ANALYSIS OF PRODUCTION EFFICIENCY AND FOOD SECURITY AMONG SMALLHOLDER RICE FARMERS IN KANO STATE, NIGERIA

MUBARAK ALIYU DANMARAYA

(SPS/15/MEX/00046)

JUNE, 2019

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A DISSERTATION SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, FACULTY OF AGRICULTURE, BAYERO UNIVERSITY, KANO, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (M.Sc) IN AGRICULTURAL ECONOMICS

JUNE, 2019

DECLARATION

I hereby declare that this work is the product of my own research efforts; undertaken under the supervision of Prof. Zilkifilu Abdu and Prof. Aminu Suleiman, has not been presented and will not be presented elsewhere for the award of a degree certificate. All sources have been duly acknowledged.

…….

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(SPS/15/MEX/00046)

CERTIFICATION

This is to Certify that the research work for this Dissertation and its subsequent write-up by Mubarak Aliyu Danmaraya (SPS/15/MEX/00046) were carried out under our supervision.

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APPROVAL PAGE

This is to certify that, this dissertation titled**"** Analysis of Production Efficiency and Food Security among Smallholder Rice Farmers in Kano State, Nigeria" Prepared by Mubarak Aliyu Danmaraya (SPS/15/MEX/00046)has been examined and approved in accordance with the regulations governing the Award of the degree of Master of Science (M.Sc.) in Agricultural Economics.

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ABP: Anchor Borrowers Programme

ADPs: Agricultural Development Programmes

CBN: Central Bank of Nigeria

FAO: Food and Agriculture Organization

FMARD: Federal Ministry of Agriculture and Rural Development

GDP: Gross Domestic Products

GHI: Global Hunger Index

NGO^{s}: Non-Governmental Organizations

HFSSM: Household Food Security Survey Model

HOA: Horn of Africa

IFRP: International Food Research Institute

MLE: Maximum Likelihood Estimate

NBS: National Bureau of Statistic

NRDS: National Rice Development Strategy

RIFAN: Rice Farmers Association of Nigeria

UN: United Nations

UNCTAD: United Nations Conference on Trade and Development

UNEP: United Nations Environmental Protection

USDA: United State Department of Agriculture

WDR: World Development Report

WFP: World Food Programme

ABSTRACT

The study was carried out to Analyse of production efficiency and Food Security among smallholder rice farmers in Kano State, Nigeria. A multi stage sampling technique was used for selecting samples of 240 for the study .Data were collected using questionnaire and analyzed using Descriptive statistics, Stochastic frontier production model, Household Food Security Survey Model and Likert scale. The results of the socio-economic characteristics revealed that all (100%) of the rice farmers were male and married, 52.5% acquired only informal education, 82.1% solely depend on agriculture, 37.9% fall within the age range of 40-49 years, none of the farmers has below 11 years of working experience and (54.6%) also have family size of between 31 to 40. Moreover, the results of production function analysis showed that seed (0.440), farm size (0.128), fertilizer (0.455) and agro-chemicals (0.128) were positive, implying that their increase would lead to increases in output of rice. Labour was negative (-0.096) implying that an increase in the use of Labour would decrease farm output because the farmers are small scale in nature. Also, few rice farmers in the state (10.5%) were marginally food secure, while most of them (89.5%) were food insecure. The most severe factors to food insecurity was climate change (84.58%) followed by High cost of farm inputs (80.41%) and finally majority (92.08%) of the farmers employed the strategy of buying from market as well as (90.83%) borrow money/food from friends and relatives to combat food shortage. It is concluded that rice farmers were economically inefficient and majority (89.5%) of the farmers were food insecure. The study recommend that policies of government on agricultural mechanization should be given necessary funding and farmers should participate in decision making in agricultural policies towards ensuring food security in Kano State.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Every era has its challenges. And each challenge demands specific responses. Globally, about 805 million people are estimated to be chronically undernourished (FAO, IFAD and WFP, 2014). The food insecure lack access to sufficient quantity and quality of food for a healthy and active life, which can compromise their health, wellbeing and productivity. A country with many food insecure citizens can lead to a lower Gross Domestic Product, making food insecurity an economic challenge, as well as a human rights problem (FAO, 2012).

Developing countries account for 98% of the world's undernourished people (FAO and WFP, 2010). According to FAO (2010), approximately 33% of the population in Sub-Saharan Africa is undernourished. The reports also indicate that there are 307 million hungry people in Africa, with most of these living in Sub-Saharan Africa are undernourished and millions are food insecure (FAO and WFP, 2010).

In Nigeria, agricultural sector is one of the most important sectors that plays vital role in the economic development of the country. The sector contributes greatly and significantly to the Gross Domestic Product (GDP) of the nation and employed about 86% of the rural households in the country (Fan, Omilola, Rhoe and Akpan, 2012). Notwithstanding, the agricultural sector is arguably the most important sector of the economy. This is owing to the fact that the growth and development of Nigeria depend to a large extent on the development of the agricultural sector (Gollin, Parente and Richard, 2012).

Meanwhile, Rice is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human

population. It is the agricultural commodity with the third-highest worldwide production (rice, 741.5 million tons) (FAOSTAT, 2014).

Rice is one of the most important food and cash crops in Nigeria. It is the fourth largest cereal crop grown in the country behind sorghum, millet and maize. It is the second crop behind wheat, with the highest investment opportunity for import substitution. Nigeria is the continent's leading consumer of rice, one of the largest producers of rice in Africa and simultaneously one of the largest rice importers in the world. As well as an important food security crop, it is an essential cash crop for it is mainly small-scale producers who commonly sell 80% of total production and consume only 20%. Rice generates more income for Nigerian farmers than any other cash crop in the country (FAO, 2014).

Nigeria's rice consumption has increased significantly over the last decade (6.5 % per annum) and is now estimated at 6 million metric tonnes annually and the total retail market value for rice in Nigeria was estimated at $3.6bn (FMARD, 2012). Furthermore, rice has become a staple food of choice in both urban and rural areas accounting for more than 20% of all meals consumed per week by a typical household. Nigeria's growing demand for rice is forecasted to reach 36 million tons by 2050 (FMARD, 2012). A recent Food and Agriculture Organization (FAO) estimate of cereal supply and demand puts the 2015/2016 world wheat production at 758.0 million tones followed by rice which is 497.8 million tonnes, while data for other grains is aggregated together as coarse grains (FAO, 2017).

Meanwhile, Rice annual demand in Nigeria has increased from 5.5 million tons in 2015 to 5.8 million tonnes in 2017. Nigerians spent not less than N1bn on rice consumption, adding that while spending had drastically reduced, consumption had increased because of increased local production of the commodity. The consumption rate now is 7.9 million tonnes and the production rate has increased to 5.8 tonnes per annum. The increase was as a result of the CBN's Anchor Borrowers Programme (ABP) with a total of 12 million rice producers and four million hectares of FADAMA rice land, (Rice farmers Association of Nigeria, 2017).

The CBN's Programme since inception had created economic linkage between Small Holder Farmers and reputable large-scale processors, thereby increasing agricultural outputs and significantly improving capacity utilization of processors. The ABP was launched by President Muhammad Buhari on November 17, 2015 in Kebbi, aimed at creating a linkage between anchor companies involved in the processing and SHFs of the required key agricultural commodities. The fund was provided from the N220 billion micro, small and medium enterprises development fund which started in Kebbi state and extended to 26 States (Punch, 2017).

Presently, Nigeria is inching closer to achieving self-sufficiency in rice production as the government targets 7 million tonnes of rice production in 2018. Importation dropped from 644,131 tonnes in 2015 to about 21,000 tonnes in 2017. This success attracts some investors from Thailand who had shown interest in establishing rice milling plants in Nigeria. This improvement was as a result of ABP initiated by President Muhammad Buhari to support farmers through inputs distribution and loans to boost rice production. As a result of this, rice importation dropped by 95 % in the last three years which led to the Government saving about 5 million dollars per day. Nigeria is currently producing 5.8 million to 6 million tons of paddy rice and the number of paddy farmers in the country has risen from 5 million to 12.2 million (Tribune, 2017).

