ANALYSIS OF SOCIO-ECONOMIC AND INSTITUTIONAL FACTORS INFLUENCING CROP-LIVESTOCK FARMERS' FOOD SECURITY STATUS IN KADUNA STATE, NIGERIA

BY

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DECLARATION

I hereby declare that this thesis titled "**Analysis of Socio-economic and Institutional Factors Influencing Crop-Livestock Farmers' Food Security Status in Kaduna State, Nigeria"** has been written by me and it is a record of my research work. No part of this thesis has been presented in any previous application for another Degree or Diploma in this or any other institution. All borrowed information have been duly acknowledged in the text and a list of references provided.

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CERTIFICATION

This thesis titled '**Analysis of Socio-economic and Institutional Factors Influencing Crop-Livestock Farmers' Food Security Status in Kaduna State, Nigeria'** by Francis Ugo ANOSIKE meets the regulations governing the award of the Degree of Masters of Science, Agricultural Extension and Rural Development, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This Dissertation is dedicated to my parents Mr. and Mrs. E. Y. Anosike, for laying the foundation on which I am building today.

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To my In-laws, friends and well-wishers, thanks for your support and prayers, God bless you all. To the one Supreme Being who alone exists by Himself, may His name be praised now and forever more. Amen.

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ABSTRACT

This study was conducted to analyze the socio-economic and institutional factors influencing crop-livestock farmers' food security status in Kaduna State. A multi-stage sampling procedure was adopted and primary data were collected from 351 crop-livestock farmers using a questionnaire instrument. In the first stage, two Local Government Areas were selected randomly from each of the agricultural zones in the State. The second stage involved the random selection of two villages from each of the LGAs giving, sixteen villages. The statistical tools used were descriptive statistics, food security index and probit regression model. It was found that most(32% and 27%)of the farmers were within the age bracket of 27-37 and 38-48 respectively. Most of the farmers(85%) were married, 38%, 34% and 21% had primary, tertiary and secondary education respectively and67%had a household sizes between 1-8 persons. Most (27%) and (25%) of farmers had farm sizes of 1.0-1.9 hectares and 2.0-2.9 hectares respectivelyand 78% had 1-11yearsof experience in crop-livestock integration. Majority (53%) of farmers did not belong to any cooperative society, 59% had been visited by extension agent, and 68% did not have access to credit. Majority (75%) of farmers practiced mixed cropping; 50% reared goats, and 44%, 39% and 33% reared poultry, sheep and cattle respectively. The nature of crop-livestock integration in the study area shows that majority (45%) of farmers practiced cereal-legume-livestock integration, while 31% of the farmers practiced cereal-livestock integration. Analysis of food security index showed that 21% of household were food secured with an average daily calorie intake of 4325.13kcal, vis-a-vis the FAO recommended daily per capita calorie intake of 2260kcaland79% were food insecured with an average daily calorie intake of 1287.77kcal. The result of probit regression revealed that; age, marital status, years of schooling, family size, crop–livestock farming experience, number of extension visits

and amount of credit received,significantly influenced the food security status of the crop-livestock farmers. Therefore, the alternative hypothesis was accepted, which is socio-economic and institutional factors significantly influence the food security status of crop-livestock farmers in the study area.The mean level of living of crop-livestock farmers in the study was ₦410, 659.009 per annum. Most (45%) of the farmers identified lack/high cost of inputs as a major constraint to crop-livestock integration, and 38% and 19% of farmers identified inadequate capital and inadequate extension agent as constraints respectively. The study concluded that majority of the farmers were food insecure, crop-livestock integration was practiced in the study area. Also socio-economic and institutional factors have significant influence on the food security status of crop-livestock farmers in the study area. The studydid recommendthat; Food insecure households should be assisted by both Government and Non-Government Organizations to increase production of staple crops and livestock to enhance their food security status. Furthermore, Government should provide the enabling environment and facilities for farmers to enhance their agricultural production, which will inturn boost the food security status.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background ofthe Study

Globally, agriculture still remains the largest industry providing livelihood for more people than any other industry (Food and Agricultural Organization, 2019). Agriculture plays a key role in reducing poverty since most of the world's poor live in rural areas and is largely dependent on agriculture. Nigeria's domestic economy is largely determined by agriculture which accounted for 21% of the Gross Domestic Product (GDP) in 2020 (National Bureau of Statistics, 2021). Agriculture has been an important sector in the Nigerian economy in the past decades and is still a major sector despite the oil boom. Basically it provides employment opportunities for the teeming population, eradicates poverty and contributes to the growth of the economy. Nigeria is endowed with substantial natural resources. These include 30.2 million hectares of arable land, 12 million hectares of fresh water sources covering 960 kilometers of coastal land with significant ecological diversity, which enables the country to produce a wide variety of crops and livestock, forestry and fisheries products (FAO, 2016). Backed by oil producing opportunity, Nigeria has a potential to become one of the leading agricultural economies in Africa (FAO, 2016).

Nigeria is a food deficit country, the most populous country in Africa (over 201 million people) and among the largest inland area (923,768 km^2). Nigeria is the number one biggest economy in Africa, the country has the 30^{th} biggest economy in the world with a gross domestic product (GDP) ofUS$ 397.30 billion in 2019 (Trading Economics, 2019). Nigerian agriculture is primarily rain-fed and characterized by low productivity, low technology and high labour intensity (IITA, 2017). Since 2005, the value addition of the

agricultural sector to the GDP has been growing rapidly, averaging about 7 percent annually (International Food Policy Research Institute, 2016).Food insecurity still represents one of the biggest challenges facing most part of the world population and must be treated with the utmost urgency (Pasquale and Matteo, 2011).Food security exists when all people, at all times, have physical, social and economic accessto sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.This definition rest on four pillars: availability, accessibility, utilization and stability.

One important way to increase food production, reduce wide spread hunger, increase income and ensure food security for farmers, and still ensure utilization of resources and environmental protection without hampering economic growth, is encouragingsmallholderfarmers to continually involve themselves in integrated crop-livestock farming systems.The Integrated farming system was introduced based on study and research results which were first known as cropping pattern, farming patterns, and nowfarming system. The Integrated farming system of crop and livestock is one of the many technologies that have been developed for the sustainability of production and increase farmers' income (Mukhlis*et al.,* 2018). Integrated farming systems is a farming system that combines a variety of crop and livestock, and the application of various techniques to create suitable conditions to protect the environment, maintain land productivity and increase farmer income. Integrated farming system is part of the agro-eco technology system consisting of various interrelated components include non-farm business components, biophysical nature, and socio-economic, political and cultural. The Integrated farming system is a systematic approach to the use of low external input between crops with livestock (Mukhlis*et al.,* 2018).

The advantages of integrated agriculture and mixed farming are more in terms of economic benefits than monocultures. Food demand is increasing day by day as food production is declining as a result of the ongoing conversion of land to residential land and also drastic reduction of working farmers (Jaishankar*et al.,* 2017).In the face of expanding human population, food production has to be increased commensurately to enhance food security among farming household, hence the need to analyze the factors influencing crop-livestockfarmers' food security status.

1.2 Statement of the Problem

One greatest challenge facing mankind today and in the coming decades is the problem of feeding the growing population of the world, which formed the basis of the Sustainable Development Goal (SDG 2) (Ibok*et al.,* 2016). Food security has become an issue of global concern. Although, some parts of Africa have made progress in reducing hunger (Paul,2017). Nigeria is one of many food-deficient countries in Africa, and its alarming hunger statistics are tired to the high levels of conflict that have plagued the region surrounding Nigeria for years (Jennifer, 2020). In particular, the challenge of hunger is more severe in northern Nigeria, relative to other states in the country; Nigeria is ranked among the seven countries facing severe hunger (FAO, 2019). In June 2021, the Nigerian government lunched a seed support initiative in partnership with a group of agricultural research institutes and programs (Ellie, 2021). The initiative worked to deliver improved seed to farmers in 13 states in order to lessen the harmful impact of COVID-19 pandemic on hunger in Nigeria. Thus, the situation calls for a guided change as food insecurity is a challenge to human society, affecting sociological, environmental and economic development.

In Kaduna State and other part of Nigeria, poor rural farming households have been facing insufficient food and limited livelihood options due to the unfavorable macroeconomic and environmental conditions in the country (Famine Early Warning System Network, 2018).This resort in their inability to meet basic food needs as food prices and farming expenses are soaring higher than the cash income of these households. This has an implication on the food security situation of farming household in the State. Given this context, crop-livestock farming systems would be relevant in addressing the challenge of food insecurity among the poor rural households.

A number of studies have been carried out by different scholars on food security. (Irohibe, *et al*. 2014; Ahmed,*et al.* 2015; Ojeleye 2015; Ojeleye,*et al*. 2015; Aromolaran*et al.* 2017). Their main focus, however, was on assessing, analyzing and determining the food security status of farming household in rural areas. Similarly, Saleh and Mustafa (2018), in their study on food security, concentrated their effort more on food security and productivity among urban farmers. A number of studies have also been carried out by different scholars on crop-livestock integrated system.(Ezeaku,*et al.*, 2015;Iyiola-Tunji,*et al.*, 2015;Daljit, 2016; Jaishankar,*et al*., 2017). Their main focus, however, was on evaluation, economic dimension, and sustainability of crop-livestock integration system. Also,Mukhlis,*et al.,* 2018 andIdris,*et al.,* 2017 in their various studies on crop-livestock integration, dealt more on rice and cattle integration.What is almost lacking in these studies, however, is analysisof the socio-economic and institutional factors influencing the food security status of crop-livestock farmers. Therefore, their studies have left a gap on factors influencing the food security status of crop-livestock farmers. It is on this basis that this studywas conceived to provide empirical analysis of the socio-economic and

institutional factors influencing the food security status of crop-livestock farmers in Kaduna State. Thus the pertinent research questions addressed were as follows:

i. What are the socio-economic characteristics of the respondents in the study area?
ii. What is the nature of crop-livestock integrated system practiced in the study area?
iii. What is the food security statusof the crop-livestock farmers in the study area?
iv. What are the factors influencing crop-livestock farmers' food security?
v. What is the level of living of the crop-livestock farmers in the study area?
vi. What are the constraints faced by the farmers in the practice of crop-livestock integrated system in the study area?

1.3 Objectives of the Study

The broad objective of the study was to analyze socio-economic and institutional factors influencing of crop-livestock farmers' food security status in Kaduna State. The specific objectives were to;

i. describe the socio-economic characteristics of crop-livestock farmersin the study area;
ii. identify the nature of crop-livestock integrated system practiced by the farming households;
iii. analyze the food securitystatusof farming householdsin the study area;
iv. determine the factors influencing crop-livestock farmers' household food security,
v. determine the level of living of crop-livestock farmers in the study area; and
vi. identify the major constraints of integrated crop-livestock farming system in the study area.

1.4 Justification of the Study

The outcome of this study would be beneficial to extension agents, crop and livestock researchers who would find the information relevant for further research on crop-livestock integration, in a bid to develop appropriate methods for integration that are better suited to meeting the needs of farmers. Also, other stakeholders in the livestock industry in Nigeria would find the outcome of this study relevant in understanding the level of participation and its outcomes at the farmers' level.It is expected that the information gathered from this work would serve as a relevant resource material to policy makers towards ensuring appropriate formulation of agricultural developmental policies aimed at improving agricultural productivity, income improvement of farming households, increase food security and effective poverty reduction among farming households through policies favorable to investment on research and promotion of improved agricultural varieties to farmers.

The result of this research work would assist extension agencies to design appropriate strategies for effective extension service delivery.Also it would serve as a guide to extension agencies in forming a data base for continuous research on integrated crop-livestock farming systems aimed at improving the living standards of crop-livestock farming households. In addition, the findings from this research would serve as a framework for further research on improving crop-livestock farmers' food security status and their level of living in the area.

1.5 Hypothesis

The hypothesis of the study is:

H_0: Socio-economic and institutional factors have no significant influence on food security status of crop-livestock farmersin the study area.

H_A: Socio-economic and institutional factors have significant influence on food security status of crop-livestock farmers in the study area

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Concept of Crop-livestock Integration

Conventional agriculture is known to cause soil and pasture degradation because it involves intensive tillage, in particular if practiced in areas of marginal productivity. An integrated crop-livestock farming system represents a key solution for enhancing crop and livestock production and safeguarding the environment through prudent and efficient resource use. The increasing pressure on land and the growing demand for crop and livestock products makes it more and more important to ensure the effective use of feed resources, including crop residues. An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment (Vinod,*et al.*, 2012).

Jitsanguan (2001) defined the integrated farming system(IFS) as an aquaculture system that is integrated with livestock and in which fresh animal waste is used to feed fish and also reported that there are synergies and complementarily between enterprises that comprise a crop and animal component that form the basis of the concept of IFS. According to this concept, integration usually occurs when outputs (usually by-products) of one enterprise are used as inputs by another within the context of the farming system. Jayanthi*et al*. (2000) describes the IFS as a mixed animal crop system where the animal component is often raised on agricultural waste products while the animal is used to cultivate the soil and provide manure to be used as fertilizer and fuel. Radhamani*et al*. (2003) described IFS as a component of farming systems which takes into account the concepts of minimizing risk, increasing production and profits whilst improving the

utilization of organic wastes and crop residues. Agbonlabor*et al*. (2003) defined the IFS as a type of mixed farming system that combines crop and livestock enterprises in a supplementary and / or complementary manner. Jayanthi (2006) stated that IFS is a component of Farming System Research (FSR), introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. Singh and Ratan (2009) defined the IFS is an integrated set of elements / components and activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis. Panke*et al*. (2010) stated that the integration is made in such a way that the product; i.e. output of one enterprise / component should be the input for the other enterprises with high degree of complementarity effects. Similarly the authors stated that the rationale of IFS is to minimize the wastes from the various sub systems on the farm and thus it improves employment opportunities, nutritional security and income of the rural people. Bahire*et al*. (2010) defined the IFS as an integrated mixed farming system, is the practice of raising different yet dependent enterprises andwhen different enterprises are dependent they are primarily complementary and supplementary to each other.

In the context of this study, crop-livestock integrated system is defined as the integration of crop and livestock enterprises in a supplementary/ complementary manner with recycling, allowing the maximum use of available resources. Crop residues are used for animal feed, while livestock and livestock by-product are used to enhance crop productivity by intensifying nutrients that improves soil fertility, reducing the use of chemical fertilizers.

2.2 Crop Production

As the population increased, the food supply has not always sufficiently been stable or plentiful to supply his needs. This probably led to the practice of crop production. Therefore, crop production began at least nine thousand (9000) years ago when domestication of plants became essential to supplement natural supplies in certain localities. The art of crop production is older than civilization, and its essential features have remained almost unchanged since the dawn of history (Birkeland, 1999). Sustaining productivity and profitability is one of the major challenges to the agricultural scientists for fulfilling the food demand of growing population in any country (Janardan, 2016). Crop production is an important branch of agricultural science which emphasizes on the crops to be cultivated in a particular climate and in each kind of soil, and water management practices to be followed in order to increase productivity (Janardan, 2016). It is basically conversion of environmental inputs (solar energy, CO2, water, soil nutrients) into economic products in the form of human or animal food or industrial raw material. Crop production plays a key role in enhancing the total production by improving productivity resulting in food and nutritional security (Janardan, 2016).

Crop plants have a wide range of development and growth responses to sunlight, day length, temperature, nutrients, and water supply (David, 2013). Farmers do not, however, choose plants as crops for optimum adaptation to individual environments, but those that are preferred food, as in developingCountries, or to meet market requirements, including global trade. In consequence, crops are managed to withstand environmental stresses. Socio-economic forces drive change in agriculture that is currently challenged to increase production by 70% to feed 9.2 billion by 2050 (David, 2013). Generally, there are many

factors influencing crop production and these include soil, relief, climate and diseases among others (Tunde*et al.*, 2011).

