The results reveal that, the critical values of Wu-Hausman and Durbin statistics indicated by Chi^2 values of 0.6883 and 0.7225 respectively were not significant, implying the acceptance of null hypothesis of no endogeneity in the model. This test confirmed that the asset score was indeed exogenous. The results of further tests involving the validity of the selected instrumental variables as well as the explanatory strength and correlation with the error terms are presented in the appendix section. The results of the two tests involving the correlation of the selected instruments with the error terms and that of the endogeneity confirmed that the estimates obtained from single equation ordered probit model were indeed unbiased, consistent and efficient and that the use of IV-ordered-probit model in the absence of endogenous variable produce consistent but not efficient estimates (Greene, 2012).

Table 4.14: Result of IV-Ordered Probit Estimation (FIML) of Food Insecurity (simultaneous equation) Model

Variable Stage 1	Coefficients	Z-value	Variable Stage 2	Coefficients	Z-value
Food insecurity status			Asset score		
Age	0.0413	3.94***	Age	150.6132	1.17
Gender	0.0606	0.29	Sex	- 721.1459	-0.24
Marital status	0.4118	2.60***	Marital status	-1856.7730	-0.89
Post pry education	0.5083	2.99***	Post pry education	5581.8890	2.37**
Household size	0.0523	1.59*	Household size	1371.7510	3.00**
Primary occupation	-0.0278	-0.14	Primary occupation	9184.1970	3.27***
Farming experience	-0.0297	-2.95***	Farming experience	209.1861	1.61*
Dependent ratio	0.0129	0.35	Dependent ratio	-1854.5000	-4.20***
Irrigation	0.4246	1.92**	Irrigation	2274.9220	0.72
Extension contact	-0.0183	-3.10***	Extension contact	-146.2126	1.60*
National grid	-0.6574	-3.70***	National grid	4808.658	1.99**
i. Livelihoods' choice			i. Livelihood strategy		
ONF-OF	-0.3134	-0.73	ONF-OF	-5386.7210	-0.93
ONF-NF	-0.4634	-1.09	ONF-NF	4946.5810	0.87
ONF-OF-NF	-0.7704	1.94	ONF-OF-NF	-156.2226	-0.03
Asset score	0.0199	3.82***	Expenditure on agric. inputs	0.2300	5.08***
			Access to credit	25725.04	11.18***
Model summary			Livestock ownership	2188.436	0.95
No of observation:	365		Constant	-2561.75	-2.95***
Wald $Chi^2(34)$	464.67		Cut_1_1	-0.2384	2.69**
Prob. > Chi^2	0.0000		Cut_1_2	1.7342	265.91***
Log likelihood	-4332.905		**Atanhrho_12**	**-0.0705**	**-0.50**
			rho_12	-0.0704	

Source: Author's computation from field survey, 2019. ***, ** and * indicate 1%, 5% and 10 levels of significance. Instrumented variable: Asset score. Instruments: Per capita expenditure on agricultural inputs, access to credit and livestock ownership. Constant term was not reported for food insecurity equation in Stata. Thus, two cuts-off values are reported. ONF-OF = On-farm + off-farm livelihood; ONF-NF = On-farm + Non-farm livelihood; ONF-OF-NF = On-farm + off-farm + non-farm livelihood.

Table 4.15: Result of 2 stage least-square (instrumental variable) Estimation of Food Insecurity model

Food insecurity scores	Coefficient	Z-value
Age	0.1219	1.69*
	(0.0718)	
Gender	-0.0083	0.005
	(1.6590)	
Marital Status	2.3705	2.05**
	(1.1545)	
Post primary education	4.7797	3.64***
	(1.3142)	
Household size	0.5130	2.04**
	(0.2513)	
Primary occupation	-0.0762	-0.05
	(1.6048)	
Farming Experience	-0.0094	-0.13
	(0.0707)	
Dependent ratio	-0.2354	-0.89
	(0.2642)	
Irrigation	5.0587	2.92**
	(1.7333)	
Extension contact	-0.2334	-4.88***
	(0.0478)	
National grid	-2.7487	-2.06**
	(1.3346)	
Agro-ecological zone	0.4681	0.27
	(1.7183)	
Asset score	0.1643	4.13***
	(0.0398)	
On-farm + off-farm	-1.4369	-0.45
	(3.1773)	
On-farm + non-farm	-0.7657	-0.25
	(3.1228)	
On-farm + off-farm+ non-farm	-5.2571	-1.80*
	(2.9205)	
Constant	28.8646	5.99***
	(4.8168)	
Model Summary		
No of observation:	365	
Wald $Chi^2(6)$:	133.21	Prob. > Chi^2: 0.0000
R-square:	0.2903	
Root MSE:	10.336	

Source: Author's computation from field survey, 2019. *, ** and *** indicate levels of significance at 10%, 5% and 1 % respectively. **Instrumented:** Asset score. **Instruments:** Age, sex, marital status, post primary education, household size, primary occupation, farming experience, dependent ratio, irrigation, extension contact, national grid, agro-ecological zone, i. Livelihood strategy, per capita expenditure on agricultural inputs, livestock ownership and access to credit.

Table 4.16: Test of Validity of the Instruments

H_0= Instruments are valid

Statistics	Critical values	P-values
Sargon, $Chi^2(2)$	3.7500	0.1534
Basmann, $Chi^2(2)$	3.5917	0.1660

Source: Author's computation from field survey, 2019.

Table 4.17: Result of Hausman Test of Endogeneity

H_0 = Exogenous of asset score (i.e. no endogeneity in the model)

Statistics	Critical values	P-values
Durbin (score), $Chi^2(1)$	0.7226	0.3953
Wu-Hausman, F(1, 347)	0.6883	0.4073

Source: Author's Computation from Field Survey, 2019.