Accordingly, food security implies livelihood security at the level of each household and all members within, and it involves ensuring both physical and economic access to a balanced diet, safe drinking water, environmental sanitation, primary education and basic health care (UNUHRD, 2012).

The most widely accepted definition of food security is from the Food and Agriculture Organization of the United Nations (FAO): A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2014).

Food security entails ensuring sustainable access, availability and affordability of adequate quantity and quality food to all citizens to meet up with their physiological requirements (Okuneye, 2014). The main goal of food security is for individuals to be able to obtain adequate food needed at all times, and to be able to utilize the food to meet the body's needs. Food security is multifaceted.

The World Bank (2001), identified three pillars underpinning food security; these are food availability, food accessibility, and food utilization. This infers from the concept that food security is not just a production issue.

Food availability for the farm household means ensuring sufficient food is available for them through own production. However, due to lack of adequate storage facilities and pressing needs, they mostly end up selling excess produce during the harvesting period, and sometimes rely on market purchases during the hungry season.

Food access means reducing poverty. Simply making food available is not enough; one must also be able to purchase it, especially the low-income households (Sen, 1981). Pervasive poverty among the rural population in Nigeria is an indication of low agricultural productivity and relatively low incomes (Abdullahi, 1999) defined absolute poverty as lack of access to resources required for obtaining the minimum necessities essential for the maintenance of physical efficiency. This connotes that the poor farmers will have little access to food, either produced or purchased.

Food utilization means ensuring a good nutritional outcome, which is nutrition security. Having sufficient food will not ensure a good nutritional outcome if poor health results in frequent sickness. Building this pillar means investing in complementary resources such as nutrition education, health care, provision of safe water and better sanitation, instituting gender symmetry, and removal of child abuse practices (Doppler, 2002).

1.2 STATEMENT OF THE PROBLEM

Africa was the only region where the number of hungry people grew over the past two decades from 175 million to 239 million, with nearly 20 million added in the past four years. The prevalence of hunger, although reduced over the entire period, has risen slightly over the past three years, from 22.6% to 22.9% - with nearly one in four hungry. In sub- Saharan Africa, the modest progress achieved in recent years up to 2007 was reversed, with hunger rising at 2% per year since then (FAO, 2012).

In Nigeria, estimates put the number of hungry people at over 53 million, which is about 30% of the country‘s total population of around 160 million; and 52% live under the poverty line (Oriola, 2009). International Fund for Agricultural Development IFAD (2009) also put the number of Nigeria‘s poor at 70% of the population with 35% living in absolute poverty. The situation seems to be worsening as the percentage of Nigerians living in absolute poverty rose from 54.7% in 2004 to 60.9% in 2010. The North West region has the highest rate at 70% of the population. It also has the highest number of food poor people with 51.8% (NBS, 2010).

The challenge of food insecurity in Nigeria is on the increase (Adebayo, 2012) and farmers are considered most vulnerable to food insecurity in the country (Adepoju and Adejere, 2013). In Nigeria, about 7.1 million people are facing acute food insecurity and in need of urgent lifesaving and livelihood protection (FAO, 2017).

Furthermore, output of almost all the staple food crops in Nigeria (Rice inclusive) has risen up. This growth in food production has been consistent for over five years (CBN, 2012). Overall as the report indicated over 20 million metric tons of food was added to Nigeria domestic food output between 2012 and 2015. The paradox however, is that as domestic food production is increasing in Nigeria, hunger and undernourishment are also increasing (IFRP, 2016).

According to International Food Research Institute (IFRP, 2016), the proportion of Nigerian population that were undernourished in 2008 was 5.9%. However, in 2016 that proportion has gone up to 7% (IFRP,

2016). This goes contrary to the position of most Nigerian scholars on food security. Nigerian government has intervened in the rice sub-sector over the past few decades but the public policy has neither been consistent nor appropriate because domestic production has continued to lag behind demand, (Akande, 2011).

Notwithstanding, the various policy measures on domestic rice production has not increased sufficiently to meet the increased demand (Akpokodje *et al.*, 2011). Consequently in Nigeria, the percentage of food insecure households was reported to be 18% in 1986 and over 40% in 2005 (Sanusi et al, 2012). Figures released by FAO in 2010 on the state of food insecurity in the world indicated that about 29% of the Nigerian population was chronically undernourished (FAO, 2010).

Finally, Kano State is facing worsening food insecurity because of the increase in its population and this has led to a high incidence of malnutrition related diseases, which not only undermine health, but hinders agricultural production FAO (2000).

In the light of the foregoing, this study provided answers to the following questions:

i. What are the socio-economic characteristics of smallholder rice farmers in the study area?
ii. What is the economic efficiency of smallholder rice production in the study area?
iii. What is the food security status of smallholder rice farmers?
iv. What are the factors responsible for food insecurity?
v. What are the coping strategies employed by rice farmers to minimize food insecurity in the study area?

1.3 OBJECTIVES OF THE STUDY

The broad objective of this study was to Analyze of production efficiency and food security among smallholder rice farmers in Kano State, Nigeria**.** The specific objectives were to;

i. describe the socio-economic characteristics of smallholder rice farmers in Kano state,
ii. determine the technical, allocative and economic efficiencies of rice production,
iii. categorize the food security status of the smallholder rice farmers,
iv. identify the factors responsible for food insecurity; and
v. describe the coping strategies employed by smallholder rice farmers to minimize food insecurity in Kano state

1.4 JUSTIFICATION OF THE STUDY

Food is regarded as the basic means of sustenance, sufficient to say that an adequate food intake in terms of quantity and quality is a key for healthy and productive life (FAO, 2005). Ensuring the basic food needs of her population is one of the major challenges confronting Nigeria. The challenge of food insecurity in Nigeria is on the increase (Adebayo, 2012) and farmers are considered most vulnerable to food insecurity in the country (Adepoju and Adejere, 2013).

Moreover, food security is national security, and any nation that is unable to feed its populace can face Economic disintegration. Beside, current estimates indicated that a total of 3.5 million people are currently in food crisis in Nigeria, while 999,959 people are in emergency situation in need of urgent assistance (WFP, FAO and USAID 2018).

It also projected that the number of people caught in the food crisis could increase to 5.2 million people during the lean period of June-August 2018. The report however, expressed worry and called for urgent steps to be taken to ensure food security by relevant authorities if not the number of people facing food crisis may rise to 1.3 million, while those in emergency situation would increase to 203,022 (Vanguard, 2018)

Essentially, the study is anticipated to make significant contribution to the existing literatures on rice production and food security status in filling existing research gap by researchers and useful as a reference material, significant to provide information on economic efficiencies and help Non-governmental organizations (NGO$^{s)}$ and other food security agencies in monitoring progress achieved so far in Kano State. Lastly, to help the Government formulate policies that would enhance efficient rice production and enhance food security status of rice farmers not only in Kano state but Nigeria at large**.**

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter begins with the conceptual review of rice production and food security. This is followed by the reviewed on empirical studies on rice production efficiency and food security. It concludes with a review of the factors responsible for food insecurity and coping strategies employed in the event of food insecurity. The purpose of review of literature is to illustrate how the subject has been studied previously and what were the gaps (Boote and Beile, 2005).

2.1 GLOBAL RICE PRODUCTION

Rice cultivation is the principal activity and source of income for millions of households around the globe. Several countries of Asia and Africa are highly dependent on rice as source of foreign exchange earnings and government revenue also Rice is the second largest produced cereal in the world after wheat (Kadiri, 2014). Rice is a crop that cuts across regional, religious, cultural, national and international boundaries. Rice production is geographically concentrated in Western and Eastern Asia. Asia is the biggest rice producer in the world accounting for 90% of the world's production and consumption of rice. China and India, which account for more than one-third of global population supply over half of the world's rice. Brazil is the most important non-Asian producer, followed by North and Central America, United States of America ranks third in North America continent after Brazil and North and Central America. Nigeria ranks second in Africa after Egypt (Kadiri, 2014).