Crop Production is the art and science of the genetic improvement of crops to produce new varieties with increased productivity and quality.It is an intricate enterprise that requires vast knowledge about the Agronomy, environmental interactions, and the application of available technology to achieve food production. This is exactly what farming in Nigeria needs to revolutionize food production (David, 2013).

2.3 Livestock Production

Livestock production is a very important sector of the economy of any nation and is crucial in ensuring food security. Livestock have been known for ages to meet the animal protein requirement of man and many other benefits they provide for farmers and the national economy (Bamaiyi, 2013).Nigeria's population is growing at a faster rate than the increase in animal products in the country whose population is expected to reach 402 million people by the year 2050 (Bamaiyi, 2013). Livestock has historically constituted one of Africa's major economic resources in terms of the livelihoods of its populations, but has remained the poor stepchild of mining and crop production in terms of its contribution to trade and export. This is because livestock has largely resisted transfer from the traditional sector to modern production methods, especially in West-Central Africa. Indeed, throughout most of this region, the majority of the livestock, especially cattle, are managed by a single ethnic group, the Fulbe, who have largely retained a pastoral system (Blench, 1990).

Animal products are responsible for one-sixth of the human food energy and also more than one-third of the protein requirement on a global basis (Bradford, 1999;Bamaiyi,

2103). Animal production trends are said to be influenced by strong demand-driven factors such as population growth, urbanization, income growth and changing customer services which are of two categories: (1) modern demand driven and capital intensive non-ruminant (swine and birds) sector and (2) traditional resource-driven and labour intensive ruminant (cattle, sheep and goats) sector (Devendra 2002; Devendra, 2007;Bamaiyi, 2013).

Livestock production is a form of agricultural production with many facets and the manifestation of these facets differs from one situation to another (Bamaiyi, 2013). It is obvious that livestock production by a nomad who keeps camels for milk to secure his subsistence is different from that of a peasant who raises some poultry in his farm yard for sale on the market. The different livestock species-camels, cattle, sheep, goats, equines, pigs and poultry –varyradically in their management requirements, their production and productivity and also in the products they supply and the functions they fulfill (Hans, 1982). But one and the same species may also be held for completely different purposes: On some farms cattle are kept to produce beef for sale, on others to supply dung for the fields andto provide tractive force in farm work. In addition the same product and function, say meat for sale, can be provided by radicallydifferent management principles; long-range migration as a form of adaptation to ecology in ii pre-technical world in one case, and the application of modern technology in an artificially controlled environment in another. And the functions of livestock are by no means restricted to production. The keeping of livestock for prestige and the payment of bride price in the form of cattle are only examples of the role of livestock that pervades the emotional, social and cultural spheres of many African societies (Hans, 1982).

With a fast growing population Nigeria is threatened with the problem of food insecurity and poverty which can be addressed with a more developed animal production sector in addition to other sectors (FasoyiroandTaiwo, 2012). The average Nigerian still consumes far less animal protein than his counterpart in the developed world because the animal production industry is still in its infancy due to hydra-headed problems and the per capita income is low leading to a consumption of less than 9grams of animal protein per capita per day as compared to over 50 grams per capita per day in North America and Europe (Grigg, 1995; Boland *et al.*,2013). Some countries even in the developing world are already considering novel approaches to meat production such as in-vitro meat production (Sachan*et al.*,2012) but in Nigeria animal production is facing numerous challenges with certain factors militating against successful animal production.

2.4 Concept of smallholder farmers

The term smallholder farming or small scale farming describes a type of production system that bears the imprint of the structural link between economic activity and family structure (Veterinaries Sans Frontieres, 2012). This relationship influences the decision making process, the type of farming, work organization, production management and the handing down of the farm as an inheritance (VSF, 2012). Smallholder Farming is a type of production system where the farm unit (a single farmer or a couple or a family or a cooperative...) is at the same time the owner, the worker and the person who makes the decisions. This means that he makes the decision process and he plays a central role in a number of choices encompassing breeding and transformation for example the plant and type of grain to sow, the number of animals and their breed, the seasonal pasturelands and related pastoral mobility, the selling of livestock and the marketing of the final products (VSF, 2012). According to FAO, 43% of the world's active population is working in

agriculture, and 53% of them live in developing countries, so the majority of this population lives from farming (VSF, 2012). There are large differences between countries, with an average of 18% of the active population working on farms in Latin America compared to over 60% in Africa and Asia.

The vast majority of this farming population works on family farms that practice small scale farming. According to International Fund for Agricultural Development (2010), approximately 450 million small-scale farmers worldwide provide livelihoods for around 2 billion people. According to the World Bank 2008 report, 1.5 billion people make their living on small farms (World Bank, 2008). In Sub-Saharan Africa, 80% of farms are family ones, and over 60% of the active population works in agriculture. However, in 2004, only 4% of public investment was attributed to agriculture. According to Aidenvironment (2012), listed some indicators to define smallholders, these indicators include, market orientation, landholding size, labor input, farm management responsibility, income, farming system, capacity, legal aspects, land tenure, level of organization. Smallholders become increasingly significant for global agricultural value chains. Smallholders, whose output supports a population of roughly 2.2 billion people, manage about 85% of the world's farms.

Agriculture is a source of livelihood for an estimated 86% of rural people worldwide, comprising 2.5 billion people and provides jobs for 1.3 billion smallholders and landless workers (Salami*et al.,* 2010).Small scale farming is also very important because of its positive and sustainable effects on the environment and its relationship with social aspects. Summarizing its main characteristics clarifies the link between small scale livestock farming and food sovereignty. Globally, 75% of the people suffering from hunger are

small farmers and inhabitants of rural areas. A huge amount of them depend on a few courtyard heads for daily food provision. Therefore, no successful program against hunger can ignore the urgent need to support the smallest household farming activities (VSF, 2012)

2.4.1 Advantages of Integrated Crop-Livestock F arming System

An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment (IFAD, 2005). Based on the principle of enhancing natural biological processes above and below the ground, the integrated system represents a winning combination that (a) reduces erosion; (b) increases crop yields, soil biological activity and nutrient recycling; (c) intensifies land use, improving profits; and (d) can therefore help reduce poverty and malnutrition and strengthen environmental sustainability (IFAD, 2005). Integrating crops and livestock serves primarily to minimize risk and not to recycle resources. In an integrated system, crops and livestock interact to create a synergy, with recycling allowing the maximum use of available resources. Crop residues can be used for animal feed, while livestock and livestock by-product production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilizers. A high integration of crops and livestock is often considered as a step forward, but small farmers need to have sufficient access to knowledge, assets and inputs to manage this system in a way that is economically and environmentally sustainable over the long term (FAO, 2001).Antonio and Silvia (2010) summarized the overall benefits of crop-livestock integration as follows:

• Agronomic, through the retrieval and maintenance of the soil productive capacity;

• Economic, through product diversification and higher yields and quality at less cost;

• Ecological, through the reduction of crop pests (less pesticide use and better soil erosion control); and

• Social, through the reduction of rural urban migration and the creation of new job opportunities in rural areas.

It helps improve and conserve the productive capacities of soils, with physical, chemical and biological soil recuperation. Animals play an important role in harvesting and relocating nutrients, significantly improving soil fertility and crop yields.

• It is quick, efficient and economically viable because grain crops can be produced in four to six months, and pasture formation after cropping is rapid and inexpensive.

• It helps increase profits by reducing production costs. Poor farmers can use fertilizer from livestock operations, especially when rising petroleum prices make chemical fertilizers unaffordable.

• It results in greater soil water storage capacity, mainly because of biological aeration and the increase in the level of organic matter.

• It provides diversified income sources, guaranteeing a buffer against trade, price and climate fluctuations.

• It provides diversified income sources, guaranteeing a buffer against trade, price and climate fluctuations.

One key advantage of crop-livestock production systems is that animal dungs are used to fertilizer the land for crop production, while livestock can be fed on crop residues and other products that would otherwise pose a major waste disposal problem. For example, livestock can be fed on straw, damaged fruits, grains and household wastes (Fakoya, 2002).

2.5Concept of Food Security

The Food and Agriculture Organization of the United Nations (FAO) reported that projections has shown that the world is not on track to achieve zero hunger by 2030 and, despite some progress made, most indicators are also not on track to meet global nutrition targets (FAO, 2020). The food security and nutritional status of the most vulnerable population groups is likely to deteriorate further due to the health and socio-economic impacts of COVID-19 pandemic (FAO, 2020). It is generally recognized that food security and food insecurity, are multidimensional phenomenon.

Several indices measuring hunger and the progress in achieving hunger eradication helped understanding the issue and monitoring the progress in eliminating hunger as well as providing targets for national and international political action (Clay, 2002). Concerns about food security can be traced back to the Hot Springs Conference of Food and Agriculture Organization in 1943, since which time the issue has undergone several redefinitions. The 1943 conference evolved the concept of a "secure, adequate and suitable supply of food for everyone" a concept that was subsequently taken up at an international level.

The issue of food security really came to the fore in the 1970s and at the 1974 World Food Conference in Rome the first explicit acknowledgement was made that this issue concerned the whole of mankind:

*"***Every man, woman and child** has the inalienable right to be free from hunger and malnutrition in order to develop fully and maintain their physical and mental faculties.Accordingly, the eradication of hunger is a common objective of all the countries of the international community, especially of the developed countries and others in a

position to help."(United Nations, 1975).Since the 1974 Rome conference the whole concept has "evolved, developed, multiplied and diversified" (Maxwell, 1996). There are now thought to be almost two hundred definitions of food security (Smith *et al.,* 1993) which is a clear indication of differing views and approaches to the problem; however, the definition that has acquired the broadest acceptance is that of the World Food Summit (WFS) in November 1996.Food security exists when all people, at all times, have physical, social and economic accesstosufficient, safe and nutritious food which meets their dietary needs and food preferences for an activeand healthy life.This definition rest on four pillars: availability, accessibility, utilization and stability.

- Food availability means the physical availability of food, focusing on the supply side. Hence, availability implies the supply of sufficient quantities of food of appropriate quality, achieved by domestic production, imports or food aid (FAO, 2003). Food availability might be a challenge in the future due to limits on natural resources and a growing world population.

- Food access alludes to physical and economic access to available food and thus to be in possession of sufficient resources to obtain appropriate foods for a nutritious diet (Aidoo*et al*. 2013). The main aim here is the self-determined opportunity to purchase food given by income, safety nets or market access. Adverse shocks like unemployment, price spikes, little income or loss of livelihood producing assets affect food access. Food security's close relationship to poverty and to social, economic and political disenfranchisement comes into clearer focus through the access lens (Barrett, 2010).

- Food utilization includes a wide range of factors, particularly the contribution of food consumption to the health and nutritional status of the individuals. This involves the nutrient content of the food consumed and the diversity of the individuals' diet, as well as actual uptake of nutrients, micronutrients, and energy along with many factors such as safe drinking-water, sanitation and hygiene. Hence, utilization focuses on a nutritionally essential diet, realized by the obtained foods and circumstances affecting health positively (Gross *et al*., 2010)

- The fourth component, stability, considers the susceptibility of the three aforementioned elements and affects the temporal dimension of food security. While transitory food insecurity captures sudden, temporary and seasonal disruptions, chronic food insecurity depicts a long-term lack of access to adequate food (Barrett, 2013). In our study, we focus on food security of smallholder farmer households, including all household members.

Concepts of food security have evolved in the last thirty years to reflect changes in official policy thinking (Clay, 2002; Heidhues*etal.,* 2004). In Nigeria the concept of food security cannot be over emphasized. Despite pretensions that it's one of the country with good agricultural potentials, Nigeria is far from being completely food secured (Emmanuel and Peter, 2012). At the global level, somewhere in the world, a child dies of hunger every five seconds, although the planet has more than enough food for all. The United Nations (UN) Secretary General, Ban Kimoon, laid out these sobering statistics as he kicked off a three day summit on world food security in Rome. "Today, more than one billion people are hungry", he told the assembly leaders. Six million children die of hunger every year, 17,000 every day. Ban Kimoon added that in 2050, the world will need to feed two million more mouths – 9.1 billion in all (see, Nigerian Compass, November, 18, 2009:6).

Meanwhile, Nigeria is one of the food-deficit countries in sub-Saharan Africa although it is arguably better in terms of production than the others. It has also not suffered any major catastrophe that could precipitate scourges of famine, mass hunger and therefore food crisis (Emmanuel and Peter, 2012).

This does not in any way prevent public policy makers from being conscious of avoiding the debilitating impact of food shortages in neighboring countries which has however made food security become a first order priority of the every Nigerian government (Atinmo and Adeniran, 1999). Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their needs and food preferences for an active and healthy life (FAO, 2015). The main goal of food security is for individual to be able to obtain adequate food needs at all time and to be able to utilize the food to meet the body's needs. The highest state of food security requires not only making food available, but that food must be accessible and also should be nutritionally well utilized within the body system. Despite spending over 40 percent of their household income on food, 65 percent of Nigerians are considered food insecure (Federal Ministry of Agriculture and Rural Development, FMARD; National Investment Plan, NAIP, 2013).

Household food security exists when all members, at all times, have access to enough food for an active, healthy life. Individuals who are food secure donot live in hunger or fear of starvation (FAO, 2006). The deprivation of basic need represented by food insecurity and hunger are undesirable in their own right and also are possible precursors to nutritional, health, and developmental problems (Bickel *et al.,* 2000). Monitoring food security can help to identify and understand this basic aspect of well-being of the population and to identify population subgroups or regions with unusually severe conditions (Jef*et al.,*

2015). Ahousehold is considered food secure when its occupant does not live in hunger or fear of starvation (FAO, 2001).

2.6 Major Determinants of Food Security

Food security at the household level is a function of many factors that empower individuals to access nutritionally adequate and safe food in appropriate ways. The access that a household has food, depends on many factors, some of the most important factors are presented below,

Income

The theoretical association between income and household food expenditures has a long and well established history. Traditional economic theory posits the so-called Engel curve, which is a functional linkage between household food expenditure and income of the household in a given time period. Assuming prices, tastes and preferences and the number of consumers are constant, the Engel curve shows how purchases of food commodities change when money income changes.

Household size

There is considerable evidence of a strong negative correlation between household size and income per person in developing countries. It is often found that people living in larger and generally younger households are typically poorer. Engel curve seeks to explain this by illustrating thatacross household of different size, the increase in household size will increase household's food share and decrease income of household. Since increase in food share is an increase in a proportion of income, a higher food share indicates lower wellbeing of households

Gender

In recent years, there has been increased recognition of the crucial importance of women's contribution to food security. Many studies show that women in all developing regions

play a predominant role in household food security through their involvement I agriculture and food production. The improvement of household food security and nutritional levels are therefore closely related to women's ability to earn income and their role in household expenditure decision.

Education

The general education level of the homemaker has been found to have a substantial impact on food expenditures. Multiple channels have been identified through which an educated person is more likely to be food-secure. Mukudi (2003) claims, that education has a key role in accessing public information, especially concerning health, nutrition and hygiene.