4.8 Influence of Rural Livelihoods on Food Insecurity Status

The results of single equation ordered probit model estimated to determine the food insecurity influence of socio-economic characteristics, assets and rural livelihoods of farming households was presented in Table 4.18 of this section.

The results from Table 4.18 reveal that the overall fitness of the model as shown by the log likelihood estimate of 220.62 and the LR statistics indicated by Chi^2 value of 152.01 was statistically significant at less than 1%. This indicates that the model adequately fits the data. As highlighted in the methodology section, the dependent variable (household food insecurity status) was ordered as 0, 1 and 2 indicating non-food insecure (food-secure), moderately food-insecure and core food-insecure respectively. While 11 out of 20 independent variables specified in model 1, are significant at 1%, 5% and 10% levels, 11 out 16 independent variables specified in model 2, representing about 70% were significant at given levels. These include age of the respondents, marital status, post primary education, household size, farming experience, irrigation practice, frequency of extension contact, access and use of electricity (national grid), agro-ecological zone, financial-asset score, aggregate livelihood-asset score and combined ONF-OF-NF livelihood. The test for multicollinearity involving Variance Inflation Factor (VIF) was presented in Appendix XI. The VIF for all the specified independent variables ranged from 1.24 to 7.05 with an average of 2.46. Since the average VIF value is less than 10, this implies that that there is no serious concern for multicollinearity in the specified models.

Focusing on key variables of interest, the results from Table 4.18 revealed that, out of the five categories of livelihoods' assets specified in model 1, financial-asset score was the only category that had significant influence on food insecurity status. The probable reason is that financial asset drives other forms of asset (e.g. natural, physical, human, and social assets) particularly for farm and non-farm activities, the outcomes obtained which includes income and food *inter alia*, depend on the intensity of committing financial asset to the activities. As expected, the coefficient of financial-asset score is positive and significantly influences food insecurity status. The estimates of marginal effect show that an increase in financial-asset scores involving microcredit use, remittances, ownership of jewelries and livestock by a unit increases the probability of

food security experiences by 16.3%, while the probabilities of moderate and core food insecurity experiences were reduced by 12.1% and 42.1% respectively. Unmesh and Narayanan (2015); Kasim *et al.* (2017) reported similar findings. The implication is that the role of financial asset in influencing the ability of farming households to pursue a successful livelihood cannot be undermined. This implies that access to credit or any accessible stock that can be easily converted to liquid asset, tends to increase the aggregate demand of individual economic agents for factor inputs and as well increase the output level, productivity and food insecurity status.

The influence of ONF-OF and that of ONF-NF livelihoods on food insecurity status of the respondents were not significant. These findings are contrary to Mequanint (2009); Jemal and Kim (2014); and Yishak *et al.* (2014), but consistent with Lohmann and Lifner (2009); Awotide *et al.* (2010); Martin and Lorenzem (2016) who argued that "distress-push" diversification prevails in low resilient agro-ecological zone characterised with high risk of droughts, flooding and land degradation. Further, an individual with poor resource-base or lack of adaptive capacity such as access to safety net, the motive for diversification is a choice rather than necessity. This finding implies that, the low productivity arising from low- resilient agricultural environments coupled with farmers' poor resource-base was likely to force the respondents to strive for improved earnings by participating in low rewarding non-farm activities, thus resulting in a more stable but lower income with attendant consequence of food insecurity.

The coefficient of combined ONF-OF-NF livelihood, relative to ONF was negative and significantly influences the food insecurity status. The marginal effects estimates show that the choice of combined ONF-OF-NF rural livelihoods decreases the likelihood of food security (non-food insecure) experience by 20.8% and it increases the probability of moderate and core food insecurity experiences by 16.9% and 3.9% respectively. This finding agrees with diversification literature positing that the motives for diversification is divided along the push (negative) and pull (positive) factors. This finding implies that combined ONF-OF-NF livelihood was driven by a necessity brought about by negative conditions that compel the respondents to combine different activities as a form of adaptation to survive (McClananhan and Wamukota, 2010). This finding is however contrary to Asmelash (2014); Yishak *et al.* (2014).

Contrary to the expectation, the coefficient of age was positive and significantly influences the food insecurity status. The estimates of marginal effect show that an increase in age of the respondents by a year increases the likelihood of food security (non-food insecurity) experience by 1.2%, but it reduces the likelihood of moderate and core food insecurity experiences by 0.9% and 0.3% respectively. This finding could be attributed to the effect of error correction mechanism over the years in farming and agricultural practices and that has translated into improved farm productivity in the form of better yield, enhanced income and increased access to adequate and nutritious food. This finding is consistent with Fekadu and Mequanent (2010) but inconsistent with Oni and Salman (2011).

The influence of marital status on food insecurity status was significant. The marginal effect estimates show that being married increases the likelihood of food security (non-food insecurity) experience by 10.7%, but it reduces the probability of household's experience of moderate and core-food insecurity by 8% and 2.8% respectively. This finding is inconsistent with *a priori* expectation, Adepoju and Adejare (2010); Oni and Fasogbon (2013). The possible reason is that, married households were more likely to pool and utilize resources more efficiently than single households. As a result, this translates to improved productivity and secured access to food.

In line with *a priori* expectation, post primary educational attainment of household heads had significant influence on food insecurity status. The estimate of marginal effect shows that a change from primary to post primary educational attainment increases the likelihood of food security (non-food secured) experience by 10.9%, while it reduces the probability of household's experience of moderate and core-food insecurity by 8.1% and 2.8% respectively. This finding is consistent with Adepoju and Adejare (2013) and Mensah (2014). The implication is that access to post primary education enhances the human capital of household heads in terms of better access to innovative and improved production technologies, including access to e- extension and communication services that together enhance their productivity, income and secured access to food.