According to Shellemiah (2006), Africa spends over two million dollars importing rice from Asia, with an increased consumption rate of almost 6%, and that rice is no longer a luxury crop since poor people as well as wealthy eat rice. The estimated annual paddy rice production of Africa is about 24million tones (15.6Mt equivalent of milled rice). Additionally, 10 Mt of milled rice is imported into the continent annually (Manful, 2010).

Despite continuously increasing production, world market rice prices remain high and do not show signs of abating (Manful, 2010). Only about 5-6% of the rice produced reaches international markets. In 2010, the three largest rice exporters, in decreasing order of quantity exported, were: Thailand, Vietnam and India. Together, they accounted for nearly 70% of world rice exports. Global rice stocks fell from 147.3 MT in 2000 to 74.1 MT in 2008. Although China and India are the two largest producers of rice in the world, both countries consume the majority of the rice produced domestically (with China becoming an importer), leaving little to be traded internationally (Manful, 2010).

2.3 ECONOMIC IMPORTANCE OF RICE

Rice is life for most people living in Asia. Rice has shaped the cultures, diets and economics of thousands of millions of people (Gnanamanickam, 2009). The United Nations designated year 2004 as the International year of rice. The various uses to which rice can be put into, makes the product very important. Throughout history, the ability to produce surplus rice has assisted development of various communities and failure of rice crop has led to wide spread of famine, death and political instabilities in many countries especially in Africa (Baba, 2003).

The popularity of rice as food has increased recently in a number of countries in Africa and America where it was not traditionally a major crop (Adeoye, 2003). It could be prepared into *"Tuwo"," Alkaki", "Masa" or" Waina"* (especially in Northern Nigeria), pudding and assorted dishes, but the commonest form of use is the boiled form and eaten with stew or alternatively, it could be in combination with beans, pears, potatoes and even yams (Allu,1994). Although rice has little protein, vitamins and minerals, it nevertheless has several distinct advantages as food. Its carbohydrates are easily digested. Broken rice grains are used in making starch, which is used in industries, cosmetics and textile industries.

2.2 RICE IN NIGERIA ECONOMY

Rice is one of the most important food and cash crops in Nigeria. It is the fourth largest cereal crop grown in the country behind sorghum, millet and maize. It is the second crop behind wheat, with the highest investment opportunity for import substitution. It was reported that Nigeria expends over USD$11 billion in the importation of wheat, rice, sugar and fish every year. Rice contributes about USD$3.56 billion to the amount (Akinwumi, 2012). Although Nigeria is Africa's leading producer of rice, it is also not only the leading consumer but is the second largest rice importer in the world. Rice has over the last three decades, witnessed steady increase in demand, estimated at 7% per annum. FMARD (2012) estimated that total demand would reach 9 million metric tonnes by the year 2016.

Nigeria is the continent's leading consumer of rice, one of the largest producers of rice in Africa and simultaneously one of the largest rice importers in the world. As well as an important food security crop, it is an essential cash crop for it is mainly small-scale producers who commonly sell 80% of total production and consume only 20%. Rice generates more income for Nigerian farmers than any other cash crop in the country (FAO, 2014).

Nigeria's rice consumption has increased significantly over the last decade (6.5 % per annum) and is now estimated at 6 million metric tonnes annually and the total retail market value for rice in Nigeria was estimated at $3.6bn (FMARD, 2012). Furthermore, rice has become a staple food of choice in both urban and rural areas accounting for more than 20% of all meals consumed per week by a typical household. Nigeria's growing demand for rice is forecasted to reach 36 million tons by 2050 (FMARD, 2012).

A recent Food and Agriculture Organization (FAO) estimate of cereal supply and demand puts the 2015/2016 world wheat production at 758.0 million tonnes followed by rice which is 497.8 million tonnes, (FAO, 2017).

Rice is grown in all the ecological zones in Nigeria, from the mangrove to the dry savannah. It is grown in all the 37 states of the Federation. It takes approximately about 3.7 million hectares of land in Nigeria,

covering 10.6 percent of the 35 million hectares of land under cultivation, out of a total arable land area of 70 million hectares. More than 70 percent of the farmed area of rice is rain-fed, of which 47 percent is lowland and 30 percent upland (Bayou, 2009).

Most rice farmers in Nigeria are smallholders (90 percent of total), applying a low-input strategy to agriculture, with minimum input requirements and low output (USAID, 2009). In spite of the fact that rice is cultivated in virtually all the agro-ecological zones in Nigeria, the area under rice cultivation remained small, yield remained the lowest in the region and quality of paddy remained poor due presence of stones, mixed varieties and broken seeds (NRDS, 2009).

Beyond the farm gate, there are several issues that retard the downstream activities which are also constraining local supply of the commodity. These include issues such as the absence of standard measures in the marketing of rice, poor transportation services and lack of proper packaging materials and poor linkages to processing industries. Rice milling in Nigeria is at the cottage industry level. The milling capacity varies from 50 kg to 5,000 kg rice per hour. The most frequent type of mill encountered is the 'medium size' (150 to 300 kg/hectares), which represents half of the sample, followed by the 'small size', the less frequent type of mills being the 'big size' and 'large size' (Lançon *et al*, 2003).

These combined with large number of participants in the value coupled with on-farm constraints add up to undermine the competitiveness rice industry in Nigeria (Daramola, 2005).

Table 1: Major Features of Nigerian Rice Production Systems

Production System	Major states covered	Estimated share of Natural rice area	Average Yield (ton/ha)
Rain fed upland	Ogun, Ondo, Osun, Ekiti, Oyo, Edo, Delta, Niger, Kwara, Kogi, Sokoto, Kebbi, Kaduna and Benue State	30%	1.7
Rain fed lowland	Ondo, Ekiti, Delta, Edo, rivers, Bayelsa, Cross River, AkwaIbom, Lagos, all major river valleys, of shallow swamps of Niger Basin, Kaduna basin and inland swamps of Abakaliki and Ogoja Rivers.	47%	2.2
Irrigated	Niger, Sokoto, Kebbi, Borno, Benue, Kogi, Anambra, Enugu, Ebonyi and Cross Rivers States	16%	3.5
Deep water/ Floating	Flooded areas of Rima valley Kebbi state, and deep flooded areas of Ilushi, Delta state	5%	1.3
Mangrove swamp	Ondo, Ekiti, Delta, Edo, Rivers, Bayelsa, Cross River, AkwaIbom, Lagos.	1%	2.0

Source: NBS, 2015

2.3 POLICIES ON RICE PRODUCTION IN NIGERIAN

Nigeria's rice policy can be discussed in reference to three important periods. According to Akpokodge, Lancon and Ereinstien (2001), these are the pre-ban, ban and post-ban periods. They reported that these periods are critical as a result of the fact that the kind of policies put in place during these periods had profound impact on the rice economy. The pre-ban period, the era prior to the introduction of absolute quantitative restriction on rice imports (1971 – 1985) can be classified into two: the pre-crisis period (1971 – 1980) and the crisis (1981 – 1985) periods. The pre-crisis period was largely characterized by liberal policies on rice imports with some ad hoc Policies put in place during times of interim shortages. While more stringent policies were put in place during the crisis period, outright ban was not a major

feature. That changed in the ban period (1986 -1995), when it was illegal to import rice into the country, although illegal importation was going on across the country's borders. In the post-ban period (1995-date) quantitative restrictions on rice importation were lifted and the country generally adopted a more liberal trade policy towards rice. From 2000 to date, the Federal Government has resorted to constant and upward adjustment of the import tariff on rice, from 50% in 2000 through 75% in 2001 to 100% in 2002. From the beginning of 2003, the tariff was adjusted to 150% (Ogundele and Okoruwa, 2006).