2.7 Food Security Programmes and Policies in Nigeria

Nigeria government since independence in 1960 had established and lunched several policies, programs and projects in order to be self-food sufficient, food reliance and food secure (Keku, 2017). Obayelu and Obayelu, (2012) identified some of these major interventions to include:

i. Farm Settlement and Plantation Programme FSP (1960)
ii. National Accelerated Food Production Programme – NAFPP (1972)
iii. River Basin Development Authority – RBDA (1975)
iv. Operation Feed the Nation – OFN (1976)
v. Agricultural Development Project – (1976)
vi. Agricultural Credit Guarantee Scheme – ACGS (1977)
vii. Rural Banking System – RBS (1978)
viii. Green Revolution – GR (1980)
ix. Directorate for Food, Roads and Rural Infrastructure – DFRRI (1986)
x. Better Life for Rural Woman Programme (Now Women Commission, 1987)
xi. Community Banking Programme- CBP (1990)

xii. National Center for Agricultural Mechanization – NCAM (1990)

xiii. National Agricultural Development Land Authority – NADLA (1991)

xiv. National Fadama Development Projects NFDP (1992)

xv. Family Economic Advancement Programme – FEAP (1994)

xvi. National Special Programme for Food Security – NSPFS (2001)

xvii. National Agricultural Development Fund – NADF (2002)

xviii. Root and Tubers Expansion Programme – RTEP (2002)

xix. Agricultural Transformation Agenda – ATA (2011)

xx. Fadama I (1990) Fadama II (1999) Fadama III (2009) Projects

Among the Various policies and programmes implemented in Nigeria by various past and present regimes, only the Agricultural Development Projects - ADPs and National Special Programme for Food Security - NSPFS are still in existence.

2.8 Evaluating Nigeria's Food Security

No doubt, food is life; hence, food has become an instrument of national power (Emmanuel and Peter, 2012). Nigeria, blessed as it is, with abundant agro ecological resources and diversity, has become one of the largest food importers in sub-Saharan Africa (Idachaba, 2009). Any system where food demand is not sufficiently marched by supply is no doubt one with looming food crisis. Years ago, most Sub-Saharan African countries, Nigeria inclusive produced most if not all of their domestic food needs (Nwalie, 2017). This trend changed significantly in the 1980s as food shortage became a recognized problem. Although food insecurity later came to be a global malaise, Sub- Saharan Africa and South East Asia were the areas worse hit. Between 1990 and 1992 the Food and Agriculture Organization (FAO) statistics indicated that 11% of the population of Latin America was undernourished, 31% in Sub Saharan Africa and South East Asia 24%. The

same pattern continued into 2006 and 2008 as the same statistics also posited 7% for Latin America, 27% for sub-Saharan Africa and 14% for South East Asia (FAO, 2011).

Despite pretensions to the contrary, Nigeria is far from being completely food secured (Emmanuel and Peter, 2012). Nigeria is one of the food-deficit countries in sub-Saharan Africa although it is arguably better in terms of production than the others. It has also not suffered any major catastrophe that could precipitate scourges of famine, mass hunger and therefore food crisis. This does not in any way prevent public policy makers from being conscious of avoiding the debilitating impact of food shortages in neighboring countries which has however made food security become a first order priority of the present Nigerian government (Atinmo andAdeniran, 1999:110). Since the advent of civilian administration in 1999 greater attention was given to food production (Emmanuel and Peter, 2012). One time Nigerian Minister for Agriculture, publicly restated government's commitment to combat hunger and malnutrition by providing adequate food for the people and ensures food security for all (Emmanuel and Peter, 2012).

The greatest challenge in achieving food security in Nigeria, no doubt, has been inadequate funding (Emmanuel and Peter, 2012). The league effect of the underfunding of agricultural sector in the federal budget has always been the unpalatable massive importation of food items. For instance, Nigeria spent $2.85 billion dollars on the importation of various food items as at 2006. A breakdown of this figure showed Nigeria imported 36 per cent of its rice need costing $267 million dollars, sugar, 99 per cent costing $1 billion, wheat 99 percent totaling $1 billion dollars and tomatoes 14 per cent costing $50 million dollars. Fish import is 66 per cent per consumption costing $500 million dollars (see *Newswatch*, May 5, 2008:27).

In March 2017 the Food and Agriculture Organization (FAO) declared that about 7.1 million people in Nigeria are facing acute food insecurity and in need of urgent lifesaving and livelihood protection (Food and Agriculture Organization, 2017). This pronouncement runs counter to general expectations as the same FAO has initially indicated that food availability is generally satisfactory in Nigeria (Martin, 2017).

Furthermore since the launching in 2011 of the Agriculture Transformation Agenda (ATA), the National Bureau of Statistics has been recording increase in agricultural output and a strong growth rate in the agricultural sector GDP (Martin, 2017). Central Bank of Nigeria (CBN, 2012) indicated rise in output of almost all the staple food crops in Nigeria in 2011-rice, wheat, yam, cassava, maize, soybeans, beans and millet. This growth in food production has been consistent for over five years. Central Bank of Nigeria, (2016) also reported an increase of 3.5% in crop production and 5.9% in livestock and fishery.

In Nigeria the genesis of food crisis has mostly been associated with the collapse of agricultural sector in the mid-1970s. As the oil industry developed, the Nigerian government's attention moved away from the agricultural sector to the petroleum sector. As a result of the 1970s oil boom and the availability of petro dollar the nation resorted to food import in place of its usual domestic production. Food crisis set in at the end of the oil boom when the oil price crashed and the petro dollar ran out (Nwalie, 2017).

Over the years the Nigeria government has been formulating and executing policies to stem the tide of food crises and ensure food security in the country. None of these policies produced the desired output and were generally judged failures (Olaoye, 2010; Iwuchukwu&Igbokwe, 2012; Nwalie, 2017). However with the introduction of Agriculture Transformation Agenda in 2011 Nigeria agricultural sector started recording a

significant improvement in domestic food production (Nwalie, 2017). This rise in agricultural output continued up to date. As indicated in Olomola (2015), from 2012 to date no crop has recorded a production shortfall in two consecutive seasons.

As a result International Food Policy Research Institute (IFPRI) in her 2016 Global Hunger Index indicated that food availability is generally satisfactory in Nigeria and Lake Chad Basin (IFPRI, 2017). These two apparent contradictory positions of satisfactory food availability and increase in hunger, malnourishment and food insecurity brings to fore a hitherto ignored fact that food security is not solely the function of food availability. It echoes the postulation of More-Lappe and Collins (1982) that people are hungry not because there is no food. Laying too much emphasis on inadequate domestic food production when analyzing food insecurity in Nigeria has been a major limitation on most previous work on the subject matter (Nwalie, 2017). This thought direction has led to the belief that rehabilitating agricultural sector through sound government policies to boost domestic food production is all the country needs to achieve food security. Adherence to this prescription has put the country in a quagmire. For the past six years domestic food production figures have been up with no reduction in hunger and food insecurity. Indicating that food insecurity is not to be measured or remedied by food production figures alone (Nwalie, 2017).

An observable feature of literatures on food insecurity in Nigeria is that while international writers acknowledge the importance of macro-economic factors, most Nigerian writers are still stuck in productivity as the panacea position (Nwalie, 2017). Ojo and Adebayo (2012) exemplify this sole concentration on food production syndrome. They see increase in domestic food production as the only solution to food insecurity in

Nigeria. This pattern was followed in Kughur, Omale and Lonrenge (2015), placing emphasis solely on the supply side. Food unavailability seems in the view of these scholars to be the only dimension of food insecurity worthy of attention and no mention was made of inaccessibility.

Even with the success achieved so far in food production in Nigeria, Ejika andOmede (2016) still stuck to the old mantra of inadequate domestic food production as the sole cause of food insecurity. Other works with similar postulation includeOtaho (2013), Ahungwa*et al.* (2014); Fasayiro and Taiwo (2012). However, Ogundari and Awokuse, (2016) in a well-researched paper presented a balanced view. While acknowledging that agricultural productivity contributes positively and significantly to all measures of food security, they also note the crucial role of macro-economic factors. In their words, "to compliment the potential effects of agricultural productivity, we also include a number of macro-economic factors as control variables". The role of macro-economic factors in food security seems to be well acknowledged internationally (Nwalie, 2017).

Beyond high prices of staple food items in Nigeria, drought and political situation in neighboring countries like Chad, Cameroun and Niger seem to pose a threat to a state like Borno as they rely on the state for their food supplies (Emmanuel and Peter, 2012). Another problem according to the Ministry of Agriculture and Water Resources, responsible for the food crisis in Nigeria is not unconnected with the fact that "Nigeria's agriculture is mainly rain-fed and she has not taken full advantage of its irrigation potential estimated between two and 2.5 million hectares" (Emmanuel and Peter, 2012). Also the current farmers/herdsmen clash in Nigeria.

2.9 Measurement of Food Security

Food insecurity is prevalent across the globe, and the international community has placed on the top of its agenda the elimination of famine and hunger by setting a goal of reducing the world's hunger to a half by 2015 according to World Food Summit in 1996 (FAO, 2009). In order to achieve this goal, seven commitments in its Plan of Action have been set up (FAO, 1996). Currently there is an estimated 1.02 billion people living with hunger, particularly in underdeveloped countries. In 2009 alone, the number of people in hunger rose by approximately one-hundred million people (FAO, 2009). Monitoring food security at the household level can help in identifying and understanding the basic aspect of the well-being of its population. It is helpful in identifying the population, subgroups or areas with unusually severe and harsh conditions (Bickel *et al.*, 2000)

Accurate measurement and monitoring of these would help to improve existing food intervention programs (Bickel *et al.*, 2000). Estimation of the prevalence of food insecurity depends on the collection of primary data such as the number of hungry or undernourished, average calorie consumption data and an estimate of the minimum nutritional requirements of each country. However, compared with estimates of the secondary data that rely on the total cost of a food basket and the cost of other basic requirements and available income, the primary data is still costly even if it is consequently updated annually (Meade and Rosen, 2002). There are four important interlinked components imbedded in looking at the measurement of food security. The first component relates to the availability of food in a given country or household through any means (production, imports or food aid). The second aspect concerns access to food by people or households as reflected by their ability to get food through purchased from market, own stock /home production, gift or borrowing. The third component relates to food utilization, i.e, the actual processing and absorption capacity of the supplied nutrients

by the body. Finally the fourth component relates to stability and sustainability over time (Napoli *et al.,* 2011). A key step in food security analysis is finding an appropriate measure (Jemal and Kyung-Ryang, 2012). There are several indicators that are used as a measure of food security.

Webb *at al.* (2006) highlights the lack of precise measures of household food security and that the most commonly used measures of food security are based on proxy measures. In particular, measures of the "access" dimension of food security have centered on agricultural productivity, food shortage or children's nutritional status. In their study on the indicators of food security based on copping behaviors, Maxwell *et al.* (2008) list the widely employed measures of household food security, which include nutritional status, actual household food consumption level based on a 24-hour recall, coping strategy index household income/expenditure, productive assets, food shortage, dietary diversity and household food insecurity access scale.

In their review of determinants of rural household food security in Africa and Asia, Bashir and Shilizzi (2013) conducted a meta-analysis of literature based on a conceptual model that takes into account the three component of food security and the factors that determine each of them (Availability, Accessibility, and Utilization). Accordingly, factors like education, household head's age, input availability, technology adoption, farm size, land quality, price of inputs and credit have been identified as determinants of the availability component of household food security. On the other hand, factors like income, distribution of income within the household, household size, total earning members and family structure are identified as determinants of the access aspect. Finally, gender and expenditure on food and health are considered as determinants of utilization aspect.

In the context of this study food security is defined as the amount of calories consumed by all in a household.

2.10 Review of Empirical Literature on Socio-economic Characteristics of Crop-livestock Farmers

Fakoya (2007) in his study did examine the utilization of crop-livestock production systems in Iseyin Local Government area of Oyo State. Sixty crop-livestock farmers were purposively selected. Interview guide was used to obtain information on the respondents' demographic characteristics. The study revealed that majority of the respondents (73.34 %) is within the ages of 31 – 50 years. Most of them (76.66%) had completed one form of formal education. Over (75%) of the respondents had more than 10 cattle and about half of the respondents (50.33%) had over 20 goats. The results revealed that the highest scores of utilized crop-livestock production systems and the level of utilization of crop-livestock were found in the Extra income through sales (96.67%), sustain food production (93.33%) and Enhancing soil fertility (85.00%). Intimate integration of crop with livestock help to exploiting the byproducts and residues from crop. Therefore, the study recommended that a lot of extension attention is however required to educate farmers on utilization of crop-livestock production systems (Fakoya, 2007)

Adesop*et al.* (2012) in their study revealed that 34.4% of the farmers were male, while 65.6% were female. Also, 14.4% of the farmers were between the ages of 31and 40 years old, 36.7% were between 41 and 50 years, 26.7% were between 51 and 60 years, while 22.2% were 61 years and above. The findings revealed that, a significant proportion of the farmers were between 41 and 50 years indicating that thefarmers were mainly middle aged who are in their economically active stage and as such, can undergo the stress and this has implication for productivity of the farmers. Furthermore, 26.7% of the farmers had no formal education, 33.3% had adult education, 22.2% of the farmers had primary education

while 6.7% of the farmers attained primary education and 11.1% received tertiary education. The findings show that a higher proportion of the respondents had adult education qualification (33.3%). Also, that a reasonable percentage (48.9%) of the farmers had 6 to 10 members in their households. About 32.2% of the farmers were single, while 67.8% of the farmers were married. It was also found that 32.2% of the farmers were members of cooperative societies while 67.8% were not. Since majority were not members of cooperative societies, their access to farm resources like agro-inputs, credits and even extension contact might be lean and this would not encourage adoption. The study also revealed that 56.7% of the respondents had 6 to 10 years farming experience, 42.2% have been visited by extension agents, while 57.8% were not visited by extension agents. About 44.4% of the farmers know about organic farming practices through friends/relatives/ neighbors, 27.8% of the farmers know about the practice through extension visit, 7.8% of the farmers got to know about the practice through radio, 4.4% got the information through television, while 7.8% of the farmers got to know about organic farming through the newspaper.

Bhutia*et al.* (2017) in their study revealed that majority of the respondents were women (89%). The percentage of women within the middle age group i.e. 31-50 years were the highest (55%) followed by old age (18%) and young age group (15%). Similarly, in male, the percentage of middle age group was higher than the other groups. Looking into the educational status, 60% of the respondents were illiterate and only 13%, 19%, 5% and 3%have passed primary, high school, intermediate and graduation, respectively. As far as landholdings were concerned, majority of the respondents were marginal farmers (72%) followed by small (19%) and medium (9%). It was also observed that 87% of the respondents had joint family structure while 13% had nuclear family structure.

2.11 Empirical Review of Literature on Crop-livestock Integrated Practices

Ugwumba*et al.* (2010), in their study on integrated farming system and its effect on farm cash income in Awka South Agricultural Zone of Anambra State, revealed that all the farmers practiced one form of partial integration with majority (47.6%) engaging in crop-livestock integration (29.76%) of the farmers incorporated catfish farming into their agricultural system and are thus practicing crop-fish-livestock integration. Other types of partial integration patronized by the remaining farmers as revealed by the study are livestock-fish integration (11.90%), crop-fish integration (9.52%) and crop-livestock-agro processing (1.19%). The study further revealed that IFS is a viable system in the area.

Vinod *et al.* (2012) in their study on integrated crop-livestock farming systems, found out that crop-livestock integrated system helps to; reduces erosion, increases crop yields, soil biological activity and nutrient recycling, intensifies land use, improving profits and can therefore help reduce poverty and malnutrition and strengthen environmental sustainability. The waste products of one component serve as a resource for the other. For example, manure is used to enhance crop production while crop residues are used to feed the animals. Crop residues can be used for animal feed, while livestock and livestock by-product production and processing can enhance agricultural productivity by intensifying nutrients that improve soil fertility, reducing the use of chemical fertilizers. A high integration of crops and livestock is often considered as a step forward, but small farmers need to have sufficient access to knowledge, assets and inputs to manage this system in a way that is economically and environmentally sustainable over the long term (Vindo*et al.,* 2012).