The influence of household size on food insecurity status was significant. The marginal effects estimates showed that a member increase in household size increases the likelihood of household's experience of food security (non-food insecure) by 1.7%, but

it decreases the likelihood of household's experience of moderate and core-food insecurity by 1.2% and 0.4% respectively. This is contrary to the prior expectation and inconsistent with Asmelash (2014); Jemal and Kim (2014). The possible reason is that the traditional farming practices in most developing nations including Nigeria depend heavily on family labour. Hence, the incentive to increase their farm size was driven by large family size and its attendant reduction in labour input cost. Consequently, the efficiency with which the labour inputs were allocated has the potential to guarantee enhanced income that determine the security of livelihoods including food.

The coefficient of farming experience negatively and significantly influences the food insecurity status. The marginal effect estimates show that an increase in farming experience by a year reduces the probability of moderate and non-food insecurity (food security) experiences by 0.5% and 0.7% respectively, while it increases the likelihood of core-food insecurity experience by 0.2%. Although this finding is contrary to the prior expectation, it revealed important information that suggests that farming experience, productivity and food insecurity are not linearly related. The possible reason is that, theoretically, years of farming experience cannot permanently increase productivity. It may at first set of years of farming experience increases productivity; productivity tends to decline at a stage when diminishing return to extra years of farming experience set in.

The influence of access and actual use of irrigation on food insecurity status was significant. The marginal effect estimates show that access to irrigation facilities increases the likelihood of food security (non-food insecure) experience by 13.8%, and it decreases the likelihood of moderate and core-food insecurity experiences by 10.2% and 3.6% respectively. This finding is consistent with *a priori* expectation, Oni and Fashogbon (2013) and Jemal and Kim (2014). This implies that, the likelihood of all year production is higher for irrigated farmers than non-irrigated farmers. As a result, they tend to have higher output per unit area, higher income and improved access to food.

The institutional variables involving the frequency of extension contacts, access and actual use of electricity (national grid) contradict the *a priori* expectations. The coefficient of frequency of extension contacts is negative and significantly influences the food insecurity status. The marginal effect estimates show that the frequency of

contacts with extension agents decreases the likelihood of food security (non-food security) experience by 0.4%, while the probabilities of moderate and core-food insecurity experiences were increased by 0.3% and 0.1% respectively. This finding is inconsistent with prior expectation and Asogwa and Umeh (2012). The possible reason is that access to extension services is a necessary condition but not sufficient to achieve improved productivity, particularly when the respondents were late adopters or even laggards (non-adopters) of improved technologies. Furthermore, access to national grid/electricity negatively and significantly influences the food insecurity status of the respondents. The marginal effects estimates show that, access and actual use of electricity (national grid) reduces the likelihood of food security (non-food insecurity) experience by 16.2%, while the probability of moderate and core food insecurity experiences were increased by 12% and 4.2% respectively. This finding is inconsistent with *a priori* expectation. This may be attributed to the fact that that access to national grid does not automatically translate into improved living condition including secured access to food. In the face of erratic or persistent collapse of national grid, no gainful investment or enterprise can thrive. This finding suggests that, lack of effective service delivery and its attendant poor power supply were capable of restricting the ability of farming households to secure improved livelihood from diversifying into rural non-farm activities.

Table 4.18: Influence of Rural Livelihoods on Food Insecurity Status of Farming Households in Southwestern Nigeria