The effect of trade policy on rice production in Nigeria can be determined by examining the growth in output before, during and after ban on rice imports. Prior to the crisis period (1971 – 1980), the average annual growth in rice output was 27%. However, this plunged to 4% during the 1981 – 85 periods, when Nigeria relied considerably on rice importation. Nigeria imposed a ban on rice imports during the 1986 – 95 period and the annual growth in rice production rocketed to 13%. But after the removal of the ban in 1995, the average annual growth dived to – 1% (Akpokodge, Lancon and Erenstein, 2001).

2.4 EFFICIENCY OF RICE PRODUCTION IN NIGERIA

Amaza and Maurice (2005) attempted to identify factors that influence technical efficiency in rice-based Fadama farmers in Adamawa State, Nigeria. The study showed that land, seeds and other costs were significant at 1% level; while fertilizer and water were significant at 5% level. The estimated coefficients for land, fertilizer, family labour, seeds, water and other costs were significant and positive, confirming to a *priori* expectation. This implies that increase in quantities of these inputs would result in increased output. The sources of inefficiency were examined by using the estimated *d* -coefficients in association with the inefficiency variables in the equation presented.

Okoruwa and Ogundele (2006), in examining technical efficiency differentials between farmers planting traditional rice varieties and those planting improved Varieties found that farm size, hired labour, herbicide and seed contributed significantly to the technical efficiency of the farmers and that increased output of rice in Nigeria had been accomplished mainly through area expansion. The coefficients of farm

size were 1.07 and 0.88, respectively, for traditional and improved rice variety farmers. This, however, poses some challenges of environmental sustainability of the cultivation method. Although the use of hired labour and herbicides was found to contribute significantly to technical efficiency among the traditional rice variety farmers, their corresponding elasticities did not suggest that increased used of these inputs will yield more than proportionate increase in output.

2.5 STOCHASTIC FRONTIER MODELS

Microeconomic theory states that the objective of firms is to produce the maximum output utilizing given inputs, to minimize costs at given outputs, or to efficiently allocate input and output in order to maximize profits. A frontier defines the maximum feasible output in an environment characterized by a given set of random factors. The stochastic components describe random shocks affecting the production process. These shocks are not directly attributable to the producer or the underlying technology (Kent and Vu, 2009).

A number of techniques can be employed to measure production efficiency grouped into non-parametric and parametric frontiers (Tchale, 2006; Chirwa, 2003).

The stochastic frontier production function is a method of economic modeling. The stochastic production frontier models was used by Ogundari (2016), Rahman and Umar (2009), Thomas (2007); Emokaro and Ekunwe (2009) and others which derived from the error model of Aigner *et al* (1977) and Meeusen and Van den Broeek (1977). The stochastic frontier production function is specified as:

$$Y_i = f(x_i.\beta) + e_i \quad \ldots\ldots (1)$$

$$e_i = v_i - u_i \quad \ldots\ldots (2)$$

Where;

Y_i = quantity of output of the i^{th} farm

x_i= vector of the inputs used by the i^{th} farm

β = a vector of the parameters to be estimated

e_i = composed error term

v_i= random error outside farmer's control

u_i = technical inefficiency effects

f (x_i, β) = a suitable function of the vector

According to Ogundari (2016), it has been used by many empirical studies, particularly those relating to agriculture in developing countries and also that the functional form meets the requirement of allowing an examination of economic efficiency:

$$\ln Y = \beta o + \beta_1 \ln X_1 i + \beta_2 \ln X_2 i + \beta_3 \ln X_3 i + \beta_4 \ln X_4 i + \beta_5 \ln X_5 i + (Vi-Ui) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where;

ln = the natural logarithm

Y = output of rice (kg/ha)

βo = constant term

β_1- β_5 = regression coefficients

Y_i = Quantity of irrigated rice output (kg)

X_1 = Farm size (ha)

X_2 = Quantity of seed used (kg)

X_3 = Labor input used (both family and hired labor) (man days)

X_4 = Quantity of fertilizer (kg)

X_5 = quantity of agrochemicals (Liters)

Vi = random variability in the production that cannot be influenced by the farmer.

U_i = deviation from maximum potential output attributable to technically inefficiency.

The inefficiency of production, U_i will be modeled in terms of the factors that are assumed to affect the efficiency of production of farmers. Such factors are related to the socio-economic and management variables of the farmers.

The determinant of technical inefficiency is defined by:

$U_i = \delta_0 + \delta_1 1nZ_1 + \delta_2 lnZ_2 + \delta_3 lnZ_3 + \delta_4 lnZ_4 + \delta_5 lnZ_5 + \delta_6 lnZ_{6+} \delta_7 lnZ_7$…… (4)

Where;

U_i = inefficiency effects

Z_1 = Age (years)

Z_2 = Household size (Number of persons)

Z_3 = Education (years of schooling)

Z_4 = Access to credit (amount borrowed in ₦)

Z_5 = Extension contact (Number of visit per year)

Z_6 = Membership of association (Years of participation)

Z_7 = Farming experience (years)

δ_0 = constant

δ_1-δ_6 = Parameters to be estimated.

These variables are assumed to influence technical efficiency of the irrigated rice farmers. The gamma ($\gamma = \sigma^2 \mu / (\sigma 2 \mu + \sigma \nu)$ which is the ratio of the variance of U $\sigma^2 \mu$ to the sigma squared (σ^2) which is a summation of variances u and v of U and V ($\sigma^2 = \sigma^2 \mu + \sigma^2 \nu$) were also determined.

On the other hand, u_i is a non-negative truncated half normal random variable associated with farm-specific factors which lead to the ith farm not attaining maximum efficiency of production. U_i is associated with technical inefficiency of the farm and ranges between zero and one. U_i follows an

independent and identical half-normal distributed N $(0.\delta^2 u)$. N represents the number of the farms involved in the cross-sectional survey.

According to Bakhsh (2007), stochastic frontier production function model is estimated using the maximum likelihood estimation procedure (MLE). In this study, Batese and Coelli (1995) model was used to specify a stochastic cost function (allocative efficiency). The stochastic frontier production function model is expressed as:

$\ln C_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + V_i + U_i$ ……………………………… (5)

where;

C_i= Total cost of rice production (₦)

β_o= intercept or constant

β_1-β_4= Parameters to be estimated

X_1 = Cost of seed (₦)

X_2 = Cost of fertilizer (₦)

X_3 = Cost of agrochemicals (₦)

X_4 = Cost of labor (₦)

V_i = Error term which are random variables

U_i = Error term which are non-random variables or technical inefficiency effect X_1 is expected to be positively related to the cost of rice production.

Economic efficiency (EE) is defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost. It is equal to the product of technical efficiency and allocative efficiency expressed as;

EE = TE * AE ………………………………………………………………. (6)

where;

EE = Economic efficiency

TE = Technical efficiency; and

AE = Allocative efficiency.

2.6 FOOD SECURITY

The history of food security was emerged in the mid of the 1970s when a critical shortage of food grain occurred globally making the World Food Conference of 1974 defined food security in terms of food supply. At the 1996 World Food Summit, 182 nations agreed on the definition as a physical and economic access by all people at all times to sufficient, safe and nutritious food, and dietary food preference for an active and healthy life (Todaro and Smith, 2011).This definition has four pillars (food availability, accessibility, utilization and stability).

Food security has been defined as a situation when all the people, at all times, have physical and economic access to sufficient, safe and nutritious food needed to maintain a healthy and active life (WB and FAO, 2010).

According to Emergency Food Security Assessment (EFSA) of WFP (2009), the analysis of food security is based on three pillars:

(i) Food availability;

(ii) Food access;

(iii) Food utilization.

Indicators for analysis of the three pillars are provided below:

Food Availability

Food availability is the physical presence of food in the area of concern through all forms of domestic production, commercial imports and food aid. Food availability might be aggregated at the regional,

national, district or community level. In an EFSA manual tool, food availability is usually analyzed at the district and community levels. According to WFP (2009), food availability is determined by:

i. Production: food produced in the area;
ii. Trade: food brought into the area through market mechanisms;
iii. Stocks: food held by traders and in government reserves;
iv. Transfers: food supplied by the government and/or aid agencies.