Iyiola-Tunji*et al.* (2015) in their study evaluated the level of access to knowledge, farm assets and inputs utilization in crop-livestock integration systems (CLIS) among rural farm

families at National Agricultural Extension Research and Liaison Services adopted villages. A total of 120 farm families were interviewed through structured questionnaire. Forty farm families were randomly chosen from two adopted villages each in South West, North Central and North West zones of National Agricultural Extension Research and Liaison Services. The data obtained were analyzed by frequency counts, percentages, means and standard error of the means. The results showed, among others, that 95.8% of farmers interviewed were aware of crop livestock integrated systems. Mixed cropping (70%) was majorly practiced. Cereals were cultivated at higher rates (88.3%) in all the agro-ecological zones. Poultry ranked highest (54.2%) among all the livestock being kept by the farmers. Farmers at NAERLS adopted villages practiced crop-livestock integrated systems at subsistent level based on their indigenous knowledge and technology. The study did recommend that, existing practices of crop-livestock integrated systems by farmers at NAERLS adopted villages should be packaged into a model that can encourage profitability and sustainability of integration of crops and livestock (Iyiola-Tunji*et al.*, 2015).

Chianu*et al.* (2007) in their study, crop-livestock integration in the savannas of Nigeria: Nature and Determinants of farmers decision to use manure for soil fertility maintenance revealed that 86% of the farmers indicated some interaction between crops and livestock, although the interaction is weak, manure is inadequately provided, only 56% of the farmers applied manure (40-67% of requirement) to their largest upland plot. The study revealed that the result of the logist model indicate that farmers' characteristics and perception are the most crucial factor. The study recommended the promotion of crop-livestock integration and the use of manure for fertility maintenance in the savannas of Nigeria and similar ecologies.

Ezeaku*et al*. (2015) in their study on integrated crop-livestock farming system for sustainable agricultural production in Nigeria found that integrated crop-livestock is advocated to be very promising in boosting food productivity and soil fertility in Nigeria owing to its numerous synergistic benefits as outlined in their study. Particularly, the system will be very suitable in the savannah regions of the country where livestock production is predominant. Although the nature of crop-livestock integrated system has been in existence in these regions, it is typically cereal based-livestock system resulting in perennial depletion of soil fertility. Introduction of legumes into the system to form cereal-legume-livestock system can function as a key integrating factor through improvement of soil fertility, provision of healthy protein in the human diet and fodder for livestock consumption. The study showed that incorporation of cowpea into the nature of crop-livestock integration system, will in greater measure increase the overall food productivity, ensures sustainability of the soil fertility and substantially improves the income of the farmers in the country (Ezeaku*et al.,* 2015).

2.12 Empirical Review of Literature on Food Security Status of Farmers

Ojeleye (2015)analyzed farm households and community food security in Kaduna State, Nigeria, by purposefully choosing two of the four agro ecological zones of the state's ADP; and the random choice of four LGAs and eight communities. The analytical tools used include descriptive statistics, Food Security Index (FSI). Multiple regressions (Tobit), Community Food Security Assessment Toolkit and Coping Strategy Index. Data were collected using structured questionnaire administered to 244 farmers and the sue focus groups. The result of the analysis revealed that only 41% of the respondents had experienced food shortage in the last five years occurring mostly between July and August. Furthermore, the FSI of household obtained showed that 66% of the respondents were able to meet the daily calorie intake of 2260kcal per capital.

Ahmed *et al.* (2015) measured food security status among farming households across the three agro-ecological zones of Borno State, Nigeria. Well-structured questionnaire was used to source information from 120 randomly selected households. Descriptive statistics, Cost-of-Calorie Function (COC) and Logit model were used to analyze the data. The result of analysis indicated that about 81% of the respondents were males, 48% of the respondents fell within the active work-age bracket of 31 – 40 years, about 57% had informal education and about 47% had an estimated monthly income of between N100,000-N149,999. About 40% of the households were food secure and the model revealed that 11 of the 12 independent variables were significant at 1% and 5%. The Logit analysis revealed that the major determinants that positively influenced food security in the study area were gender, age, level of education, cooperative membership, and extension agents' contact, farming experience, access to credit, income, and farm size while household size and child dependency ratio negatively influenced food security. Food diversity result showed that about 57% belong to the low food diversity group.

According to Muche*et al.* (2014) education status of household head, family size, numberof oxen owned and use of farm input are the determinants of household food security. Terefe, (2013) in his study on household food security in Ethopia Identified household size, livestock ownership, farm size, access to market and technology adoption as the determinants of household food security while Kahsay and Mutugera (2014) in their study on determinants of rural household food in Thigray, Ethiopia found out that age of household head, use of improved seeds and land size have positive relationship with food security.

Misgina (2014) carried out a study on rural household food security status and its determinant; the case of LaelaymychewWoreda, central zone of Tigrai, Ethiopia. The data were randomly from three kebeles of 125 rural households. The data collected were analyzed using descriptive statistics and econometric model (logit model). The study showed that 31.2% and 68.8% of the sampled household were food secured and food insecure respectively. The model results revealed total cultivating land holding size, total livestock holding, total annual income per Adult equivalent and use of chemical fertilizer were found positively related and statistically significant to food security status in the study area. Similarly, family size of the household was also found negatively related and statistically significant to food security status of the rural household.

Victoria and Benjamin (2012) analyzed the food security situation among Nigerian rural farmers. Data collected on 202 farmers from Benue State were analyzed using descriptive and inferential statistics. A muli-stage random sampling technique was used for sample selection. 60.83% 0f the respondents had medium dietary diversity. The most commonly used coping strategies during food stress included, intercropping 99.2%, reliance on less preferred food 98.1%, and limiting portion size at meal time 85.5% and crop diversification 70.8%. Food secured household are above the food security line by only 4% while the food insecure household are below the food security line by 14%. 67.5% of the respondents are food secure while 32.5% are food insecure.

2.13 Empirical Review of Literature on Factors Influencing Farmers' Food Security

Keku (2017) in his study 'Analysis of Food Security and Coping Strategies of Rural Farm Households in Kaduna State', revealed that membership to cooperative society, access to credit, farm size and non-farm income was positive and significantly influenced the food security status of the farming household. The result of his study was in line with the

findings of Pappoe, (2011), who found that access to credit improves the food security status of farming households among bio-fuel producers.

Jemal and Kyung-Ryng(2012), examined the determinants of food security among rural households in Ethiopia using data from the latest round of Ethiopia rural household survey. Two measures of household food security (a self-reported food security status and a multi-dimensional index generated based on principal components analysis- PAC) were used. Ordinary least square regressions were first run to identify important determinant based on the two measures, disregarding endogeneity problems. Then instrumental variable (IV) estimation was carried out to account for endogeneity issues. The results revealed that age and education of household head, adequacy of rainfall, livestock possession, participation in off-farm activities, soil conservation practices and per-capital consumption expenditure strongly and positively influencedhousehold food security, while access to credit and remittance had a negative influence. The study went further to reveal that 51.8% of the household are relatively food insecure, i.e, less food secured. Also farmers with larger livestock possession positively contribute to household food security. Similar findings have been reported for Ethiopia in Beyene and Muche (2010).

Omoteshoet *al.* (2006) identified the determinants of food security among rural households in Kwara State. Data were collected from 165 rural farming households, using a three-stage random sampling technique. Descriptive statistics and logistic regression model were used to analyze the data. 66% of the rural farming households were food insecure and that farm size of the households, gross farm income, total nonfarm income and household size are the significant determinants of rural household food security in the study area.

Abdullahiet *al.* (2016) in their study; determinants of food security status among rural farm household in North-western Nigeria, examine the factors affecting food security

status among rural Farm farmers in Kaduna state, Nigeria. Interview guides were employed to elicit information from randomly selected 180 respondents from 12 agricultural villages from two agricultural zones of Kaduna State. The result of the logit regression model shows the factors that determine the food security status of the respondents in the study area. The determinants of food security in the study area were educational level and household size of the respondents out of the seven variables included in the model. The study recommended, that Imparting more knowledge to farmers should be encouraged by the government, recruit more extension workers and give them adequate trainings and provide them with necessary and sufficient working materials so as to educate more farmers to boost their agricultural production activities.

2.14 Empirical Review of Constraints of Crop-livestock Integrated Systems

Bhutia*et al.* (2017), in their study of the constraints analysis in the crop-livestock farming system of small and marginal farmers of Bihar, revealed that the foremost problem in crop production was non availability of quality seed/planting material (88.99%) followed by high cost of inputs, high incidence of pest and diseases, smaller and fragmented landholdings and scarcity of farm credit. In case of livestock production, infertility problem in cattle which has been ranked first (85.40%) followed by lack of knowledge about scientific management practices, non-availability of improved breeds, lack of green fodder and lack of knowledge on balanced feeding.

Daljit (2016) in his study on ‘economic dimension of crop-livestock integrated system in sub-mountainous zone of Punjab’, identified low yields, poor quality seeds, animal menace, fragmented land, poor extension services, non-availability of processing units and poor connectivity to the market to be the major constraints in crop production and non-availability of high quality breeding bulls, high cost of treatment, incidence of

reproductive problems, high cost of feed and fodder, poor health care facilities, problem of disposal of unproductive animals to be the major constraints in livestock production

Amejo*et al.* (2018) in their study on integrating crop and livestock in smallholder production system for food security and poverty reduction in sub-Saharan Africa, did revealed that the major constraints of crop-livestock integration are infrastructural limitation and poor market access.

2.15 Theoretical Framework

2.15.1 Theory of food insecurity

The theory applied for this study is the theory of food insecurity. There are various theories used in and developed from the knowledge of the understanding of food insecurity. According to Nord, 2014, there are seven (7) predominant theories and they are: Neo-Malthusian theory which analyses food insecurity from the perspective of food production (Maisonet-Guzman, 2011). The techno-ecology theory, which sees food insecurity as being caused by the improper, inadequate or non-harnessment of technology and human ingenuity for the aim of solving food production problems (Peter, 2007; Merlet, 2007). The modernization theory, which sees food insecurity as being the result of the lack of will of countries to modernize their infrastructure, food production system, institutions, savings, and revamp/restyle their government as well as their educational system to one that solves problems rather than that, that studies problems (Scanlan, 2003). The dependency and world system theory which views food insecurity as a product world trade imbalance, food aid politicization and the extent to which development goals are pursued (Tausch and Heshmati, 2010). The urbanization theory, which proposes that the root cause of food insecurity is the uneven distribution of development between urban and rural areas. It believes that for food insecurity problems to be eliminated from the planet,

development in the rural area have to increase at a rate greater than the rate inherent in the urban areas (Raid and Hussin 2016; Drebold, 2017). The social stratification theory, which posits that food insecurity, is as a result of social stratification and the imbalance that comes as a result of that stratification (Jha, 2017; Safe, 2018). Lastly, the militarization theory, which sees food insecurity as being the result of food being used as a weapon of war and a provision of help bargaining tool (Scanlan, 2003).In the context of this study, the food insecurity theory on which this study is built, is the theory of techno-ecology, which sees food insecurity as being caused by the improper, inadequate or non-harnessment of technology and human ingenuity for the aim of solving food production problems.

2.16Theoretical Model

The various variables influencing crop-livestock farmers' food security at household level are represented in the theoretical model below. The socio-economic and institutional variables determine the status of the households' food securitystatus which could be secure or insecure, thus leading to the level of living of the households.

Independent Variables **Dependent Variable** **Expected Outcome**

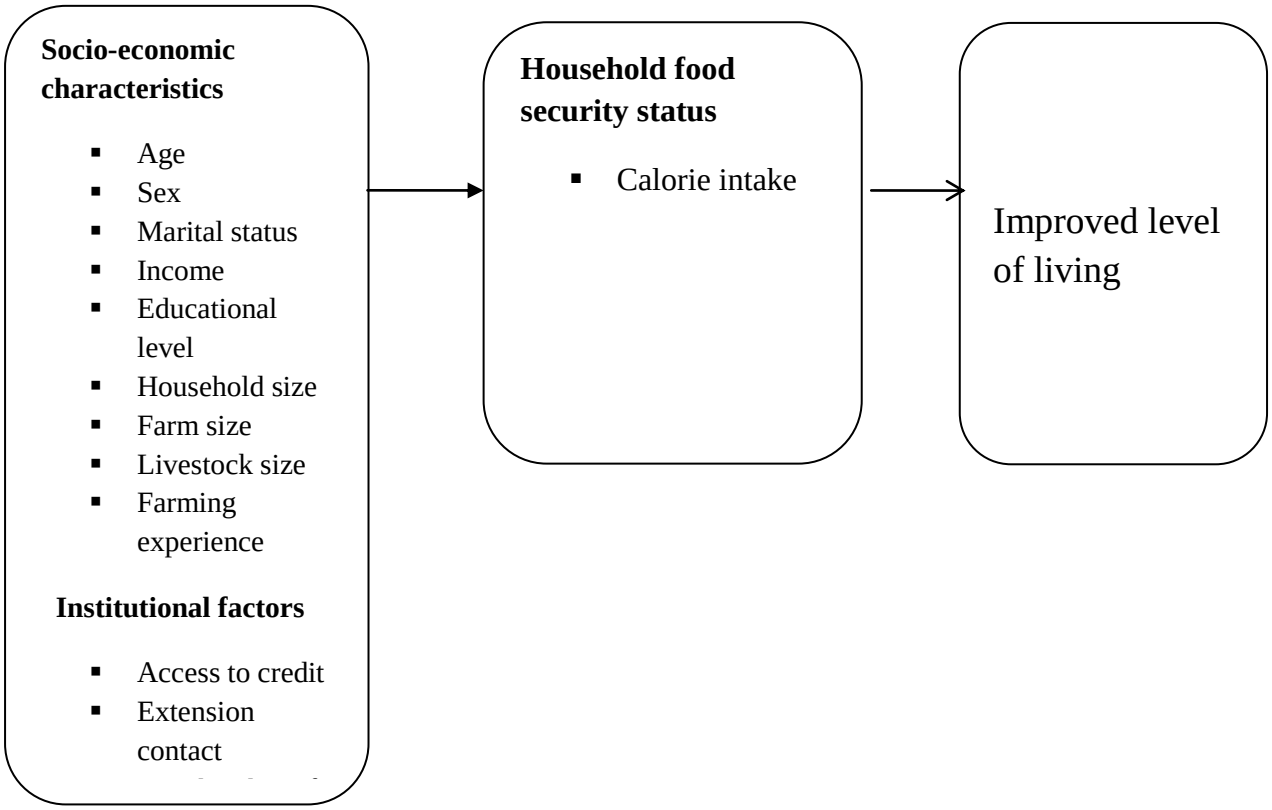

Figure I: The Theoretical model showing factors influencing crop-livestock farmers' food security status and its expected outcome.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

The study area is Kaduna State of Nigeria. The State is located in the Northern part of Nigeria's High Plains. Kaduna State lies between latitudes 10^0 31'20''N and longitudes $07^0$26' 17.81''E of the Green-Wich Meridian and comprises of Birnin-Gwari, Chikun, Giwa, Igabi, Ikara, Jaba, Jema'a, Kachia, Kaduna North, Kaduna South, Kagarko, Kajuru, Kaura, Kauru, Kubau, Kadan, Lere, Makarfi, Sabon-Gari, Sanga, Soba, Samaru-Kataf, and Zaria, Local Government Areas with a total land area of 46,053Km^2. These Local Government Areas are grouped into 4 Agricultural Development Programme(ADP) zones, namelyMaigana, Lere, Samaru-kataf and BirninGwari zones. According to the 2006census, the total population of the State was estimated at 6.1 million with an average density of 137 persons per square kilometer.The projected population of the State in 2019 is about 9.1million, based on an annual growth rate of 3.2% (National Population Commission, 2016). The climate of the State is characterized by two distinct seasons; the rainy and dry seasons. The rainy season lasts from May to September with average rainfall of between 600 mm to 1000 mm. (Kaduna State Ministry of Economic Planning, 2013).