Variables	Model 1 (with disaggregated livelihood asset)	$\frac{\partial Pr(Y=2)}{\partial X}$	$\frac{\partial Pr(Y=1)}{\partial X}$	$\frac{\partial Pr(Y=0)}{\partial X}$	Model 2 (with aggregate livelihood asset)	$\frac{\partial Pr(Y=2)}{\partial X}$	$\frac{\partial Pr(Y=1)}{\partial X}$	$\frac{\partial Pr(Y=0)}{\partial X}$
Food Insecurity status	Coefficient	Core-food insecure	Moderately-food insecure	Non-food insecure	Coefficient	Core-food insecure	Moderately-food insecure	Non-food insecure
Age	0.0417	-0.0030(3.28)***	-0.0085(-4.08)***	0.0115(4.19)***	0.0417	-0.003(3.38)***	0.8712(4.23)***	0.0117(4.37)***
Sex	0.0644	-0.0046 (-0.30)	-0.0131(-0.30)	0.0177 (0.30)	0.0547	-0.0039 (-0.27)	-0.0113(-0.27)	0.0152 (0.27)
Marital status	0.3913	0.0277(-2.27)**	-0.0796(-2.51)***	0.1073(2.53)***	0.4053	-0.0291(2.33)**	-0.0835(2.60)**	0.1126 (2.62)**
Post Pry education	0.3977	-0.0282(-1.40)*	-0.0809 (-1.43)*	0.1090 (1.44)*	0.5228	-0.0375(2.78)***	-0.1077(3.14)**	0.1452(3.21)***
Household size	0.0604	-0.0043(-1.74)**	-0.0123 (-1.84)**	0.0166 (1.84)**	0.0550	-0.0039 (1.62)*	-0.0113 (1.70)*	0.0153 (1.70)*
Primary occupation	0.0709	-0.0050 (-0.39)	-0.0144 (-0.39)	0.0194 (0.39)	0.0012	-0.0008 (-0.01)	-0.0002 (-0.01)	0.0003 (0.01)
Farming Experience	-0.0257	0.0018(2.28)**	0.0052(2.53)***	-0.007(2.55)***	-0.0210	0.0022 (2.62)***	0.0062(3.05)***	-0.0083(3.07)**
Dependent ratio	-0.0060	0.0004 (0.17)	0.0012 (0.17)	-0.0016 (-0.17)	0.0071	-0.0507 (-0.20)	-0.0015 (-0.20)	0.0020 (0.20)
Irrigation	0.5018	-0.0356(-2.05)**	-0.1020 (-2.18)***	0.1376(2.20)***	0.4320	-0.3099 (-1.87)*	-0.0890(1.96)**	0.1200 (1.97)**
Extension contact	-0.0149	0.0011 (2.16)**	0.0030 (2.33)**	-0.004(2.36)***	-0.0182	0.1307(2.70)***	0.3756(3.13)***	-0.005(3.17)***
National grid	-0.5912	0.0419 (2.76)***	0.1202 (3.23)***	-0.162(3.27)***	-0.6499	0.0466 (3.07)***	0.1339(3.73)***	-0.180(3.81)***
Agro-ecological zone	0.5167	-0.0366(-1.76)**	-0.1051(-1.90)**	0.1417(1.90)**	0.5404	-0.0388(-1.91)**	-0.1114(2.10)**	0.1505(2.10)**
Natural asset score	-0.0599	0.0039 (1.01)	0.0114 (1.04)	-0.0153(-1.04)	-	-	-	-
Physical asset score	-0.0599	0.0039 (1.01)	0.0114 (1.04)	-0.0153 (-1.04)	-	-	-	-
Human capital score	0.0206	-0.0015(-0.44)	-0.0042(-0.45)	0.0057 (0.45)	-	-	-	-
Financial asset score	0.5940	-0.4210(3.56)***	-0.1210(-4.82)***	0.1630(4.96)***		-	-	-
Social asset score	-0.1311	0.0093(0.98)	0.0267(0.99)	-0.0360(-0.99)	-	-	-	-
Aggregate asset score	-	-	-	-	0.0183	-0.0131(3.40)**	-0.3770(4.54)**	5.0900(4.63)***
ONF-OF livelihood	-0.3992	0.0143 (1.02)	0.0864(0.94)	-0.1007(-0.96)	-0.3289	0.0117(0.85)	0.0719(0.78)	-0.1048(-0.80)
ONF-NF	-0.4895	0.0190 (1.34)	0.1063 (1.16)	-0.1252(-1.20)	-0.4508	0.0178 (1.25)	0.0990 (1.09)	-0.1169(-1.13)
ONF-OF-NF	-0.7858	0.0393 (2.86)***	0.1691 (1.96)*	-0.2085(2.15)**	-0.7718	0.0402(2.86)***	0.1678(1.96)*	-0.2081(-.16)**
Model summary						Model summary		
No of observation:	365					Observation:	365	
LR $Chi^2(20)$:	152.01	Prob. : 0.0000				LR $Chi^2(20)$:	152.01	Prob. :0.0000
Pseudo R^2 :	0.2562					Pseudo R^2 :	0.2562	
Log likelihood :	220.6246					Log likelihood :	-220.62462	

Source: Author's computation from field survey, 2019. ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. Values in parenthesis are Z-values. ONF-OF = On-farm + off-farm livelihood; ONF-NF = On-farm + Non-farm livelihood; ONF-OF-NF = On-farm + off-farm + non-farm livelihood

The influence of agro-ecological zone on food insecurity status was negative and significant. This finding is in line with *a priori* expectation. The marginal effects estimates show that a shift from derived savanna or savanna zone to rain-forest agro-ecological zone increases the probability of food security (non-food insecurity) experience by 14.2%, while the probability of moderate and core food insecurity experiences were reduced by 10.5% and 3.7% respectively. This implies that household heads who resided in rain forest zone had higher tendency of being food-secure, compared to their counterparts who resided in savanna/derived savanna agro ecological zone. This may be attributed to the lower incidence of heat stress, drought and less variability in weather condition of Rain-forest compared to savanna/derived savanna agro-ecological zone which in turn affect the crop yield and household's access to adequate food. Oni and Fashogbon (2013); Yishak *et al.* (2014) reported similar findings. The composite score of livelihoods' assets variable was used to replace the disaggregated variables of livelihoods' assets in model 2 as shown in Table 4.18. The coefficient of aggregate asset score was positive and significantly influences the food insecurity status. The marginal effect estimates show that an increase in aggregate livelihood-asset score by a unit increases the probability of non-food insecurity (food security) experience by 9%, while it reduces the probability of moderate and core food insecurity experiences by 37.7% and 1.3% respectively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This section highlights the summary of major findings, the conclusions drawn from the study as well as the policy implication of the findings. It also presents the highlights of recommendations based on the significant findings from the study.

5.1 Summary of Major Findings

This study conducted the empirical analysis of rural livelihoods' choices and their influence on food insecurity status of farming households in Southwestern Nigeria. Specifically, it examined the extent to which farming households had access to livelihoods' assets; identified and profiled the choice of rural livelihoods pursued; identified factors determining the choice of rural livelihoods; profiled food insecurity status of farming households and as well analysed the influence of rural livelihoods on food insecurity status. Five-stage sampling technique was adopted. Information was elicited from the respondents selected proportionately from Osun and Ekiti states using primary source of data collection. The analytical techniques used include descriptive statistics, frequency distribution, Principal Component Analysis, Income Portfolio Analysis, Multinomial Logit model, Food Consumption Score, Instrumental-Variable (IV) Ordered Probit model and Ordered Probit model.