However, national and regional food availability may be considered when developing future scenarios and discussing response options.

Food Access

Food access concerns a household's ability to acquire adequate amount of food, through one or a combination of own home production and stocks, purchases, barter, gifts, borrowing and food aid. The following are some examples:

i. Own production – crops, livestock, etc.
ii. Hunting, fishing and gathering of wild foods
iii. Purchase at markets, shops, etc; and
iv. Barter – exchange of items for food

Food may be available but not accessible to certain households if they cannot be acquired in a sufficient quantity or diversity of food through these mechanisms.

Food Utilization

Food utilization refers to households' use of the food, to which they have access, and individual's ability to absorb and metabolize the nutrients– the conversion efficiency of the body. Food utilization includes:

i. The ways in which food is stored, processed and prepared, including the water and cooking fuel used, and hygiene conditions

ii. Feeding practices, particularly for individuals with special nutrition needs, such as babies, young children, the elderly, sick people, and pregnant or lactating women

iii. The sharing of food within the household, and the extent to which this corresponds to individuals' nutrition needs - growth, pregnancy, lactation, etc

iv. The health status of each member of the household.

Food may be available and accessible but certain household members may not benefit fully if they do not receive an adequate share of the food in terms of quantity and diversity, or if their bodies are unable to absorb food because of poor food preparation or sickness (WFP, 2009). Regardless of the definition adopted, availability of food and access to food are two essential determinants of food security (Hartwig *et al.*, 2011; Babatunde *et al*., 2008). However, availability does not necessarily ensure access. Food may be available globally but not to all countries, all households, or individuals within the household h can access it (Dauda, 2010).

2.7 FOOD INSECURITY

Food insecurity is the opposite of food security. Therefore, it may be defined as a situation where people, individuals at times, lack physical and economic access to sufficient, safe and nutritious food needed to maintain a healthy and active life. Household food insecurity arose when food is not available, cannot be accessed with certainty in socially acceptable ways, or is not physiologically utilized completely (Nanama, 2012).

Food insecurity occurs whenever enough and safe foods are not available or the ability to acquire such foods is limited. Food insecurity represents a major public health concern and is a useful index of health and well-being because it is associated with poverty, ill health, poor dietary intake, and limited social capital (Hadley *et al*, 2012).

2.8 CAUSES OF FOOD INSECURITY

Food insecurity in Africa is considered as a challenge across the region, and that its causes are complex, attributed to multiple, and often intertwined factors (Paul & Thurlow, 2011). The main concerns are the impacts of climate change, an increase in food prices, loss of subsistence and traditional food crops and cash crop (FAO &WOCAN, 2010). General causes of food insecurity in Nigeria and which are similar in many other developing countries, include dependency on rainfall; the use of low-level technologies for tillage, poor crop and livestock husbandry, poor storage and processing of crop and livestock products, post-harvest losses, financial inability to use improved seeds, fertilizers, pesticides, and herbicides; low prices offered in cash crops, poor markets for agricultural and livestock products; poor agricultural extension services; poor division of labour at the household level; bad farming practices leading to various environmental degradation; and poor transportation means that affects distribution of input supply and products transportation to market places (Kayunze *et al.,* 2009).

The major factors affecting food availability are low production due to low productivity of land, labour and other production inputs, high incidences of crop and livestock pests and diseases, inadequate processing, storage and marketing infrastructure. This is caused mainly by inadequate finance to obtain productivity enhancing inputs or capital, limited availability of support services and appropriate technologies. In addition, many rural households face labour shortages due to migration of young people to the urban areas in search of employment (URT, 2006)

The HIV/AIDS pandemic has also contributed to a loss of labour for household agricultural production since the infected and those caring for them cannot devote enough time and energy for agricultural production (URT, 2009b; Basukuba *et al.,* 2007).

Other factors affecting food availability include high pre and post-harvest losses due to pests and, disease and climatic conditions. According to Makale (2012) losses caused by insects during six months of storage were 2% to 3% for husked maize cobs, as regards threshed from grains loses due to insects

infestation after three months storage was 15%. Poor transportation infrastructure also impacts on food security in Tanzania as it restricts the flow of food from surplus to deficit areas.

2.10 GLOBAL FOOD SECURITY SITUATION

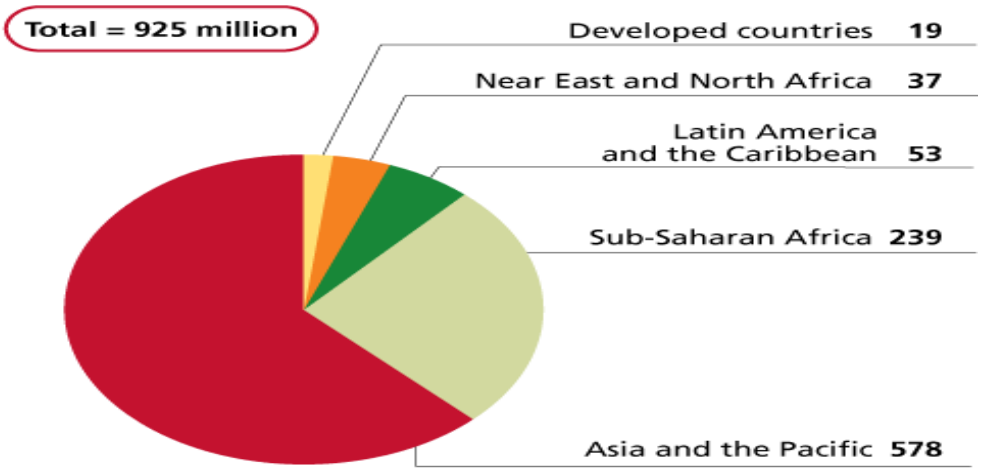
The number of undernourished people in the world remains unacceptably high at near one billion marks despite an expected decline in 2010 for the first time since 1995. This decline is largely attributable to increased economic growth foreseen in 2010 particularly in developing countries and the fall in international food prices since 2008. However, a total of 925 million people are still estimated to be undernourished in 2010. Developing countries account for 98 percent of the world's undernourished people (FAO & WFP, 2010).

According to the World Bank, between 45 to 50% of the population in Sub-Saharan Africa live below the poverty line, making it the poorest region in the world. FAO (2010) reports show that approximately 33 per cent of the population in Sub-Saharan Africa is undernourished. There are 307 million hungry people in Africa, with most of these living in Sub-Saharan Africa (265 million). More than 40% of the population in the Horn of Africa (HOA) is undernourished and millions are food insecure (FAO, 2010).

Worldwide, per capita food availability is projected to increase around 7 % between 1993 and 2020 from about 2,700 calories per person per day in 1993 to about 2,900 calories. Increase in average per capita food availability is expected in all major regions. China and East Asia are projected to experience the largest increase in per capita food availability and west Asia and North Africa the smallest. The projected average availability of about 2300 calories per person per day in Sub-Saharan Africa is just barely above the minimum required for healthy and productive life. Since available food is not equally distributed to all, a large proportion of the region's population is likely to have access to less food than needed (FAO, 2010).

By 2020, the number of food-insecure people in Sub-Saharan Africa is projected to exceed 500 million out of a total population of roughly 1 billion. The region's food security position also deteriorates

relative to the other regions. In 2020, the region accounts for only 27 % of the population of the 70 countries, but it has about a 59 % share of the total number of food insecure people (FAO, 2010).



Source: FAO, 2010

Figure 1 Hungry people in the world in millions (925 million in 2010)

2.11 FOOD INSECURITY IN THE HORN OF AFRICA

The Horn of Africa is one of the most food-insecure regions of the world. Out of a total population of almost 160 million, some 70 million people (around 45 percent) live in areas that have been subject to extreme food shortages and the risk of famine at least once every decade over the past 30 years (FA0, 2010) .