High temperatures are normally recorded between the months of April and September. The average daily minimum and maximum temperatures are 15^0Cand 35^0C. The vegetation cover is Sudan Savannah type, characterized by scattered short trees, shrubs and grasses. The soil is mostly loamy to sandy type. A substantial amount of clay is found also. The climate of the area favours the production of crops such as maize, beans, groundnut, guinea corn, millet, cotton, yam, carrot, sugarcane, tomatoes, pepper, onions garden eggplant, lettuce, amaranthus and tobacco. The state is also known for livestock

production activities such as cattle, goat, sheep, poultry, and fisheries (Kaduna State Ministry of Economic Planning, 2013).

In Kaduna State where environmental and macroeconomic conditions are unfavorable, poor rural farming households have been facing significant food deficits and limited livelihood options. About 80 percent of the state's population is engaged in peasant farming, producing both crop and livestock (Kaduna Agricultural Development Project, 2014). Employment opportunities, such as construction work and transportation, have been adversely affected by water shortages, fuel scarcity, and high prices, and as a result, poor households are now limited to casual agricultural labour and reliance on remittances (Adebayo *et al.,* 2012). This results in their inability to meet basic food needs due to financial constraint (Esew, 2016). In addition, while the cash income of poor households is deteriorating, their expenditures are increasing due to high food prices and seasonal farming expenses. Thus, Kaduna State is facing worsening food insecurity, as noted by FAO (2017), this is due to the continual herdsmen – farmers clash, and this has led to a high incidence of malnutrition related diseases, which not only undermine health, but hinders agricultural production in the region.

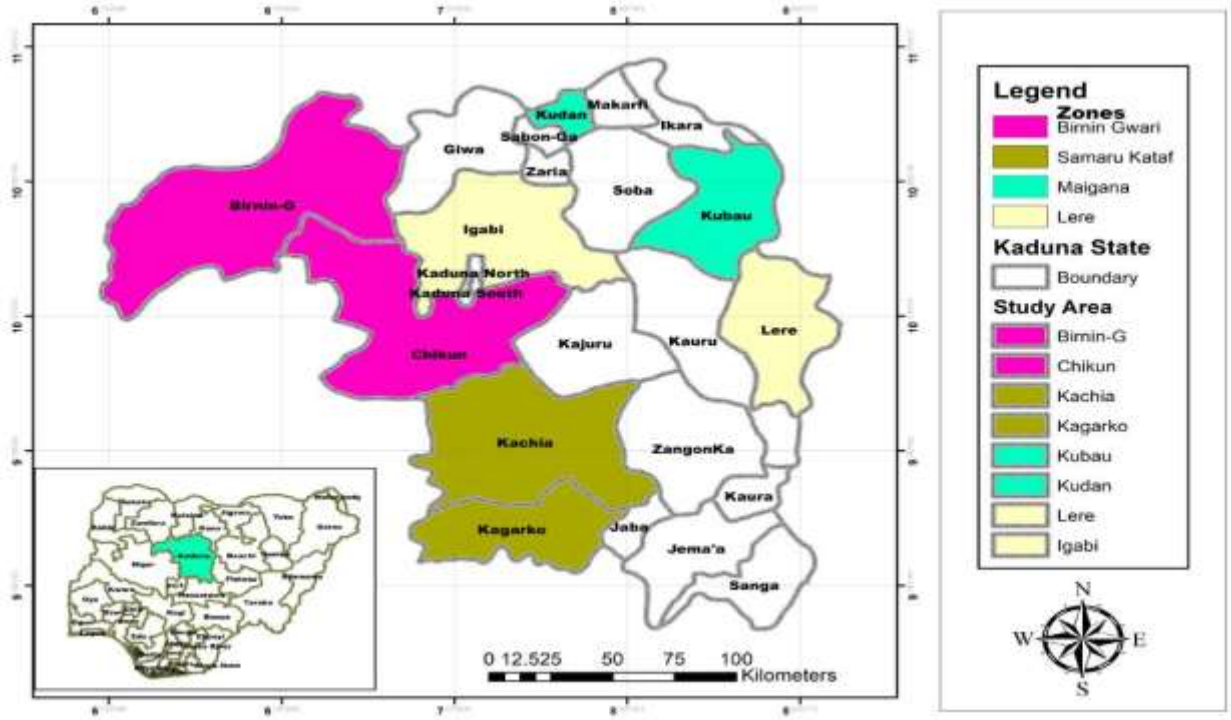

Figure II: Map of Kaduna State, Showing the Study Areas.

3.2 Sampling Procedure and Sample Size

A multi-stage sampling techniquewas employed in selecting farming households in the study area for data collection. KadunaState is divided into four (4) agricultural zonesviz:.Maigana, Lere, Samaru-Kataf, and BrininGwari zones. The first stage involved random sampling of two Local Government Areas (LGAs) form each of the zones.The randomly selected LGAs are Kudan, Kubau, Lere, Igabi, Kachia, Kagarko, BirinGwari, and Chukun, making a total of eight Local Government Areas. The second stage was the random selection of two villages from each of the selected Local Government Areas.

Finally, using Yamane (1967) slovinformula, (as applied by Abdurahman*et al.*, 2016) the sample size based on an assumed 5% margin of error, 95% confidence and applying finite correction factor was determined, from the list of rural farmers obtained from Kaduna State Agricultural Development Programme (KADP) during a recognizance survey in 2018.

The Slovian formula is given as:

$$n_0 = \frac{N}{1+N\ (e^2)}$$

Where: n_0 = sample size; e = 0.05; N = total number of observations. Therefore:

$$n_0 = \frac{N}{1+N(e^2)}$$

$$n_0 = \frac{3526}{1+3526\ (0.05 \times 0.05)}$$

$$n_0 = \frac{3526}{1+8.815}$$

$n_0 = \frac{3526}{9.82}$ = 351. Therefore, n_0 = 351 i.e. 351/ 3526 X 100 = 9.95 = 10% of the sample frame.

A sampling size of n = 351 satisfies the central unity theory which asserts that, a sample size of at least n = 30 is large enough to ensure a normal distribution in the sampling process (Webster, 1995). It also satisfies Runyon *et al.* (1996) who found out that a sample larger than 100 has no appreciable gain in targeting a target population and also satisfies the stipulation of Ladele and Chah (2015) who recommended a sample size greater than n = 30 but less than n = 1000 for extension research purpose.

Table 1: Sampling procedure and sampling size

Zones	LGA Selected	Villages Selected	Sample Frame	Sample Size (10% of sampling frame)
MaiganakudanJaja	34	1		
Kwakwaren Manu	26	3		
KubauDamau	31	4		
Dutsenwai	25	1		
LereLereRamin Kura	15	3		
Kayarda	25	4		
IgabiFarakwai	16	2		
TurunkuTsohuwa	23	1		
SamaruKatafKachiaKatari	33	3		
Doka	17	1		
KagarkoJere	28	2		
Kasiri	14	4		
Birnin-GwariBirinGwariUdawa	25	2		
Dogondawa	12	1		
ChukunMarabanrido	11	1		
Buruku	16	3		
Total			**3526**	**351**

Source: Recognizance Survey (2018)

3.3 Method of Data Collection

Primary data was used for the study. The data were obtained through the use of a questionnaire instrument administered to 351 household heads. The researcher and well trained enumerators from Kaduna State Agricultural Development Agency (KADA) were involved in data collection. The instrument was first subjected to content validation by the Supervisors and a pre-test of the validity of the questionnaire was also carried out. The data collected during the field survey include socio-economic characteristics,data on crop-livestock integrated farming systems, and farming household food consumption for determining the various dimension of food security.

3.4 Analytical Technique

The analytical tools that wereused to achieve the research objectives include descriptive statistics, food security index andprobit regression model.

3.4.1 Descriptive statistics

Descriptive statistics such as frequency, mean, range and percentages were used to describe the socioeconomic characteristics of farmers, identify the nature of crop-livestock integrated system practice by farmers in the study area, identify the level of living of farmers in the study area andidentify the constraints of crop-livestock integrated farming system in the study areaas stated in objectives (i), (ii), (v) and (vi).

3.4.2 Food security index

Food security index wasused to achieve objective (iii) of this study. In order measure household food security status, a food security index was constructed. Thisinvolved two steps: identification and aggregation. Identification is the process of defining a minimum level of nutrition necessary to maintain healthy living – the "food security line" for the population under study, below which households are classified as food insecure. Aggregation on the other hand derived food security statistics for the households. Household calorie availability was estimated using food nutrient composition of Oguntona and Akinyele (1995). The nutrients content of both produced and purchased food item are used to derive calorie availability. A daily recommended level of 2260kcal per capita per day defines the food security line used in this study. The nutrient content of produce wasused to derive the calorie availability following the study ofOlayemi, (1998) and Olorunsanya*et al.* (2012). It is stated as

$$Z = \frac{K}{R} \text{----------(1)}$$

Where:

Z = Food Security Index

K = Per capita calorie available to a household per day

R = Recommended per capita calorie intake per day

For this study, a household is defined as a group of people living together and eating form the same pot. Thus, a household is said to be food secure if its calorie food intake is more than or equal to Z, several food security measures were calculated as follows:

The short fall or surplus index, P, which is given as:

$$P=\frac{1}{m}\sum_{j=1} G_j \text{---------- (2)}$$

Where m = number of households that are food secure (food surplus index) of food insured (food shortfall index). It measures at the aggregate level, the extent at which the household are below or above the food security.

$$G_j=\frac{Xj-R}{R} \text{---------- (3)}$$

Gj = is the deficiency or surplus faced by jth household

X_j= is average calorie available to the jth household

R = as defined above

The Head Count Ratio (H) is defined as:

$$H=\frac{M}{N} \text{---------- (4)}$$

M = Number of food secure household

N = Sample population

3.4.3 Z-statistics

$$Z=\frac{\overline{X_1}-\overline{X_2}}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} \text{---------- (5)}$$

Where

Z =calculated z-value

$\overline{X_1}$ = mean of food secure

$\overline{X_2}$ = mean of food insecure

S_1 = Standard deviation of food secure

S_2 = Standard deviation of food insecure

n_1 = number of food secure

n_2 =number of food insecure

3.4.4Probit model

The probit model will be employed to achieve objective (iv), which is to analyze the factors influencing crop-livestock farmers' food security status in the study area. Probit model is specified implicitly as;-

$Y = \sum \beta_0 + e_i$ ---------- (6)

Where, Y = Food security status (1, for food secure households; 0, for food insecure households) X_1-X_{12} = Vector of explanatory variables (predictors)

$\beta_1 - \beta_{12}$ = Coefficients

β_0= Constant

e_i= Error term

Probit Model is specified explicitly as:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + ei$---------- (7)

Y = Food security status (1, for food secure households; 0, for food insecure households)

X_1 = Age (years)

X_2 = Marital status (Married = 1, Single = 0)

X_3 = Sex (Male = 1, Female = 0)

X_4 = Income (Naira) per year (both farm income and non-farm income)

X_5 = Education (Number of years of formal education)

X_6 = Household size (number)

X_7 = Farm experience (years)

X_8 = Farm size (hectare)

X_9 = Herd size (tropical livestock unit)

X_{10} = Amount of credit obtained (Naira)

X_{11} = Extension contact (Number of contacts per year)

X_{12} = Membership of cooperative (years)

3.5 Definition of Variablesused in the Analysis

In this study, the cross-sectional data needed for econometric analysis and the information that is specifically required were collected from farmers. Variables on which data were collected include socio-economic characteristics, crop-livestock integrated system activities, institutional factors and food security.

3.5.1Independent variables

i. **Age of household head:** This was measured by the number of years an individual had attained from birth at the time of questionnaire administration. The age of household head was expected to impact on his or her labour supply for food production. Young and energetic household heads are expected to cultivate larger farms and keep more livestock compared to the older and weaker household head. It also determines the ability to seek and obtain off-farm Jobs and income which younger household heads can do better. Arene and Anyaeji, (2010) on the other hand, found older household heads to be more food secure than the younger household heads. Hence the expected effects of age of household head on food security could be positive or negative.

ii. **Sex:** This is the classification of the respondents according to biological sex into either male or female. It was measured with the use of dummy by allocating one

(1) to male and zero (0) for female. Sex of household head looks at the role played by the individuals in providing households needs including acquisition of food. Female headed households have higher dependency ratios which hinder household capacity to allocate labour to on-farm or other income generating activities. Also female headed household tend to be older and have fewer years of education than male heads of household (FAO, 2012). The expected effect of this variable is positive.

iii. **Marital status:** This is a condition or state of being married or unmarried as indicated by the respondents. Dummy was used for measurement of the variable thus: married = 1, single = 0.

iv. **Income:** This was measured by the sum of earnings of household from both off-farm and on-farm sources. The more household head engage in gainful employment, the higher his/her income and the greater the chances of being food secure. The income is expected to increase household's food production and access to more quantity and quality food (Babatunde*et al.*, 2007).

v. **Education level:** Education is generally considered an important variable that could enhance farmer's acceptanceof new technologies. Ogunbameru (2001) posited that education was likely to enhance the adoption of modern farm technologies by youth and thereby sustaining a virile farming population. Level of education was measured by number of years spent in formal education.No formal education =0, adult education =1, primary education =2, secondary =3, tertiary education =4. It is expected that the higher the level of education attained by a farmer, the more he would be receptive to modern technologies and innovation, thereby increasing his level of food security.

vi. **Household size:** This was the total number of people in the house which include the wives, children and dependents that resided within the same house. Since food requirements increases with the number of people in the household and also because land and finance to purchase agricultural inputs are limited, increasing family size, according to Brown (2004), tends to exert more pressure on consumption than the labour it contributes to production. However, larger households are expected to have more hands to supply manual labour which is important in small scale production. The estimated coefficient of household size is expected to have positive sign on food security.

vii. **Farming experience:** This was measured by the number of years spent in crop-livestock farming business. It is expected that, as the number of years of farming increases, the level of food security of the household increases. It was measured by estimating the number of years the respondents has spent on farming enterprise.

viii. **Farm size:** Farm size was the total area of land cultivated to food and cash crops by households measured in hectares. The larger the farm size of the household, the higher the expected level of food production, it is therefore, expected of a household with a larger farm size to be more food secure than a household with a smaller farm size. Hence the expected effect on food security would be positive. Farm size in the context of this research work refers to the land area that was actually used for crop-livestock production during the survey year

ix. **Livestock size:** This was measured as the number of livestock kept by the respondents during the production year. The more animals kept by the farmer, the higher the expected level of food production. It was therefore expected that households with more livestock, would have more marketable surplus thereby being food secured.

x. **Credit:** This refers to amount of money received from either formal or informal credit sources. It was measured as the actual money/credit borrowed. Credit is a very strong important factor that is needed to acquire or develop farm enterprise (Ekong, 2003). This was measured as the actual amount received in naira. The estimated coefficient of credit obtained is expected to have positive effect on the household food security. Household that have received some credit in the last one year were coded = Yes and = No.

xi. **Extension contact:** Agricultural extension service constitutes a driving force for any meaningful agricultural development. The relationship between agricultural extension agent and the farmer is an important determinant in improving yield and income, of the farmers as well as in ensuring food security (Chikezie*et al.,* 2012). It was measured in terms of number of visits made by or to extension agents/ agencies. The estimated coefficient of extension contact is expected to have positive sign on the household food security.

xii. **Co-operative membership:** Farmers that belong to a co-operative society are likely to adopt new technology more easily than those not in any co-operative. They contribute to the dissemination of new ideas, practices, and products as well as in sourcing for loans and farm input (Chikezie*et al.,* 2012). Thus influencing the attitude of members towards food security. The estimated coefficient of cooperative membership is expected to have positive effect on the household food security. Membership of cooperative was measured as: = Yes and = No.