Based on descriptive analysis, the findings show that, the larger population of the respondents were male (81.4%), married (90.7%), between the age of 36 and 55 years (59.7%) with a mean age of 52 ± 11.38 years, had 6-10 members of household size with a mean size of 8 members. Most of the respondents had at least primary educational attainment (90.9%), access to microcredit (74.5%), membership of formal organisation (78.4%) and derived their livelihoods primarily from farming activities (78.6%), smallholdings with at most 2.0 hectares (64.9%). The mean farm size in the study area was 2.7± 3.2. The mean monthly income of farming households was ₦57,423.3± ₦59,236.46. On the aggregate, most of the respondents (66.6%) ranked low in terms of

access to livelihoods' assets. Also, majority of the respondents were ranked "high" in terms of access to natural (52.9%), physical (63.3%), human (77.8%) and social (72.6) assets, while majority (60.0%) of the respondents were ranked "low" in terms of access to financial assets. Agriculture was the dominant livelihood activity as it accounted for 55.9% of the total earnings. Majority (58.9%) of the respondents pursued the most-diversified (ONF-OF-NF) of rural livelihoods, while the least percentage of the respondents (3.8%) specialised in on-farm livelihood.

The analysis of the determinants of livelihoods' choices revealed that increase in farm land (i.e. area) by a unit increases the likelihood of pursuing on-farm (ONF) livelihood while dependency ratio, age of the respondents and distance to the market decreases it. Factors determining the choice of ONF-NF livelihoods were access to irrigation, remittance and access to national grid, while marital status, remittance and access to national grid determine the choice of combined ONF-OF-NF. Considerable percentage of the respondents were food insecure with about 35.89% and 4.38% were moderately and core food insecure respectively, while 59.73% were non-food insecure.

It was also found from the study that, the incidence of food insecurity was higher among female-headed households (50%), relatively younger household heads (51.2%), and being married (41.9%) and household heads with primary occupation in non-farm activities (58.9). Furthermore, the least percentage of the food insecure was found among households with post primary education (35.3%), while the household heads who had no access to credit (43.2%), not a member of any social organisation (41.8%) and that resided in savannah or derived savannah agro-ecological zone (47.1%) were found to experience higher prevalence.

The influence of rural livelihoods on food insecurity status as analysed revealed that, increase in age of the respondents by a year, being married, completed post primary education, increase in household size, access to irrigation, resided in rain forest agro-ecological zone, on-farm (agriculture) livelihood and increase in financial-asset score increases the likelihood of household's experience of non-food insecurity (food security), and reduces their likelihood of experiencing moderate and core food insecurity.

5.2 Conclusion of the Study

The main focus of this study was to identify the influence of rural livelihoods on food insecurity status of farming households in Southwestern Nigeria. Based on the analysis from the descriptive and inferential statistics, the following were the highlights of the conclusions drawn from the findings:

Most of the study households were male-headed, and smallholders farming households with average farm size of about 3ha. Majority of the households were poorly endowed particularly with financial asset. On-farm, off-farm and non-farm (ONF-OF-NF) was the most pursued livelihoods among the respondents in rural southwestern Nigeria. Rural livelihoods' choices were affected by gender of the respondents, age, dependency ratio, post primary education, farm size, livestock ownership, irrigation and distance to the market. About 4.38% and 35.40% of the respondents experienced core and moderate food insecurity, while 59.73% were non-food insecure (food secure). The prevalence of food insecurity was higher among female-headed households and among the asset-poor and most livelihood-diversified households. Access to livelihoods' assets and the choice of on-farm relative to ONF-OF-NF livelihood significantly reduced food insecurity.

5.3 Recommendations

The following recommendations were made based on findings from the study in order to improve on the effectiveness of food security strategies.

i. Access to irrigation was found to significantly influence food insecurity. Hence, farming households should intensify their efforts in practicing irrigated agriculture.
ii. Access to credit is a financial asset that was found to significantly influence food insecurity status. Therefore, this study recommended that the existing credit policy in Nigeria should be reviewed for improved service delivery and be more inclusive to rural farmers.
iii. Specialisation in agriculture/on-farm livelihoods' choice was found to significantly influence the food insecurity status. Thus, efforts should be intensified to scale up investment in agricultural sector particularly the livestock sub-sector by increasing the share allocated to the sub-sector.

iv. Education was also found to significantly contribute to food insecurity status. Hence, strengthening the human capacity of farm households through skills acquisition and trainings on improved technologies is key.
v. Savanna and derived savanna agro-ecological zone were found to be more prone to food insecurity. Hence the social safety-net programme aimed at reducing food insecurity should pay special attention to farming households in these zones as they live in high risk agricultural environment.

5.4.1 Contributions to Knowledge

i. The study used income portfolio analysis to identify the household's sources of income but used activity variables to group them into mutually exclusive livelihoods' choices as against the use of aggregate index or actual income which is stochastic. This made it possible to identify the livelihoods' choices that are food insecurity reducing and those that are food insecurity increasing.
ii. The nexus between the choice of rural livelihoods and food insecurity status of farming households in rural southwestern Nigeria was established in this study thus unraveling the underlying factors that contribute to severe food insecurity as well as those that determine the risk of falling deeper into food insecurity.
iii. Determinants of rural livelihoods' choices and food insecurity status as reported in this study corroborated the existing theory and scientific evidence in the literature, while in some instances challenged the existing empirical evidence with thought provoking arguments.
iv. The study provided some useful policy options or alternatives such as increased investment in agriculture particularly the livestock sub-sector, reviewing the existing credit policy in Nigeria for improved inclusive access as this will enhance the financial capacity of farming households for improved productivity and well-being and may as well contribute to overall economic growth.

5.5 Area of Further Study

The debate regarding the effectiveness of non-farm livelihood diversification in mitigating food insecurity problem particularly in the rural area is divided along the two narratives. At one end of the narratives are the set of scholars in favour of positive

influence of diversification on food insecurity, while at the other end, are those that reported negative influence on food insecurity with consideration only for the better-off rural households. In view of this, further empirical efforts are required to investigate the link between the wealth status of rural farming households and the choice of livelihood diversification in order to validate the existing empirical evidence. Further, given the suspicion of bi-causality (endogeneity) in analysing the relationship between non-farm diversification and wealth status of farming households, such efforts should be directed at investigating the bi-causality in the relationship as this was not attempted by this study.