In East Africa as a whole, 42 % of the population is undernourished, and the figures for Somalia, Eritrea and Ethiopia are among the highest in the world. Chronic undernourishment is reflected in a very high incidence of stunting among children in low life expectancies. Child under nutrition, especially among those aged between six and 24 months is particularly damaging in that it results in a life-long reduction in physical and cognitive abilities, (FAO, 2010).

More than 40% of the population in the Horn of Africa (HOA) is undernourished and millions is food insecure. Those suffering most from food insecurity are subsistence farmers, pastoralists and agro-pastoralists whose livelihoods largely depend on agriculture and animal production. With limited food and water availability, animals produce less milk, which is more prone to diseases with their mortality incidence increases (FAO, 2010).

2.12 FOOD SECURITY IN NIGERIA

As a follow-up to the 1996 World Food Summit, Nigeria as one of the 82 low-income food deficit countries (LIFDCS) requested for assistance from the Food and Agriculture Organization (FAO) to establish its National Special Programme for Food Security (NSPFS). This is aimed at achieving food security and reduction in poverty as a step to realize the first Millennium Development Goal (MDG 1) which is reducing by half hunger and extreme poverty by 2015. The Federal Government of Nigeria (FGN) with assistance from FAO implemented the Special Programme for Food Security (SPFS) as a pilot programme in Kano State, with the objective of identifying, adapting, testing and promoting intervention packages that promote growth in the agriculture sector. The SPFS was further up-scaled into a five-year nationwide National Special Programme for Food Security (NSPFS) between 2001 and 2006, covering the whole country (3 sites per State which gave a total of 109 sites).

The programme was funded mostly by the FGN, States and local governments in the country while the FAO provided technical implementation assistance. International donor agencies including African Development Bank (AfDB) and Islamic Development Bank (IDB) also provided some funds for the programme. The FGN administered the funds. The states must pay their counterpart funds to the FGN in order to access the required funds. The programme covered about 30,000 farm families and the first phase was completed in June 2007.

The second expanded phase of the NSPFS called the National Programme of Food Security NPFS (2007-2013) started after the completion of the NSPFS in 2007. While NSPFS was operated in 109 sites, one

site per senatorial district, the NPFS involved expansion to three sites in each senatorial district. Therefore, 218 new sites were added to the existing 109 sites.

Thus, the expansion phase covered 327 Local government areas (LGA), slightly less than half of the total number of LGAs in the country with one site per LGA. It is expected that about seventy thousand (70,000) farm households (HH) would benefit directly from the programme while another 785,000 households would benefit through the outreach component. As with the NSPFS, the general objective of the NPFS is to increase national and household food security through the development of smallholder agriculture, increase incomes and reduce poverty in an economical and environmentally sustainable basis (NPFS, 2007). It emphasized the use of tested technologies, grassroots participation and South-South cooperation (Oriola, 2009).

The specific objectives of the program include the following:

i. Improve household food security and incomes through increases in agricultural productivity, diversification and sustainable use of natural resources.
ii. Enhance food security of consumers through improved availability of and access to a variety of foods.
iii. Increase the incomes of producers through the adoption of value addition to primary products and more efficient marketing.
iv. Enhance farmers and consumers access to support services such as extension, credit, nutrition and health education; and
v. Foster the participation of poorer section of the rural population such as women, youths and other vulnerable groups into the development of the community.

These objectives are to be achieved through four components:

Component 1: Site Development and Outreach

The objective of this component is to improve agricultural productivity, enhance processing, on farm storage and promote diversification of agricultural enterprises. It has the following sub-components.

i. Crop intensification
ii. Water use and control
iii. Soil fertility management
iv. Agro forestry
v. Animal production and health
vi. Aquaculture and Artisanal Fisheries Development
vii. Agro processing and On-farm storage
viii. Research Extension Farmer-Input linkage
ix. Nutrition and Health

Component 2: Community Driven Development

The objective of this component is to create awareness and facilitate the participation of rural communities in the programme through group formation and strengthening of existing ones. It has the following sub components.

i. Group and Community Development
ii. Marketing of Agricultural Inputs and Commodities
iii. Rural Finance

Component 3: Rural Infrastructure Component

This component is to provide and develop infrastructure such as feeder roads, culverts, drainages, markets and small earth dams where needed by the participating communities.

Component 4: Project Management Support Component

The component is to provide for both institutional and operational support for the implementation of the program. The Federal Ministry of Agriculture and Rural Development (FMARD) are responsible for national implementation through its Projects Coordinating Unit which coordinates implementation activities between Federal and States Governments. The FAO provides technical and advisory support for program implementation. The sub components are:

i. Federal Government Level Coordination
ii. State Government Level Coordination
iii. Local Government Area Level Coordination
iv. Planning, Monitoring and Evaluation

2.13 NIGERIAN POLICY ON RICE TOWARDS ACHIEVING FOOD SECURITY

Agriculture has remained the mainstay of the Nigerian economy since the 1960s until the discovery of oil. The Nigerian government depended on agriculture to provide infrastructure and run services. The broad goal of agriculture within this period was the rapid attainment of food sufficiency at least regarding the energy foods, vegetables and edible oils. This can be demonstrated by the efforts made by successive governments since independence to achieve food security in the country (Akpan, 2012).

Several programmes have been introduced in the country to attain food security. Such programmes include the National Accelerated Food Production Programme (NAFPP) in 1973, Operation Feed the Nation (OFN) in 1976, River Basin Development Authorities (RBDA) in 1977, National Agricultural and Land Development Authority (NALDA) in 1991, Agricultural Development Programmes (ADPs) in 1972, Green Revolution in 1980, Directorate for Food, Road and Rural Infrastructure (DFRRI) in 1986 etc (Jibowo, 2005).

Rice production in Nigeria is dominated by smallholder farmers with 0.5 – 1.5 hectare per farmer using manual labour for virtually all its operations. About 52 rice varieties with yield capacity of 2-8 tonnes per

hectare and maturity periods of 25 – 140 days have been developed. Most of these varieties are suitable for cultivation in diverse agro-ecological zones .The enormity of our national demand for rice and the need to conserve foreign exchange show clearly that the nation cannot depend on smallholder farmers. Thus the urgent need to address the production constraints for increasing output to satisfy domestic consumption and even produce for export becomes paramount (Akpan, 2012).

2.14 FACTORS AFFECTING FOOD SECURITY

A number of factors such as income, educational level, and household sizes are known to affect household food security, as they directly affect economic access and the sustenance of such access. Lack of food security, referred to as food insecurity, hunger, and poverty are closely linked. For farm households in rural areas, food availability means ensuring that sufficient food is available for them through their own production or purchase from markets. However, due to lack of adequate storage facilities and pressing needs, they mostly end up selling excess produce during the harvesting period, and sometimes rely on market purchases during the hunger season, thereby creating a situation of food insecurity for most rural farm households (Akinyele, 2009).

Food security is a term used to describe whether people are having access to sufficient quality and quantity of food or not. The Red Cross Society (RCS) observed that the factors that affect food security are complex and include such factors as HIV/AIDS, climate change, environmental degradation, conflict, population, governance and the state of public sector services. Others include poverty, rate of food production and the availability of infrastructures like the markets.

2.14.1 Climate Change

Climate change directly affects agricultural production as agricultural is inherently sensitive to climate conditions. As Ziervogel, Nyong, Osman, Conde (2006) observed, the consequences of climate change on agriculture include the drying out of water sources, scarcity of grazing lands, and shortage of dairy products and loss of wide plants for gathering, migration of grazers, poor harvest and livestock losses.

Climate change affects food availability, accessibility and utilization. For instance, the quantity of crop and livestock production are highly affected or determined by climatic conditions. It has been observed that too scanty or too heavy rainfall reduces crop production.

Also high temperatures reduce crop yields and livestock yields especially milk and egg production (Ziervogel *et al.* 2006).