3.5.2 Dependent variable

i. **Household food security status**

Food security was measured by per capital calorie available to a household per day. A food secure household is defined as one whose calorie supply per day is greater than or equal to the minimum daily calorie requirement of 2260 Kilocalories (FAO, 2011). Household with low calorie intake was considered to be food insured. Food quantities consumed at the household level in a day was converted to calories using the available food consumption Table in Appendix I. Resulting calorie values was divided by the number of adult equivalent in the households, in order to obtain numbers that are comparable across households of different size (Maxwell *et al.,* 2000).

$$Z = \frac{K}{R} \quad \text{---------- (1)}$$

Where:

Z = Food Security Index

K = Per capita calorie available to a household per day

R = Recommended per capita calorie intake per day

3.5.3 Expected outcome

i. Level of living

Level of living is one of the important indicators of social status. Level of living refers to material and impersonal resources with which individuals can master and command their living condition. In this study, level of living score was computed for the surveyed farmers based on the durable assets listed in the questionnaire acquired and possessed by an individual farmer as a result of crop-livestock integrated system. The durable items were: (a) cars (b) bicycles (c) motorcycles (d) radios (e) televisions (f) mobile phones (g) water pumps (h) animal traction (i) tractors (j) generatosr (k) land (l) fridges (m) beds (n)

cushions (o) chairs (p) watches and average amount of money spent on household food, health and children's school fees in 2018

Each item was given monetary value based on its current market value in 2018. The monetary value of each item was multiplied by the total number of the same item possessed by the individual farmer. The products for all the items possessed were summed up to give the individual farmer's level of living score.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Crop-Livestock Farmers

The socio-economic characteristics of crop-livestock farmers in the study area were described in detail. These provide information on the socio-economic variables that can potentially influence the food security status of crop-livestock farmers in the study area. The socio-economic variables considered are: age, sex, marital status, education, household size, farm size, years of experience, cooperative membership, access to credit, access to extension services and in the study area.

4.1.1 Age of the farmers

Table 2 shows the age distribution of the respondents. Most (32%) and (27%) of the farmers were within the age bracket of 27-37 and 38-48 years respectively. On the other hand 19% and 14% of the farmers were within the age bracket of 16-26 and 49-59, respectively. Also 8% of the farmers were within the age bracket of 60 years and above. This implied that most of the farmers were within the economically and productive age, as such were able to bear the rigor of crop-livestock production activities. This is in line with the findings of Ojeleye*et al*. (2015) who in their study on assessment of farm household food security and consumption indices in Nigeria, opined that farmers were within their productive age. Also Adesope*et al*. (2012) in their study on the effect of socio-economic characteristics of farmers on their adoption of organic farming practice asserted that farmers were within the age bracket of 30-50, and Bhutia*et al*. (2017) in their study on constraints analysis of small and marginal farmers of Bihar revealed that crop-livestock farmers were within the age bracket of 31-40 years.

Table 2: Distribution of farmers according to age

Age (years)	Frequency (f)	Percentage (%)
16-26	66	19
27-37	113	32
38-48	96	27
49-59	49	14
60 and above	27	8
Total	351	100
Mean	38	
Minimum	16	
Maximum	73	

4.1.2 Sex offarmers

Majority of the farmers (87%) were male while (13%) were female. The predominance of male actors in the study area is attributed to the fact that majority of the household heads interviewed are male. This result disagrees with the findings of Adesope*et al.*(2012) who in their study on the effect of socio-economic characteristics of farmers on their adoption of organic farming practice and Bhutia*et al.* (2017), who in their study onconstraints analysis of small and marginal farmers of Bihar in India,revealed that majority (65.6%) and (89%) respectively of crop-livestock farmers were female.

4.1.3 Marital status of the farmers

The higher proportions (85%) of farmers were married, while (15%) were unmarried (either single, widow or widower). This implies that about 85% of farmers interviewed in the study area have family responsibilities, which shows that majority were married and could have children who would help in various farm operations. Marital status may influence the size of household as married farmers may have larger household size which may encourage them to participate in agricultural production in order to raise their income and improve their food security status. This finding agrees with that of Keku, (2017) who in his study on analysis of food security and coping strategies of rural farm household in

Kaduna State, asserted that majority of the farmers were married.Also,Saleh and Mustafa, (2018) in their study on food security and productivity among urban framers in Kaduna State, reported that a high proportion of the farmers were married

4.1.4 Educational level of the farmers

Table 3 shows the educational distribution of farmers. Most of the farmers(38%), (34%) and (21%) had primary, tertiary and secondary education respectively, while (7%) had no form of education. This implied that majority of the farmers were literate, having attained one stage of formal education or the other. Also the result implies that the farmers could easily adopt and adapt to new innovations and technologies introduced to them to help increase their productivity,income and food security status. Educational attainment is very important because it could lead to awareness of modern farming techniques. This findingis in agreement with Keku, (2017) who in his study on analysis of food security and coping strategies of rural farm household in Kaduna State and Bhutia*et al.* (2017) who in their study on constraints analysis of small and marginal farmers of Bihar, in Indiarevealed that majority of crop-livestock farmers had one form of education or the other. Education would enhance farmers' ability to make informed and accurate decisions in the management of farms.

Table 3: Distribution of farmers by their educational levels

Educational level	**Frequency (f)**	**Percentage (%)**
Non-formal	25	7.12
Primary	133	37.89
Secondary	74	21.08
Tertiary	119	33.90
Total	**351**	**100**

4.1.5 Family size of the farmers

Table 4 shows the distribution offarmers according to family size. Most (67%) of farmers had family size of 1-8 persons, 24% had family size of 9-16 persons, while a few (7%) and (2%) hadfamily size of 17-24 and 25 and above respectively. In general, the average household size was 8 persons per household and this implies that farmers with larger household size were likely to have more family labour supply for their crop-livestock activities such as cultivating more lands and rearing more animals to increase productivity and income, with reduction in cost of labour. This finding is in agreement with the one reported byBhutia*et al*. (2017) who in their study on constraints analysis of small and marginal farmers of Bihar, in Indiaasserted that majority of the respondents had joint family structure with a few having nuclear family structure. Also itcorroborates with Ojeleye*et al*. (2015) who in their study on assessment of farm household food security and consumption indices in Nigeria asserted that large household size may provide the needed labour requirement for farming but their impact can be limited by the small farm cultivated.

Table 4: Distribution of farmers according to family size

Family size	**Frequency (f)**	**Percentage (%)**
1-8	236	67
9-16	83	24
17-24	25	7
25 and above	7	2
Total	351	100
Mean	8	
Minimum	1	
Maximum	50	

4.1.6 Farm size of the farmers

Table 5 shows the farm size distribution of farmers. Most (27%) and (25%) have farm size of 1.0-1.9 hectare and 2.0-2.9 hectares respectively, while (19%), (15%) and (14%) have

5.0 or more, 3.0-3.9 and 4.0-4.9 hectares respectively. In general the average farm land cultivated by farmers was 3.5 hectares.This implies thatfarmers had access to small farm size for crop-livestock integration, indicating thathouseholds were small scale farmers. This is in line with the findings of Saleh and Mustafa, (2018) who in their study on food security and productivity among urban framers in Kaduna State asserted that farmers had farm size of 3 hectares or more. Also Salau*et al.* (2017) who in their study on effect of cassava products consumption on food security of farming households in Kwara State, Nigeria reported that farmers operated at a subsistence level with a mean farm size of 4.8 hectares. According to Oyewole, (2012), food production can be increased extensively through expansion of area under cultivation. Therefore, under subsistence agriculture, farm size is expected to play a significant role in influencing food security of the rural farm household.

Table 5: Distribution of farmers according to farm size

Farm size	**Frequency (f)**	**Percentage (%)**
1.0-1.9	94	27
2.0-2.9	88	25
3.0-3.9	53	15
4.0-4.9	48	14
5.0 and above	68	19
Total	351	100
Mean	3.5	
Minimum	1	
Maximum	40	

4.1.7 Years of farming experience of thefarmers

Table 6 shows years of farming experience offarmers.Most (78%) of farmers had 1-11 years of farming experience, 14% of farmers had 12-22 years of farming experience, while (6%), (2%) and (1%) of farmers had 23-33, 34-44 and 45 and above years of farming experience. In general the farmers had an average year of farming experience of 8. This implies that most of the farmers have a good knowledge of farm innovationsand would be

able to make sound decisions as regards resources allocation on their farms. This is in line with the findings of Adesope*et al.* (2012), who asserted in their study on effect of socio-economic characteristics of farmers on their adoption of organic farming practices that majority of the farmers, had 6 to 10 years farming experience. Also Saleh and Mustafa, (2018) in their study on food security and productivity among urban framers in Kaduna Stateasserted that the mean farming experience of the respondents was 8 years. Framing experience is expected to influence agricultural production positively because the accumulation of skills overtime by experience farmers can make them combine different farming techniques which would improve their income level and food security status.

Table 6: Distribution of farmers according to years of farming experience

Experience in crop-livestock integration	**Frequency (f)**	**Percentage (%)**
1-11	273	77.78
12-22	48	13.68
23-33	22	6.27
34-44	6	1.71
45 and above	2	0.57
Total	351	100
Mean	8	
Minimum	1	
Maximum	60	

4.1.8 Income distribution of the farmers

Table 7 shows the income distribution of farmers in the study area. Farmers had income from both farming and non-farming activities.

The result revealed that many of the farmers had farm income less than ₦200, 000 per year.The reason for this relatively low income could be due to the fact that farm household usually satisfied their food needs before the excess are taken to the market for sales. Also the farmers-herdsmen clasheshad affected agricultural production in the study area. The average farm income of rural household in the study area was ₦426, 372.98 per annum.

This translates to a monthly farm income of ₦35, 531 which is higher than the approved national minimum wage of ₦30, 000 per month. The finding is consistent with Keku, (2017) who in his study on analysis of food security and coping strategies of rural farm household in Kaduna State,andSalau*et al.,* (2019) who in their study on effect of cassava products consumption on food security of farming households in Kwara State, Nigeria reported that majority of the farming household earned less than Two hundred and One Thousand Naira (₦201, 000) per annum respectively.

Household non-farm income is an important factor in household access to food. The result shows that the mean non-farm income for rural household in the study area was ₦278, 829.60 per year, which translates to a monthly non-farm income of ₦23, 236 and a daily non-farm income of ₦774.53.

Household non-farm income in the study area comes from formal and informal jobs such as education, health, construction, self-employment which include barbing, tailoring, bricklaying, hair dressing, hand-crafts, carpentry, trading, shoe-cobbling and driving.

Table 7: Distribution of farmers according to household income

Household sources of income	Frequency (f)	Percentage (%)
Farm income		
≤100000	100	28
100001-190001	42	12
190002-280002	54	15
280003-370003	37	11
370004-460004	38	11
≥460005	80	23
Total	**351**	**100**
Mean	**426372.98**	
Maximum	**5000000**	
Minimum	**15000**	
Non-farm income		
≤100000	234	67
100001-190001	16	5
190002-280002	27	8
280003-370003	24	6
370004-460004	7	2
≥460005	43	12
Total	**351**	**100**
Mean	**278829.60**	
Maximum	**1900000**	
Minimum	**10000**	

4.1.9 Cooperative membership of the farmers

Majority (53%) of the farmers were not members to any cooperative group, while 47%were members. This implies that Since majority were not members of cooperative societies, their access to farm resources like agro-inputs, credits and even extension contact might be lean and this would not encourage adoption of new farm innovation. This agrees with the findings of Adesop*et al*. (2012) who in their study on effect of socio-economic characteristics of farmers on their adoption of organic farming practices asserted that majority of farmers were not members of cooperative society. However, it contradicts the findings of Keku, (2017) who asserted in his study on analysis of food security and coping strategies of rural farm household in Kaduna State, that majority of the farmers

belonged to cooperative groups. Cooperative societies has the propensity to provide credit facilities to members since people come together to pool their resources so as to meet individual needs that could not be met by individual limited financial capacityKeku, (2017). Membership of co-operative afford farmers the opportunity of sharing information on modern farming practices. However, most of these associations were grossly underdeveloped and inactiveKeku, (2017).

4.1.10 Extension visits of the farmers

Majority (59%) of farmers had been visited by extension agents, while 41% had not.This implies that most of the farmers in the study area had access to new agricultural innovation and technologies, which in turn would help to boost their productivity, income and improve their food security status. This findings disagrees with the one reported by Saleh and Mustafa, (2018) who in their study on food security and productivity among urban framers in Kaduna State, opined that the rate of extension contact was low. Also Adesop*et al.* (2012) who in their study on effect of socio-economic characteristics of farmers on their adoption of organic farming practices asserted that extension agent visits to crop-livestock farmers was low.

4.1.11 Access to credit bythe farmers

Table 12shows the distribution of farmers according to their access to credit. Most (68%) of farmers had no access to credit, while 32% did. In general farmers'access to credit facilities in the study area was low. This implies that lack of access to credit by some crop-livestock farmers can constitute a constraint for adoption of improved technologies and management practices to enhance their crop-livestock integrated activities and improve their food security status. This non-access to credit facilities by some of the farmers may not be unconnected to the fact that many of the farmers do not belong to cooperative

society which is the major means of obtaining assistance either from Government or Non-Government Organizations (NGOs). This finding contradictsKeku, (2017) who asserted in his study on analysis of food security and coping strategies of rural farm household in Kaduna State, that majority of the farmers had access to credit facility. Ekong, (2003) asserted that credit was a very strong factor that was needed to acquire or develop any enterprise; its availability could determine the extent of production capacity.

Table 8:Distribution of farmers according to institutional factors

Factors	Frequency (f)	Percentage (%)
Cooperative membership		
Yes	164	47
No	187	53
Extension visits		
Yes	206	59
No	145	41
Access to credit		
Yes	113	32
No	238	68
Total	**351**	**100**

4.2 Nature of Crop-Livestock Integrated System Practiced by Farming Household

The nature of crop-livestock integrated system practiced in the study area was described in detail. This provides information on the nature of crop-livestock integration that can potentially influence the food security status of crop-livestock farmers in the study area. The nature of crop-livestock integrated variables considered are: type of cropping system practiced, species of livestock reared and nature of integration in the study area.

4.2.1 Cropping system practiced by the farmers

Table 9 shows the distribution of the type of cropping system practiced by farmers in the study area. Most (75%) of farmers practiced mixed cropping while 23%practiced sole cropping and 2% practiced relay cropping. In general mixed cropping is the most

practiced cropping system in the study area. This implies that farmers who practiced mixed cropping are able to harvest multiple crops in a farming season, which in turn would help the farmers to be food secured. This finding agrees with the findings of Amujoyegbe and Alabi, (2013) who in their study on cropping system analysis of two agro ecological Zone of Southwestern Nigeria, reported that mixed cropping and crop rotation was the prominent cropping systems among farmers in the derived savannah zone.

Table 9:Distribution of farmers on the types of cropping system practiced

Cropping system	**Frequency (f)**	**Percentage (%)**
Sole cropping	79	22.51
Mixed cropping	264	75.21
Relay cropping	8	2.28
Total	**351**	**100**

4.2.2 Species of livestock reared by farmers

Table 10 shows the distribution of the farmers on species of livestock reared. Majority (50.14%) reared goats, while (43.59%), (38.46%) and (32.48%) reared poultry, sheep and cattle respectively. Only a few (3.42%), (1.99%), (1.99%) and (1.14%)reared ducks, rabbits,pigs and donkeys respectively. In general livestock production was predominant in the study area, which shows that every farming household reared one form of livestock or the other. This finding agrees with that ofAdewumi*et al.* (2015) who in their study on rural farm families' probable acceptability of small ruminant's milk for consumption in Ogun State, asserted that majority of the farmers reared goat and sheep. It also agrees with Adefalu*et al.* (2013) who in their stud on the perceived causes of livestock involvement in road accident: threat to livestock production among women in Oyo State, Nigeria, reported that majority of the farmers reared poultry.