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APPENDICES

APPENDIX 1: Analysis of Objectives

S/N	Objectives	Meaning	Data Required	Analytical tools
1.	To assess the extent of farming household's access to livelihoods' assets.	To find out the extent to which farming households have access to livelihood assets.	Data on access to different forms of assets	Descriptive Statistics, Principal Component Analysis (PCA)
2.	To identify the choice of rural livelihoods pursued by farming households	To group farming households into similar livelihoods categories using activity variable (s)	Data on agricultural and non-agricultural income sources	Analysis of Income Portfolio, Descriptive statistics
3.	To identify factors determining the choice of rural livelihoods	To show how socio-economic and institutional/resilience variables determine the choice of rural livelihoods	Data on household's socio-economic, institutional and production/consumption variables	Multinomial Logit Model (MNL)
4.	To profile food insecurity status of farming households in the study area	To examine food insecurity status based on socio-economic, institutional and livelihood specific variables	Data on household's consumption of eight (8) food groups, socio-economic variables, assets and sources of income generating activities	Food Consumption Scores (FCS) and Descriptive Statistics
5.	To determine the influence of rural livelihoods on Food Insecurity of farming household in the study area	To unveil how livelihood's assets and the choice of rural livelihood influence food insecurity status.	Data on access to assets, sources of income generating activities, socio- economic variables and consumption of food groups	Instrumental Variable (IV)-Ordered probit Model

Source: Author's narrative from field survey, 2019.

APPENDIX 11: Scoring Factors and Summary Statistics of Variables Selected for the Computation of Natural-Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
Land area	0.5256	1.5197	1.6951	0.4344
Forest access	-0.7670	0.7554	0.4314	0.4519
Irrigation access	0.3680	0.0576	0.2337	0.4216
Overall KMO:				**0.4384**
Weighted score of Natural assets:				

Source: Author's computation from field survey, 2019.

APPENDIX III: Scoring Factors and Summary Statistics of Variables Selected for the Computation of Physical-Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
House ownership	0.1832	0.7770	0.4178	0.5943
Vehicle ownership	0.3038	0.2230	0.4178	0.5434
National grid	0.5317	0.4388	0.4980	0.5296
Access to market	0.4794	0.3957	0.4908	0.5504
Access to road	0.6014	0.5971	0.4923	0.5179
Overall KMO:				**0.5327**
Weighted score of Physical assets:		0.9922	0.6652	

Source: Author's computation from field survey, 2019

APPENDIX IV: Scoring factors and Summary Statistics of Variables Selected for the Computation of Financial-Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
Remittances	0.5682	49484.89	77780.09	0.5995
Microcredit	0.4644	45431.84	147840.00	0.6312
Tropical livestock unit	0.3737	1.5892	4.3067	0.6039
Ownership of jewelry	0.5672	0.0863	0.2819	0.5946
Overall KMO				**0.6046**
Weighted score of Financial assets:		49216.51	91733.99	

Source: Author's computation from field survey, 2019.

APPENDIX V: Scoring Factors and Summary Statistics of Variables Selected for the Computation of Human-Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
Dependent ratio	0.6804	0.7838	0.6912	0.5034
Distance to health centers	0.2343	3.3058	1.3331	0.5545
Formal education (years)	0.6019	12.1151	4.0110	0.5174
Health status	0.3461	0.7914	0.4078	0.4661
Overall KMO				**0.5051**
Weighted score of Human assets:		8.8738	2.6795	

Source: Author's computation from field survey, 2019

APPENDIX VI: Scoring Factors and Summary Statistics of Variables Selected for the Computation of Social-Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
Membership of org.	0.6918	0.7698	0.4225	0.4958
Decision making	0.7025	0.6906	0.4639	0.4959
Income share of remittances	-0.1670	0.0978	0.1523	0.3835
Overall KMO				**0.4932**
Weighted score of social assets:		1.0014	0.5804	

Source: Author's computation from field survey, 2019.

APPENDIX VII: Scoring Factors and Summary Statistics of Variables Selected for the Computation of Composite Asset Score

Variable	Scoring factor	Mean	Standard deviation	KMO
Distance to the market	0.3092	2.5010	1.9114	0.7724
Distance to the road	0.3518	1.5894	1.3996	0.7410
House ownership	0.1973	0.6438	0.4795	0.6671
Vehicle ownership	0.1409	0.2575	0.4379	0.6734
Land area	0.1530	2.7443	3.1567	0.6328
Membership of org.	0.3615	0.7836	0.4124	0.5771
Microcredit received	0.0676	80164.48	169056.3	0.6249
Dependent ratio	0.2246	0.6572	0.5958	0.6855
Tropical livestock unit	0.0549	2.2790	5.4747	0.6483
Access to forest resource	0.3870	0.6027	0.4900	0.7828
Access to health facilities	0.3150	0.3890	0.4882	0.7006
Health status	0.0981	0.7589	0.4283	0.6218
Remittances received	0.2494	23635.34	54574.9	0.5352
Decision making	0.3535	0.7068	0.4558	0.5778
Remittance income share	0.2379	0.0446	0.1074	0.5331
Postsecondary education	0.0855	0.3151	0.4652	0.5709
Overall				**0.6211**

Source: Author's computation from field survey, 2019.

APPENDIX V111: First Stage Regression Summary Statistics (2-stage least square)

Variable	R-square	Adjusted R^2	Partial R^2	F(3,346)	Prob. > F
Asset score	0.4861	0.4593	0.3433	60.3005	0.0000

Source: Author's computation from field survey, 2019.