2.14.2 Health

According to Mutangandura and Mukarazita (1999), the HIV/AIDS pandemic is generally negatively affecting the performance of smallholder agriculture and in particular their food security prospects. Resultantly, these reduce the area cultivated and shifts cropping pattern to less labor-intensive practices. An increase in household expenditures on Medicare results in declines in savings and the loss of assets through the sale of productive and non-productive assets. Thus the loss of human capital leads directly to declines in the financial capital of the household and consequently less food secure due to less production (FAO, 2000).

2.14.3 Agricultural production

Higher agricultural production can improve food security by decreasing food prices for consumers, increasing rural incomes and contributing to economic development. Studies show that a one percent rise in per capita agricultural output led to a one percent rise in incomes of the poorest 20% of the people in Bangladesh. However, improved agricultural production alone is not enough to achieve food security but requires the combination of other factors as institutional and industrial development (Postnote, 2006).

Science and technology can help boost agricultural production, improvement in cost and quality of food storage, processing, purchasing and marketing, labor-saving technologies and better communications. Improved crop varieties developed using traditional plant breeding methods and biotechnologies can help achieve higher yields, increased nutritional content, more tolerance to drought and more efficient use of

water and soil nutrients. Lack of access to agricultural knowledge, technologies and methods can affect food security.

2.14.4 Gender Issues

Gender refers to the socially assigned roles and behavior of men and women. It is the social meaning of biological sex difference. It affects the distribution of resources of wealth, work, decision-making and political power, and the enjoyment of rights and entitlements within the family as well as public life (Barnett and Rugalela, 2001).

While food security is traditionally viewed as having two dimensions- spatial and temporal, in fact it has three with gender being the third and the most overlooked. Identifying individuals' differential access to resources and benefits is the fundamental feature of gender analysis, and ensuring equitable access to resources and benefits is the fundamental feature of gender analysis, and ensuring equitable access and distribution will enhance food security (Johnson, Alemu, Msaki and Sengendo, 2000).

Research has clearly shown the different roles and responsibilities that men and women play in their individual lives, families, households and communities. Women also provide the majority of the care for the family take their children to hospitals and ensure a healthy environment- the very component of good nutrition. They may not have control over household's budget and may lack good education (United Nations Conference on Trade and Development, [UNCTAD] and the United Nations Environmental Protection, [UNEP], 2008).

2.14.5 Infrastructure

These include amenities like road, markets, communication networks etc. it has been found that the presence or lack of these will impact on food security. For example, lack of market can stop farmers from selling their surplus or purchase food in times of shortage. Also, the absence of good roads can hinder the movement of food from the farms, rural areas etc to places where there is demand for them say urban areas. This can create scarcity and cause food insecurity (UNCTAD and UNEP, 2008).

2.14.6 Conflict/Political Instability

Conflict and political instability can affect food security because food emergencies, reverse economic growth, destroy infrastructures and migration. Political problems including corruption, collusion and nepotism can significantly hinder any attempt to tackle food insecurity.

2.14.7 Income level

According to Hossain *et al.* (2005) the dominant determinant of food entitlement of households is obviously the level of income. Income level varies among individuals and has been found to be lower in rural areas than in urban areas. The income level also determines the per capita expenditure. Households with higher income level are more likely to have a higher per capita expenditure majority of which goes into feeding.

According to Sen and Hume (2004) income level determines the standard of living. Low income earners are more likely to have a lower standard of living than high income earners. This translates to the level of poverty and the purchasing power of households as low income households will have a low purchasing power and a high level of poverty.

2.15 FOOD COPING STRATEGY CONCEPT

Generally, households that face the dilemma of food shortage do not sit back in despair. To combat food shortages, the households engage in food-acquiring activities or change their eating behavior; these responses are known as food-coping strategies. Food-coping strategies are defined as the mechanisms employed by households when the means of meeting needs are disrupted by one or a combination of factors, including drought, low income, or high food prices (Ninno *et al*., 2003).

The definition by Snel and Staring (2001) captures the broad notion of coping strategies, namely that "all the strategically selected acts that individuals and households in a poor socio-economic position use to restrict their expense or earn some extra income to enable them to pay for the basic necessities (food, clothing, shelter) and not fall too far below their society's level of welfare" (Snel and Staring, 2001).

Above all, the general tendency is that the lower the household asset status, the more likely the household would engage in erosive responses such as selling off productive assets such as farm implements (Hoddinott, 2004).

Households that do not experience severe food shortages may employ Food Coping Strategy to add variety to their monotonous diet, whereas households that run short of food employ strategies to increase the availability of food. Even though many families are caught up in the dilemma of food insecurity, girls and women, as the primary food producers and providers in African households, will struggle and devise means (strategies) to put food on the table and to keep the stomachs of the household members full (Maxwell *et al*, 1999).

Administration of these Food Coping Strategies indicates a problem of household food insecurity, but not necessarily the intensity (severity) of the food insecurity. Thus, for example, a household that skips meals for the whole day is more food insecure than one that switches from consuming meat to consuming soya mince (Maxwell *et al*., 2003).

Generally, there is no universal set of Food Coping Strategy; however, they tend to follow the same pattern and can be grouped into four categories: altering the diet, food rationing, food-seeking strategies, and altering the household as put forward by Kruger *et al* (2008).

Table 2: The Four Generic Categories of Food-Coping Strategies

Category	**Explanation**	**Examples**
Altering the diet (dietary Change strategies)	Use of less preferred or cheaper food items	Substituting milk, fish, or eggs for meat
Food rationing (managing insufficiency)	Skipping meals Staying hungry the whole day, without meals Feeding working members at the expense of none working members (buffering) Limiting portion sizes	Eating 1 or 2 meals instead of at least 3 per day Giving fathers larger shares while other members (especially women and children) receive small portions
Food seeking (increasing The amount of food available in the short term)	Borrowing food or money Gathering wild food	Borrowing money to buy food Borrowing food Purchasing food on credit
Altering the household (household structure strategies)	Sending children away Decreasing the number of people to be fed in the short term	Sending children to eat or stay with friends or relatives

Source: Kruger *et al*., (2008).

2.17 THEORETICAL FRAMEWORK ON FOOD SECURITY

This study is guided by two theories of food security namely, Malthusian and Anti-Malthusian theory and the entitlement approach to food security. The entitlement to food theory which contends that food insecurity occurs due to people lacking entitlement to access food, and Malthusian theories which argues that population increase causes food scarcity; and Anti- Malthusian which argue the opposite to the Malthusian theory, thus an increase in population causes increase in food production (Kayunze, 2008).

2.17.1 Malthusian and Anti-Malthusian theory

Malthusian and Anti-Malthusian theories take two contentious positions in relation to food availability and population growth. Kayunze *et al*., (2007), argued that food insecurity is caused by having being too many people compared to the amount of food produced. Population increases in a geometrical manner and food production increases only in an arithmetical ratio. This means that a strong and constantly

operating check on population from the difficulty of subsistence is a necessity. However, other Anti-Malthusians argue that there can never be too many people in a country.

Education may lead to lower birth rates, and therefore, reducing family size and expansion of food production for example during the green revolution of India in the 1970s as a result of improved agricultural technology is difficult today because the environmental changes has left farmers with few options to improve food crop output. Demands for water irrigation water the use of additional fertilizers on currently available crop varieties has little or no yields increase While Malthusians are pessimistic and argue that in future there will be too little food for the increasing population, Anti-Malthusians comments that improved agricultural technology will increase food production (Kayunze *et al.*, 2008).

2.17.2 The Entitlement Approach to food security

The entitlement approach to hunger discusses the ability of people to command food through the legal means available in the society. Entitlements are defined as the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces (Young *et al*., 2001).

According to Sen, (1981) people's exchange on entitlements reflects their ability to acquire food. Sen sub-divides these entitlements as follows:

i. production-based entitlements
ii. own-labour entitlements
iii. trade-based entitlements; and
iv. Inheritance and transfer entitlements.

He argues that people do not usually starve because of an insufficient supply of food at the local, national, or international level, but because they have insufficient resources, including money ('entitlements') to acquire it. Some of the limitations of Sen‟s work include the entitlement approach

which views famines and other food-related emergencies as economic disasters. His approach concentrates on rights within the given legal structure in that society, but some transfers are illegal acts, and therefore not accommodated by the entitlement approach nor can they be measured easily (Young *et al*., 2001).