Table 10: Distribution of farmers based on the species of livestock reared

Species of livestock rear	Frequency (f)	Percentage (%)
Cattle	114	32.48
Sheep	135	38.46
Goat	176	50.14
Poultry	153	43.59
Swine	7	1.99
Rabbit	7	1.99
Duck	12	3.42
Donkey	4	1.14
Others	3	0.85

* Multiple responses allowed

4.2.3 Nature of integration in the study area

Table 11 shows distribution of the nature of integration in the study area. Most (45.30%) of farmers practiced cereal-legume-livestock integration, while 31% practiced cereal-livestock integration. 11% practice vegetables-livestock integration, 6% practiced legumes-livestock integration, 6% practiced root and tuber-livestock integration. A few (2%) each practiced forage and pasture livestock integration and other forms of integration respectively. In general the result showed that every farming household were involved in one form of crop-livestock integration or the other. This implies that crop-livestock integrated system was predominant in the study area. This findings agrees with the one reported by Iyiola-Tunji*et al*. (2015) who in their study on evaluation of crop-livestock system among farm families at adoption villages of the Nation Agricultural Extension and Research Liaison Services asserted that the farmers were capable of accepting the crop livestock integration system, since they were already practicing some form of mixed farming. They also reported that vegetables-livestock and forage-livestock integration were low reported by farmers all across the three agroecological zones studied.

Table 11: Distribution of farmers on the nature of integration

Nature of integration	Frequency (f)	Percentage (%)
Cereal-Livestock	107	30.48
Legumes-Livestock	22	6.27
Cereal-Legume-Livestock	159	45.30
Root and Tuber-Livestock	20	5.70
Vegetables-Livestock	39	11.11
Forage and Pasture-Livestock	8	2.28
Others	8	2.28

* Multiple responses allowed

4.3 Food Security Status of Farming Households

The food security status of farmers in the study area has been described in details. Food security index was used to determine the food security status of farming households based on their daily calorie intake. Table 12 shows the food security status of the farmers in the study area based on their average calorie intake and the recommended daily per capita calorie intake of 2260Kcal. The result shows that 21% of the farmers were food secured with an average daily calorie intake of 4325.13 kcalwhich is higher than the recommended daily per capita calorie intake, while 79% of the farmers were food insured with an average daily calorie intake of (1287.77kcal) which is lower than the recommended daily per capita calorie intake. This implies thatmajority of the farmers were food insecured.The food insecurity gap and surplus index which measures the extent of deviation from food security line shows that food secure households exceeded the calorie requirement by 91%, while the food insecure households fell short of the calorie requirement by 43%. This shows a gap between the food secure and food insecure households in the study area. The reason why majority of farming households in the study area were food insecure is as a result of the insecurity (constant farmers/herders clash, boko haram insurgence, banditry and kidnappings) which has hindered farmers from having access to the farm lands and displacing to many from their ancestry homes.This contradictsSalau, *et al.,* (2019) who in the study on effect of cassava products consumption on food security of farming

households in Kwara State, Nigeriareportedthat 72% of the farming household were food secure while 28% are food insecure, it also contradicts the findings of Ojeleye, (2015) who in his studyon analysis of farm household and community food security in Kaduna State, assertedthat the food security index of household obtained showed that 66% of the respondents were able to meet the daily calorie intake of 2260kcal per capital. However thefinding agreed with Misgina, (2014) who in his study on rural household food security status and its determinant: The Case of LaelaymychewWoreda, Central Zone of Tigrai, Ethiopia asserted that few of the sampled households were food secured while majority were food insecure. This result corroboratedthatofSaleh and Mustafa, (2018) who in their study on food security and productivity among urban framers in Kaduna State, reported that majority of the respondents in the study were food insecure.

Table 12Crop-livestock farmers'food security status in the study area

Statistical estimates	**Food secure**	**Food insecure**
Frequency	74	277
Percentage	21.08	78.92
Average daily calorie intake (kcal)	4325.13	1287.77
Maximum daily calorie intake (kcal)	9999.59	2242.8
Minimum daily calorie intake (kcal)	1056.07	453.4
Shortfall/surplus index (P)	0.91	-0.43
Head count ratio (H)	21	79
Standard deviation	2633.97	508.02
Recommended daily per capita calorie intake (Kcal)`	2260	

4.3.1 Statistical comparison between the food secured and food in secured households of Crop-livestock farmers

The result of the Z test as presented in Table 13 showed the statistical comparison between the food secure and food insecure households of Crop-livestock farmers. It reveals that the calculated z value (10.970) is greater than the table z value of 1.64 at one tail and 1.96 at two tail respectively and it is significant at 1% probability level. This implies that there

was a significant difference between the food secured and food insecured households of crop-livestock farmers.

Table 13: Estimate of z-test for food secured and food insecuredhouseholds

Parameter	Food secure	Food insecure
Mean	3.143	0.570
Known Variance	4.059	0.051
Observations	74	275
Hypothesized Mean Difference	0.000	
Z-value	10.970	
P(Z<=z) one-tail	0.000	
Z Critical one-tail	1.645	
P(Z<=z) two-tail	0.000	
Z Critical two-tail	1.960	

4.4. Factorsinfluencingcrop-livestock farmer's household food security status

The factors influencing the food security status of farmers in the study area wasanalyzed in details using probit regression model.The probit regression result shows that likelihood ratio is positive and significant at 1% probability level and this implies that crop-livestock integration farmers were food secured.

Age was found to havepositive and significantinfluence on the food security status of farmers at 1% level of probability. Implying that the older the farmers the more food securedthe households. This indicates that age increases the food security status among crop-livestock farmers by 7%. This finding is consistent with the one reported by Ahmed *et al.* (2015) who in their study on measurement of food security among farming household across the three agro-ecological zones of Borno State, reported that age positively and significantly influenced the food security status of farmers in the study area. Also Kahsay and Mutuger, (2014) in their study on determinant of rural household food security in Thigray Ethiopia, reported that age of household head, was positive and significantly influenced food security of the rural household.

Marital status was found to have negative and significant influence on the food security status of farmers' at 10% level of probability. This implies thata unit increase in size of household the more food insecure the household. This indicates that higher marital status decreases the food security status of crop-livestock farmers' by10%. This is in line with the findings of Akukwe, (2020), who reported in her study on household food security and its determinants in agrarian communities of southeastern Nigerian that marital status was negative and significantly influence the food security status of farming households at 5% level probability.

Educational level was also found to have negative and significant influence on the food security status of farmers at 1% level of probability. Implying that the less educated the more food insecure the household. The marginal effect indicates that educational level of respondent decreases the food security status of crop-livestock farmers' by 4%.This finding agrees with that of Djangmah, (2016) who in his study on comparative analysis of food security status of farming households in eastern and northern regions of Ghana asserted that food security decrease with increasing number of years spent in education in Northern region of Ghana. This finding disagrees with that of Akukwe (2020), who in her study on household food security in agrarian communities of southeastern, Nigeria, reported that educational level of household heads was positive and significant at 5% level probability. Also Abdullahi,*et al.* (2016), in their study on the determinant of food security status among rural farm household in North-western Nigeria, reported that one of the major determinant of food security was educational level of the household. Furthermore, Ahmed *et al.* (2015) reported in their studyon analysis of food security among farming households in Borno State, that one major determinant that positively influenced food security in the study area was level of education.

Family size was found to have negative and significant influence on the food security status of farmers at 10% level of probability. Implying that as household size decreases, food security status increases. The marginal effect indicates that family size decreases the food security status of crop-livestock farmers by 7%. This is in line with the findings of Salau*et al.*(2019), who in their study on effect of cassava product consumption on food security of farming households in Kwara state Nigeria foundthat household size had a negative coefficient that was significant at 5% level of probability.Also the result of this finding corroboratesMisgina (2014) who in his study on rural household food security status and its determinant inLaelaymychewWoreda, Central Zone of Tigrai, Ethiopia,assertedthat family size was found to be negative and statistically significant to influencing the food security status of rural household.This disagrees with the result obtained by Much*et al.* (2014) who in their study on determinants of household food security among southwest Ethiopia rural households asserted that family size positively and significantly influenced the food security status of farming household.

Crop-livestock experience was found to be negative and significantly influenced the food security status of farmers at 10% level of probability. This implies that the less experienced they were in the practice of crop-livestock integration the more food insecure the household. The marginal effect indicates that crop-livestock experience decreases the food security status of crop-livestock farmers by 5%. This contradictsManza, *et.al*, (2016), who in their study on the evaluation of food security status and profitability of farming household in Atyap Chiefdom, in ZangonKataf Local Government Area of Kaduna State, reported that year of farming experience was positive and significant at 5% level of probability. This finding is also dissimilar to the one reported by Ahmed *et al.* (2015) who in their study on analysis of food security among farming households in BornoState,

reported that one of the major determinants that positively influenced food security in the study area was farming experience,

Number of extension visits was found to be positive and significantly influenced the food security status of farmers at 1% level of significance. Implying that the more extension contacts the farmer had more food secure the household. The marginal effect indicates that number of extension visit increases the food security status of crop-livestock farmers' by 7.9%. This contradictsthe result obtained by Manza, *et.al,* (2016), who in their study on the evaluation of food security status and profitability of farming household in Atyap Chiefdom, in ZangonKataf Local Government Area of Kaduna State, reported that extension contact with farmers was negative and significant at 5% level of significance. This corroborated the findings of Ahmed *et al.* (2015)who in their study on analysis of food security among farming households in Borno Stateasserted that contact with extension agent was found to positively influence the food security status of farming households across the three agro-ecological zones of Borno State, Nigeria.

Amount of credit received was found to be negative and significantly influenced the food security status of farmers at 10% level of probability. Implying that the less amount of credit received the more likely food insecure was the household. The marginal effect indicates that amount of credit received decreases the food security status of crop-livestock farmers by 3%. This finding disagrees with the one reported by Ahmed *et al.* (2015) who in their study on measurement of food security among farming household across the three agro-ecological zones of Borno State, reported that one of the major determinants that positively influenced food security in the study area was access to credit. A dissimilar result was obtained from the finding by Keku, (2017) who in his study on analysis of food security and cropping strategies of rural farm households in Kaduna State reported that access to credit was positive and significantly influenced the food security

status of farming household. Furthermore, a similar result was obtained from the findings of Jemal and Kyun-Ryng (2012) who in their study on determinant of household food security in rural Ethiopia reported that access to credit was negative and statistically significant to influencing the food security status among rural household in Ethiopia.

Table 14: Estimate of probit regression of the determinants of food security status

Variable	Coefficient	Standard error	T-value	Marginal effect
Constant	0.91689	0.48989	1.872*	
Age	0.02612	0.00924	2.826***	0.0066
Marital status	-0.40115	0.22577	-1.777*	-0.1019
Educational level	-0.15794	0.05777	-2.734***	-0.0401
Family size	-0.02915	0.01749	-1.667*	-0.0071
Farm size	0.03859	0.02813	1.372	0.0098
Crop –livestock experience	-0.02030	0.01058	-1.918*	-0.0052
Years of membership of cooperative society	-0.02107	0.02534	-0.831	-0.0053
Number of extension visit	0.03099	0.01217	2.546***	0.0079
Amount of credit received	-0.00009	0.00006	-1.665*	-0.0034
Total household income	0.00006	0.00011	0.547	0.0058
Pseudo R^2	0.217			
LR $chi^2(10)$	41.83			
Prob> chi^2	0.0000			
Log likelihood	-158.30			

Note: *** and * significant at 1% and 10% levels of probability

4.4.1 Test of Hypothesis

H_0: Socio-economic and institutional factors have no significant influence on food security status of crop-livestock farmers in the study area.

Based on the result in Table 14, socio-economic factors(age, marital status, years of schooling, family size and crop –livestock farming experience) and institutional factors(number of extension visits and amount of credit received) significantly influenced the food security status of crop-livestock farmers in the study area. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

4.5 Level of living of farmers

Table 15 shows the level of living of crop-livestock farmers in the study area. In this study, level of living score was computed for the surveyed farmers based on the durable assets acquired and possessed by an individual farmer as a result of crop-livestock integrated system. Each item was given monetary value based on its current market value in 2018. The monetary value of each item was multiplied by the total number of the same items possessed by the individual farmer. The products for all the items possessed were summed up to give the individual farmer's level of living score. The result shows that most (48%) of the farmers level of living fell within ₦100, 001- ₦300,001, while (15%) and (14%) level of living fell within ₦300, 002 - ₦500,002 and less than ₦100,000 respectively. The mean level of living of crop-livestock farmers in the study was ₦410, 659.009. This finding when compared with the global poverty line which is set at $1.90 which has its equivalent of ₦ 693.5, showed that majority of the farmers in the study area lived above the poverty line. This is seen in the mean level of living of crop-livestock farmers which was₦ 410, 659.009, indicating that farmers in the study area have an average monthly income of ₦ 34,221.58 and an average daily income of ₦ 1,140.19. The result of this study disagreed with the findings of Global Poverty Statistics as asserted by Olawale, (2018) and Will, (2018) that 70% of Nigerians live below the poverty line. This implied that crop-livestock integration has helped to improve the level of living of crop-livestock farmers in the study area.

Table 15: Estimate of the level of living of farmers in the study area

Level of living score (₦)	Frequency	Percentage
≤ 100, 000	49	14
100, 001-300, 001	167	48
300, 002-500, 002	54	15
500, 003-700, 003	24	7
700, 004-900, 004	15	4
900, 005-1, 100, 005	10	3
≥1, 100, 006	32	9
Total	351	100
Mean	410, 659.009	
Standard Deviation	480915.731	
Minimum	₦ 46, 000	
Maximum	₦ 3, 178, 000	

4.6 Constraints of Crop-Livestock Integration

Table 16 reveals that majority (45%) of the farmers identified lack/high cost of inputs as a major constraint to crop-livestock integration in the study area. Also, (38%) and (19%) of farmers identified inadequate capital and extension agent as constraints to crop-livestock integration.Then (16%), (14%), (14%) and (13%) of farmers identified lack of sensitization in modern technologies, insecurity, lack of government assistance/inconsistence of government policies and poor market price/ lack of market as constraints to crop-livestock integration respectively. In general the farmers in the study area encounteredone form of constraint or the other. This implies that despite the benefit of crop-livestock integration it is still not without constraints. This corroborated the findings with Amejo*et al.* (2018) who in their study on integrating crop and livestock in smallholder production system for food security and poverty reduction in Sub-Saharan Africa suggested that the major constraints of crop-livestock integration are infrastructural limitation and poor market access. It also corroborated with the findings of Bhutia*et al.* (2017) who in their study on constraints analysis of small and marginal farmers of Bihar asserted that high cost of input was a constraint of crop-livestock integration. Furthermore,

the finding is in line with Daljit, (2016) who in their study on economic dimension of crop-livestock integrated system in Sub-Mountainous zone of Punjab reported that poor extension services and poor connectivity to the market were constraints of crop-livestock in the studyarea.