APPENDIX IX: First Stage Regression Summary Statistics (FIML)

Variable	R-square	Adjusted R^2	F(18,346)	Prob. >F
Asset score	0.4861	0.4593	18.18	0.0000

Source: Author's computation from field survey, 2019.

APPENDIX X: Test for Correlation of Instruments with Error Terms

Minimum eigenvalue statistics = 60.3005

Critical values # of endogenous regressors: 1

H_0: Instruments are weak # of excluded instruments: 3

	5%	10%	20%	30%
2SLS relative bias	13.91	9.08	6.46	5.39
2SLS size of nominal 5% Wald test	10%	15%	20%	25%
	22.30	12.83	9.54	7.80
LIML size of nominal 5% Wald test	6.46	4.36	3.69	3.32

Source: Author's computation from field survey, 2019.

APPENDIX XI: Multicollinearity Test among Regression Variables

Variable	VIF	TOLERANCE (1/VIF)
Age	2.33	0.4292
Sex	1.47	0.6805
Marital status	1.24	0.8059
Post primary education	3.63	0.2751
Household size	1.90	0.5265
Primary occupation	1.38	0.7255
Farming experience	2.01	0.4968
Dependent ratio	1.70	0.5894
Irrigation	1.20	0.8346
Extension contact	1.53	0.6553
National grid	1.45	0.6874
Agro-ecological zone	1.78	0.5627
Natural Asset score	1.76	0.5671
Physical Asset score	1.45	0.6883
Human asset score	4.51	0.2215
Financial Asset score	1.34	0.7476
Social Asset score	1.19	0.8419
ONF-OF	5.00	0.1997
ONF-NF	5.26	0.1886
ONF-OF-NF	7.05	0.1404
	Mean VIF = 2.46	

Source: Author's computation from field survey, 2019. ONF-OF = On-farm + off-farm livelihood; ONF-NF = On-farm + Non-farm livelihood; ONF-OF-NF = On-farm + off-farm + non-farm livelihood

APPENDIX XII: QUESTIONNAIRE

School of Postgraduate Studies,
Faculty of Agriculture,
Department of Agricultural Economics
University of Ibadan, Ibadan.
Nigeria.

Dear Respondent,

I am a Ph.D student of the above named institution, currently undergoing a research study on the topic titled “Rural Livelihoods and Food Insecurity among farming households in South west, Nigeria.

The interview schedule is intended to elicit relevant information that will assist in achieving the cardinal objectives of this study. Feel free to objectively furnish such information as it will be treated with the strictest confidentiality it deserves.

Thank you.

Yours faithfully

Yaqoob A.M

RURAL LIVELIHOODS AND FOOD INSECURITY AMONG FARMING HOUSEHOLDS IN SOUTHWESTERN, NIGERIA

HOUSEHOLD LEVEL QUESTIONNAIRE

SECTION A:

State		Questionnaire No:	Date			Completed by:
ADP zone			Day	Month	Year	
L.G.A / Village		Interview				
Respondent		Supervision				
Head of Household		Data Entry				

SECTION B: Demographic Characteristics on Household Head

No	Socio-economic Characteristics	Responses	Codes for option
1.	Sex		1= Male, 0= Female
2.	Age		
3.	Marital status		1= Married, 2= Single 3= Widowed, 4= Divorced
4.	Family type, if married		1=Monogamous 2= Polygamous
5.	Household size		
6.	Member of household 0-5 (years) 6-14 15-23 24-32 33-41 42-65 > 65	M F	
7.	Number of years spent in school		
8.	Highest Educational Qualification attained		0 = No formal 1 = Primary 2 = Secondary 3 = Tertiary

SECTION C1: Access and ownership of livelihood assets

9. Are these physical infrastructures present in your locality? Tick as appropriate. Market / / Road (motorable) / / Hospital/Clinic/Dispensary/ / Portable water source / /

10. What is the distance from your place of dwelling to your choice (s) in q.9 above?
    i. Market ……. Km
    ii. Road (motorable) …..…… Km
    iii. Portable water source……. Km
    iv. Hospital/Clinic/Dispensary …… Km

11. Please, complete the table below to show the ownership and access to livelihood assets by your household.

No	Access and ownership of Livelihood Assets	Responses	Codes for option
1.	Do you have house of your own?		1=Yes, 0 = No
2.	If yes, how much would you have paid if it is to be rented Naira per month?		
3.	Do you have vehicle of your own?		1=Yes, 0 = No
4.	If yes, what is the current value of vehicle in Naira		
5.	Do you have access to land?		1=Yes, 0 = No
6.	What is the unit in which your land area is measured?		1=Acre, 2=Hectares, 3=Heaps, 4=Plot, 5= Ridges, 6=Stands
7.	What is the total area of land in use?		
8.	How did you obtain the land in q.7 above?		1=Inheritance, 2=Purchase, 3=Rent, 4=Lease, 5= Others(specify)
9.	Do you have access to the national grid?		1=Yes, 0 = No
10.	Do you have jewelry (silver or gold)		1=Yes, 0 = No

12. How many members of your household were ill in the past seven days? .....

SECTION C2: Membership of organization and Sources of credit

13. Do you or any member of your household belong to any association/Cooperative societies? Yes/ / No/ /. If yes, give the type of association. Cooperative societies/ / Farmers Association/ / Traders Association/ / Religious Association/ /Village Association/ /

14. Do you or any member of your household participate in decision making of the organization or association specified in q.13 above?