Table 16: Constraints encountered by farmers in integrated crop-livestock farming

Constraints	**Freq.**	**Percent**
Lack/high cost of inputs	158	45.01
Inadequate capital	133	37.89
Inadequate extension agent	67	19.09
Lack of sensitization in modern technologies	55	15.67
Insecurity	51	14.53
Lack of government assistance/inconsistence of government policies	49	13.96
Poor market price/ lack of market	44	12.54
Pest/ diseases	33	9.40
Unfavorable weather condition	30	8.55
Inadequate improved seed and livestock species	28	7.98
Land tenure/lack of land	26	7.41
Poor of storage facilities	24	6.84
Others	22	6.27

** Multiple responses allowed

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study analyzed the socio-economic and institutional factors influencing crop-livestock farmers' food security status in Kaduna State, Nigeria. A multi-stage sampling technique was employed in selecting crop-livestock farming households in the study area. The first stage involved random sampling of two LGAs from each of the four agricultural zones in the state. The randomly selected LGAs were Kudan, Kubau, Lere, Igabi, Kachia, Kagarko, BirniGwari and Chukun. The second stage was random selection of two villages from each of the selected LGAs. Finally using the Yamane, (1967) Slovin formula, a sample size of 351 farmers was determined from the Kaduna State Agricultural Development Agency (KADA). The objectives of the study were to: describe the socio-economic characteristics of farmers in the study area; identify the nature of crop-livestock integrated system practiced by the farming household; analyze the food security status of farming household; analyze the factors influencing crop-livestock farmers' household food security; and identify farmers constraints in crop-livestock integrated system in the study area.

The study made use of primary data collected from 351 farmers using a questionnaire instrument. The statistical tools used to analyze the data were descriptive statistics, food security index and probit regression model. The study found that 87% of the farmers were male with an average age of about 40 years.Eighty-five percent were married, and most 38% and 34% had primary and tertiary education respectively. The average household size was 8 persons, and the average farm size was 3.5 hectares. The average experience for crop-livestock integration was 8, and 53% of the farmers were not members of cooperative

society. The result shows that 59% of the farmers had extension visits, 75% werepracticing mixed cropping, 50%, 44%, 39% and 33% kept goat, poultry, sheep and cattle respectively. The result further revealed that 45% of farmers practiced cereal-legume-livestock integration, and 31% practiced cereal-livestock integration.

Food security status of farmers showed that 79% of farmers were food insecured with an average daily calorie intake of 1287.77Kcal which is below the FAO recommended daily per capita calorie intake of `2260Kcal.However 21.08% of farmers were food secured with an average daily calorie intake of 4325.13Kcal which was above the recommended daily per capita calorie intake of `2260Kcal. The shortfall/surplus index of food secured household was 0.91 and that of the food insure household was 0.43.

Probit regression indicated that age and number of extension visit were positive and statistically significant at 1% probability level, and marital status, years of schooling, family size, crop-livestock experience and amount of credit were negatively significant at 10%, 1%, 10%, 10%, 10% probability level respectively.

Based on the probits regression age, marital status, education level, family size, crop–livestock experience, number of extension visits and amount of credit significantly influenced the food security status. Therefore, the null hypothesis which states that socio-economic and institutional factors have no significant influence on the food security status of crop-livestock farmers was rejected and the alternative hypothesis was accepted.

Constraints encountered by crop-livestock farmers shows that lack/high cost of inputs,inadequate capital, inadequate extension agent, lack of sensitization in modern technologies and insecurity were the major constraints encountered in the study area.

5.2 Conclusion

In conclusion, evidence from the survey indicates thatmajority of thefarmers in the study area were food insecured. Crop-livestock integration was practiced in the study area. Furthermore, socio-economic and institutional factors; age and number of extension visit were positive and significantly influenced the food security status of crop-livestock farming household, while, marital status, years of schooling, family size, crop-livestock experience, and amount of credit were negative and significantly influenced the food security status of crop-livestock farming households negatively.

However, there were some constraints affecting crop-livestock integration in the study area that needed to be addressed to ensure that the full potential of crop-livestock integration is reaped. These constraints wereinadequate and high cost of inputs, inadequate capital, inadequate extension agents, inadequate sensitization in modern technologies, and insecurity.

5.3 Recommendations

From the findings of this study, the following recommendations were drawn:

i. Majority of the households was found to be food insecure. Therefore, food insecure households should be assisted by both Government and Non-Governmental Organizations to increase production of staple crops and livestock to enhance their food security status.

ii. Socio-economic (age, marital status, family size, crop-livestock experience, educational level)and institutional factors;(extension contact, and amount of credit received)influenced the food security status of crop-livestock farmers. It is therefore, important that policy makers take into consideration the significant influence of socio-economic and, institutional factors in

formulating policies on crop-livestock integration and food security in Kaduna State.

iii. Based on the constraints identified by crop-livestock farming households in the study area, andits effect on poor yield and subsequently affecting their food security status. It is therefore recommended that government at all levels; NGOs and the private sectors should provide an enabling environment and facilities for farmers to carry out their farming activities. This in turn would help improve that food security status.

5.4 Contribution of the Study to Knowledge

i.The study revealed that majority (79%) of the respondents were food insecured with an average daily calorie intake (kcal) of 1287.77, lower than the recommended daily per capita calorie intake (kcal) of 2260.

ii. The study also revealed that most of the farmers lived above the global poverty line which is set at $1.90 per day, which has its equivalent of ₦693.5. This is seen in the mean level of living of crop-livestock farmers which is said to be ₦410, 659.009, indicating that farmers in the study area have an average monthly income of ₦34, 221.58 and an average daily income of ₦ 1, 140.19.

iv. The study did also reveal that crop-livestock integrated system is predominant in the study area, having most (45%) of farmers practicing cereal-legume-livestock integration, and 31% of farmers practicing cereal-livestock integration.

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APPENDIX 1

Table 3.2 Calorie content of some commonly eaten foods in Nigeria

Food items	Kcal/kg	Food items	Kcal/kg
Staple foods			
Cassava Tuber	1500	Mango	590
Cassava flour	3800	Pawpaw	300
Cassava chips	3000	Pineapple	320
Garri	3840	Apple	320
Yam Tuber	1100	Coconut	580
Yam flour	3810	Guava	730
Yam chips	3000	Sugar cane	360
Sweet potatoes tuber	1100	***Meat and Animal products***	
Sweet potatoes chips	900	Cow meat	2370
Irish potato	1200	Goat Meat	2370
Cocoyam tuber	3830	Sheep meat	2370
Maize grain	4120	Pork	2370
Maize green	3100	Bush meat	2370
Maize flour	4120	Chicken	2380
Sorghum grain	3500	Turkey	2380
Sorghum flour	3500	Fish	2230
Millet grain	3500	Snail	2245
Millet flour	3500	Shrimps	2230
Rice	1230	Crayfish	2200
Wheat grain	3400	Crabs	2200
Wheat flour	3300	Eggs	1400
Cowpea (beans)	5920	***Dairy products***	
Groundnut	5920	Milk	4900
Soyabeans flour	2600	Cheese	4900
Soya beans	4050	Yoghurt	4100
Melon (shelled)	5670	Ice cream	4100
Plantain	770	***Beverages***	
Banana	960	Cocoa	1200
Vegetable		Tea (leaves)	1200
Okra	4550	Tea (liquid)	1200
Tomato	880	Coffee (powder)	1340
Pepper	3930	Coffee (liquid)	1340
Onion	440	***Drinks***	
Carrot	400	Soft drinks	620
Egg plant	440	Orange juice	400
Cucumber	270	Apple juice	550
Chochorus/ ewedu	500	Pineapple juice	560
Spinach	220	Local beer	740
Bitter leaf	220	Bottled beer	460
Water leaf	180	Wine	330
Cabbage	230	***Condiments and spices***	
Pumpkin	440	Maggi	220
		Salt	180

Source: Oguntona and Akinyele, (1995)

APPENDIX 2
QUESTIONNAIRE

DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL DEVELOPMENT, FACULTY OF AGRICULTURE, AHMADU BELLO UNIVERSITY, ZARIA

RESEARCH QUESTIONNAIRE FRO RESPONDENTS

Dear Respondent,
I am a student of the Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Ahmadu Bello University, Zaria, conducting a research on **Analysis of Factors Influencing Crop-Livestock Farmers' Food Security Status In Kaduna State, Nigeria.** Please, I need information from you to enable me conduct my research. All information will be treated with confidentiality and strictly for the purpose of research.
Thank you.

Village/Community…….
L.G.A……

A. SOCIO ECONOMIC CHARACTERISTICS

1. Name of Farmer…….. Phone No……..
2. Gender: Male ( ), Female ( )
3. Age (Years)…….
4. Marital Status: Married ( ) Single ( )
5. Highest level of Education
   (a) No Formal Education ( ) (b) Primary School Education ( )
   (c) Secondary Education ( ) (d) Tertiary Education ( )
6. Family Size (All the number of the people depending on you for living)…….

7. What is the size of your farm land? (Hectare)…….
8. How long have you been involved in crop farming? (Years of experience)…….....
9. How long have you been involved in livestock farming? (Years of experience)…….....
10. How long have you been practicing crop-livestock integrated farming system? (Years)…....
11. Do you belong to any co-operative/ association? Yes ( ) No ( )
12. If yes (Years of participation)……
13. What benefit did you derive as a member? .....
(a) access to loan ( ) (b) access to farm input ( ) (c) access to farm knowledge ( )
(d) others ( ).....
……...
……...
14. What is your major source of capital for farming?
   (a) Borrowing ( ) (b) Savings ( ) (c) Both ( )
   (d) Others specify …….
   ……..
   …….
15. If you borrow, what were the sources of the credit and the amount borrowed?

SOURCE OF LOAN	AMOUNT (₦)	INTEREST RATE (%)
Commercial Bank		
Bank of Agriculture		
Cooperative Society		
Money Lenders		
Friends and Family		

Others (Specify)……..

……..

Extension visit on Crop Farming

16. Have you been visited by an extension agent in the last one year? Yes ( ) No ( )
17. If yes, how many times in the last one year? .....
18. Did you visit an extension agent last year? Yes ( ) No ( )
19. If yes, how many times in the last one year? …….
20. Have you been trained on any aspect of crop farming? Yes ( ) No ( )
21. If yes, of what benefit was the training?
    (a) Not beneficial ( ) (b) Somehow beneficial ( )
    (c) Beneficial ( ) (d) Very beneficial ( )

Extension visit on Livestock Farming

22. Have you been visited by a livestock extension agent in the last one year? Yes ( ) No ( )
23. If yes, how many times in the last one year? .....
24. Did you visit a livestock extension agent last year? Yes ( ) No ( )
25. If yes, how many times in the last one year? …….
26. Have you been trained on any aspect of livestock farming? Yes ( ) No ( )
27. If yes, of what benefit was the training?
    (a) Not beneficial ( ) (b) Somehow beneficial ( )
    (c) Beneficial ( ) (d) Very beneficial ( )

Extension visit on Crop-livestock Farming

28. Have you been visited by an extension agent in the last one year? Yes ( ) No ( )
29. If yes, how many times in the last one year? .....
30. Did you visit an extension agent last year? Yes ( ) No ( )
31. If yes, how many times in the last one year? …….
32. Have you been trained on any aspect of crop-livestock farming? Yes ( ) No ( )
33. If yes, of what benefit was the training?
    (a) Not beneficial ( ) (b) Somehow beneficial ( )
    (c) Beneficial ( ) (d) Very beneficial ( )

B. CROP-LIVESTOCK INTEGRATION

34. What is the type of your crop-livestock integration?
    (a) Cereal – livestock integrated system ( )
    (b) Legumes – livestock integrated system ( )
    (c) Cereal- legume – livestock integrated system ( )
    (d) Roots and tuber – livestock integrate system ( )
    (e) Vegetables – livestock integrated system ( )

(f) Forage and pasture - livestock integrated system ( )
(g) Others (specify) ……
……
……

35. What are the various activities carried out by you in your practice of crop-livestock integration system?
(a) Fertilization of farmland with animal waste (organic manure). ( )
(b) Feeding of livestock with crop residues ( )
(c) Land preparation using animal traction ( )
(d) Covering of Soil with crop residues ( )
(e) Others specify ……
……..
……

36. What type of livestock production system do you practice?
(a) Extensive ( )
(b) Semi-intensive ( )
(c) Intensive ( )

37. What species of livestock do you rear?
(a) Cattle ( )
(b) Sheep ( )
(c) Goat ( )
(d) Poultry ( )
(e) Swine ( )
(f) Rabbit ( )
(g) Duck ( )
(h) Donkey ( )
(i) Others (please specify) ……..
…….
……..

38. What type of cropping system do you practice?
(a) Sole cropping ( )
(b) Mixed cropping ( )
(c) Relay cropping ( )

39. What are the benefits you derive from the practice of crop-livestock integrated system?
(a) Increase in farm income ( )
(b) Soil improvement ( )
(c) Reduction in cost of feeding livestock ( )
(d) Reduction in time spent on land preparation ( )
(e) Increase in crop yield ( )
(f) Increase in animal production/products ( )
(g) Others specify ...…….
……
…….

C. FOOD SECURITY STATUS OF HOUSEHOLD

40. In the past 12 months, were there months in which you did not have enough food to meet your family's need? Yes ( ) No ( )

41. Have you ever experienced food shortages/less to eat in the last 5 years? Yes ( ) No ( )

42. If yes, usually in which months of the year?

Seasons	Duration	Response (tick)
A. January-March		
B. April-June		
C. July-September		
D. October-December		

43. Do you think that your household is currently food secure? Yes ( ) No ( )

44. Please complete the table below with respect to your average quantity of food consumption in the last 7days.

Food items	Food Consumed in last 48 hours
Rice	
Maize	
Sorghum	
Millet	
Cowpea	
Soya beans	
Yam	
Cassava	
Cocoyam	
Gari	
Acha	
Bread	
Meat/cow/goat/sheep/etc	
Chiken	
Fish	
Eggs	
Cooking oil	
Vegetables	
Fruits	
Salt	
Maggi/Dawadawa	
Sugar	
Beverages	
Milk/Kindirimo	

Others specify.....

.....

.....

45. What do you think is the cause of the food shortage?

(a) Inadequate food storage facilities ( )

(b) Inadequate money to buy during those periods ( )

(c) Inadequate farm inputs such as fertilizer, pesticides, improved seeds, improved animal breed ( )

(d) Lack of knowledge of innovations such as improved technology ( )
(e) Others (specify).....
.....
.....

46. In which month does your household rely on food purchase for feeding?
……
47. In which month does your household rely on food from gift
.....
48. Give the months when food prices are
highest……
49. How much do you spend on food purchase for last season?
……
50. How many times do you eat in a day? ……
51. Why? .....
.....
.....

D. INFORMATION ON EXPENDITURE

52. Household expenses (LAST FARMING SEASON)

S/N	Items	Amount (₦)/Week	Amount (₦)/Month
a	Food		
b	Rent		
c	Clothing		
d	Housing maintenance		
e	Light/electric power		
f	Fuel		
g	Hospital care		
h	School fees		
i	Community levy/ contribution		
j	Financial assistance/ monetary gift		
k	Travel		
l	Contributions to associations and groups		

Others (please specify).....
.....
.....

E. INFORMATION ON INCOME AND LIVELIHOOD OF FARMERS

53. On-farm and off-farm income for last year (provide estimation)

	Source		**Amount**
a	Farm income	a. Crop	
		b. Livestock	

b	Off-farm income	**c.** Civil Service	
		d. Trading	

Others (specify).....
.....
.....

Kindly provide the following information

Animals	Number of Animals	Value per each Animal
Cattle		
Sheep		
Goat		
Poultry		
Rabbitry		
Piggery		
Horse		
Donkey/Mulley		

Kindly provide the following information

Crops	Quantity in Bags (100 kg)	Price per bag
Maize		
Sorghum		
Millet		
Beans		
Rice		
Other		

Kindly provide the following information

Item	Quantity	Value in ₦
Car		
Bicycle		
Motorcycle		
Radio		
Television		
Mobile phone		
Water pump		
Animal traction		
Tractor		
generator		
Land		

F. CONSTRAINTS FACED BY FARMERS

54. State the constraints you face in practicing crop-livestock integrated system?

i ……
ii ……...
iii ……..
iv ……
v ……....
vi …….

55. What suggestions will you give to help in solving the above constraints?

i……
ii……
ii……
iv……
v……
vi……

Thank you for your Attention.