Never / / Sometimes/ / Often/ /

15. What are the major sources of financing your enterprises or household's needs?

Banks/ / NGO/ / Cooperative Societies/ / Government agencies/ / Local lenders/ / Daily savings & credit / / Savings & revolving credit / / Personal Saving/ / Friends and Relatives/ / Others (Specify)……

16. Have you or any member of your household obtained credit from any of the sources in q.15 above in the last twelve months? Yes / /No / /. If yes, How much in Naira have you obtained from the credit source identified in q.15 above in the **last twelve months**…….?

17. How many of your household members are working? ….....
Please, state the value in Naira of assistance you get from them.

S/No	Occupation	Monthly	Quarterly	Annually

SECTION C3: Ownership of Livestock, Poultry and Fishing Activities

18. Do your household own or raise/caught livestock in the last twelve months? Yes/ / No/ /. If yes, Please complete the table below to show the number of livestock owned, raised/caught **in the last twelve months.**

No	Livestock owned	How many are owned?	Unit price (₦)	How many are sold?	Value of total sold (₦)	Value of product sold (if any)	Value of home consumed (₦)
1.	Pigs						
2.	Poultry e.g. Chicken, Guinea fowls, Ducks, Turkey						
3.	Rabbit						
4.	Cattle/Cows						
5.	Sheep						
6.	Goat						
7.	Fish						

8.	Others (Specify)						

SECTION D: Livelihood and Income generating activities

19. What is your major occupation? Farming/ / Trading/ / Private salaried job/ / Government salaried job/ / Craft/Artisans/ /. Others (specify)……
20. Do you have farm of your own? Yes/ / No/ /. If yes, how long have you been farming? ……

21. Do you have access to forest resources and/or products? Yes/ / No/ /.

22. From the table below, how much do you realize from the following Non-farm and Off-farm activities in the last **twelve months?**

No	**Sources of income & livelihood**	**Amount (₦)**	**How long have you been in these activities?**	**No**	**Sources of income & livelihood**	**Earnings (Cash or kind) in ₦**	**How long have you been in these activities ?**
1	Trading			1	Agric.wage labor (e.g. planting, ridging, etc.		
2	Govt. salaried job			2	Rented land for sharecropping		
3	Private salaried job			3	Rented land for cash income		
4	Craft /artisans			4	Gathering of firewood		
5	Pension			5	Charcoal production		
6	Govt.bonus/ transfer			6	Hunting (including snail collection)		
7	Remittances(Friends &Relatives)			7	Others (specify)		
8.	Others(specify)			8.	Others		

23. Please supply information on the **staple crops and cash/tree crops** produced by your household in the last twelve months. How much do you realize from the following farming activities in the last twelve months?

No of plots	Was plot irrigated? 1=Yes; 0=No	Source of water for irrigation Natural (rivers/stream)...1 Natural (Lake/pond)…...2 Natural spring….. 3 Irrigation dam..... 4 Irrigation well….. 5 Irrigation canal.... 6 Others (specify).... 7	Unit of land area ref.q.6	Size of land area	Types of crop /crop mixture		Value of output sold (₦)		Value of output consumed (₦)	
Plot 1										
Plot 2										
Plot 3										
Plot 4										

24. How many times did your household have contacts with extension agent in the last one year……..?

SECTION E: EXPENDITURE ON FARM INPUTS

Please supply information in the table below to show the costs and expenses incurred for the production of food/cash crops over the **past twelve months.**

S/N	INPUTS	Purchase Yes = 1 No = 0	Amount (₦)		S/N	INPUTS	Purchase Yes = 1 No = 0	Amount (₦)	
			CASH	KIND				CASH	KIND
	SEEDS				11.	Urea fertilizer			
1.	Maize				12.	Others (Specify)			
2.	Rice				13.	Herbicides			
3.	Sorghum				14.	Insecticides			
4.	Millet				15.	Rodenticides			

5.	Cowpea				16.	Vet. Drugs & Med.			
6.	Groundnut				17.	Tractor/Equipment			
7.	Soybeans				18.	Others (Specify)			
8.	Cassava				19.	Irrigation			
9.	Yam				20.	Transportation			
10.	Potato				21.	Animal feeds			
11.	Others(Specify)				22.	Hired labor			
12.	NPK fertilizer				23.	Others (Specify)			

SECTION F: Consumption of food groups

1. Please complete the table below to show the frequency of consumption of different foods or food groups by your household. How many times in the **last seven days** have your household consumed any of the following food items?

S/N	**Food groups**	**Food items**	**Frequency of consumption**	**Weight: codes for option** **Meat, fish and dairy products….. 4** **Pulses ……..... 3** **Cereals and tubers…….. 2** **Vegetables and fruits....1** **Sugar and Oil…… 0.5**	**Sum**
1	Cereals	Rice			
		Sorghum			
		Maize			
		Bread			
		Wheat			
		Pasta			
		Other cereals			

	Root and tubers	Yam			
		Cocoyam			
		Potato			
		Cassava			
		Sweet potato			
		Other tubers			
2	Legumes/ nut/seeds	Beans/Cow peas			
		Peanuts			
		Groundnuts			
		Melon			
		Bean cake			
		Moin-moin			
		Other pulses			
3	Vegetables	Tomato			
		Onion			
		Carrot			
		Okra			
		Red pepper			
		Amaranthus			
		Cassava leaves			
		Other green leaves			
		Cucumber			
		Lettuce			
		Green beans			

		Other vegetables			
4.	**Fruits**	Mango			
		Pawpaw			
		Watermelon			
		Banana			
		Apple			
		Orange/Tangerine			
		Pineapple			
		Other fruits			
5.	**Meat**	Sheep/goat			
		Beef			
		Chicken			
		Pork			
		Other meat			
	Fish	Dried/Smoked			
6		Eggs			
7	**Dairy products**	Milk			
		Cheese			
		Yoghurt			
		Vegetable oil			
8	**Fat and oil**	Palm oil			
		Other fats/oil			