Understanding the severity of food insecurity is essential for determining the best type of coping strategies (Young *et al*., 2001). Again Sen, (1984) also argue that during war, the ratio of food producers to food consumers falls, employment-based entitlements, during a war cash crop production and marketing networks collapse, employment opportunities (demand for agricultural labour, petty trading activities) contract and farmers and pastoralists are attacked for food and livestock. Entitlement theory has been criticized on two further counts. First, it implies a straightforward sequence of entitlement failure leading to hunger and then to malnutrition, starvation and death. Second, it implies that people's actions are largely determined by their need to consume food (Young *et al*., 2001).

Production based Entitlement

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

Inheritance and transfer entitlements

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

Trade-based entitlements

Food prices vary seasonally, but poor households often sell their crops just after harvesting at lowest price because of an urgent need for cash for credit payments, school fees and medical bills. Market forces in terms of supply and demand for food affect food prices hence the extent to which various people have access to food through buying it. The supply of food can be compounded by poor infrastructure, or poorly integrated food markets in famine-prone areas as well as high transport costs and risks.

According to Graaf (2011), high transport costs, small markets and lack of infrastructure are the main common factors that affect agricultural production and food security negatively in all SSA countries. Food production greatly affect food markets, because it takes time for planted seeds to bear fruits, food production cannot be expanded rapidly, and the supply of food will be inelastic with regard to demand. Consequently, where the level of food supply is low, relative to its demand, the prices will tend to rise. On the other hand, where the supply is greater than the demand, prices will tend to fall (Graaf, 2011).

Own-labour entitlements (waged labour and professions)

Own-labour entitlements help people to generating sufficient income to allow people to access food. Improving access to food through increasing incomes can be seen as helpful to look at the impact of increasing agricultural productivity in three main areas which hare direct impact on farmers, incomes, including those of smallholders, impact in terms of increasing rural employment opportunities and rural wage rates including those in the non-farm rural economy and wider impact on economic growth and poverty reduction more generally. In response to a decline in people's entitlements, people actively try to protect their livelihoods. These livelihoods are normally termed as coping strategies and they can be as short-term and long term coping strategies in responses to declining food entitlements (Young *et al*., 2001).

2.18 EMPIRICAL REVIEW

Socio-economic characteristics of arable crop producers Socio-economic characteristics play significant role in the farmers‟ lives in the sense that they influence willingness to accept changes which contributed significantly in raising farm productivity and ultimately their standard of living. Some of the most commonly used socio-economic variables includes age, sex, marital status, level of education, household size, farm size, farming experience, land acquisition, labour, access to credit, member of cooperative, extension contact and other estimated economic variables like income, output and standard of living.

In the study of Onwueme and Sinha(1999) observed that more than half (58.3%) of the farmers cultivated their rice between May and June, (34.2%) between July and August while only (7.5%) planted between March and April. The reason for planting of rice around May, June, and July is because rice requires enough moisture and rainfall provides adequate water in the soil during this period of the year.

According to Emmanuel *et al*. (2006) farmers participating in irrigation project had some type of formal education and not all of them are illiterate. In survey of pigeon pea production systems utilization and marketing in semi-arid lands of Kenya, the average age of farmers in both locations was 46.5 years with over 40% having attended at least 4 years school and average family size was 8.6 people (Mergeai *et al*., 2001).

Muhammed-Lawal *et al*. (2009) also reported that 82.73% of the youth in agriculture are male. Chikezie *et al*. (2012) revealed in his findings of factors constraining rural youth involvement in cassava production that majority of the youths in Onu-Imo local government area of Imo State were at the productive age where their energies could be harnessed and utilized for productive venture in agriculture especially cassava production. From his findings 9.17% of the respondents were less than 20 years, 43.33% and 33.33% were between 21–25 years and 26–30 years, respectively, while only 14.17% of the respondents were more than 30 years of age. He also revealed that 81.67% of the respondents were male,

while 18.33% were female. According to Adewale *et al*. (2005) gender is no barrier to active involvement in cassava production activities.

Abdullahi *et al.* (2012), which reported that in Ikara Local Government Area of Kaduna State, majority of the sampled respondents were middle aged farmers. Similarly, this finding is in line with Okwoche *et al* (2012) found that 37.68% of sampled respondents were between 30 and less than 40 years, while 30% of the farmers were between 20 and 30 years. The implication of the foregoing results is that rice farming in the study areas has higher patronage among young people who are energetic enough to withstand the stress involved in the rice farm operations and more so that rice farming is dominated by men considering the data from these Northern State. The result is also confirmation of Asogwa *et al.* (2012), findings on age, ranging between 31 and less than 40 years is predominant with 42%. Also 32% of the respondents are of the age of between 20 and less than 30 years.

Level of Education of farmers according to Mustapha *et al.* (2012), shows that most (41.10%) of the respondents had formal education. This implies that the respondents could apprehend the improved technology being disseminated to them. The findings was in agreement with that of Asogwa *et al* (2012), who asserts that most of respondents in study area have formal education (54%0).This result suggests that almost all the respondents are literate enough to give room for effective communication in doing their rice farming business in the study area. This is acceptable on the ground that education affects the way farm business is managed as well as overall production (Nkang *et al*., 2009). Educational level plays a good role in adoption of new policy and undertaking risks.

Daudu and Ajayi (2009) assessed the performance of the NSFSP in Benue State. The study concludes that the performance of the programme was high in the following components; farm intensification, water management, diversification, fisheries, and group management based on the performance indices. While the following components: Input distribution, credit and cost recovery, and agro-processing recorded low

performance. They also indicated that the major problems faced by the programme were language barrier, untimely release of funds, lack of means of transportation and untimely supply of inputs.

Ayoade *et al*. (2011) investigated the impact of NSPFS on poverty alleviation among women in the three project sites of Oyo State. The women‘s participation has significantly improved their mobility status and water consumption. Loans provided for the project participants assisted the recipients in boosting their farm production as a result of increase in farm size cultivated. A significant relationship was found between output, level of participation, marital status and poverty alleviation level.

Ahmed (2015), in his study found improved seed to have significant positive effect with the food security status of households. Households using improved seed are more likely to be food secure than those who did not apply. Improved seed and other technological inputs help farmers to augment productivity and to boost production. Farmers can enhance their production by using high yielding varieties and other complementary farm. He also found non-farm income to have significant and positive relation with the food security status of the household indicating farmers engaged in non-farm activities have better chance to be food secure.

Oriola (2009) developed from his study titled a ‘’Framework for Food Security and Poverty Reduction in Nigeria’s ‘’framework for understanding the relationship between irrigation system, food production and poverty. He recognizes the natural endowment; soil and water resource of the nation for productive agriculture and irrigation technology as remedy to vagaries of weather as militating factor against adequate food production. He concludes that with the full commitment of all the three tiers of government to agriculture, through the proposed framework for irrigation projects, the projects will bring out the best from both the small and large-scale schemes all over the country. The schemes will be more functional, efficient, generate employment, enhance farmers ‘income and reduce poverty and at the end make food security sustainable.

Mercy (2010) carried out a study on the determinants of food security in Nigeria. She examined the determinants of food security in Nigeria with food security index (FSI) proxied by per calorie availability between 1976 and 2006 and also the structural factors influencing the food deficit profile of the country. Total Domestic Output of Food (TDOF), Food Imports (FIMP), Real Per Capita Income (RPCI), Domestic Food Price Index (DFPIX) and Share of Government Expenditure in Agric (SAGE) were identified as factors determining food security. The study brought into focus the need to increase total domestic output of food, reduce the level of food imports, and increase agricultural funding and policies that will improve income in order to achieve food security.

CHAPTER THREE

3.0 METHODOLOGY

3.1 THE STUDY AREA

Kano State is located between latitudes 12°0'7.85"Nand longitude 8°35'31.04"E. The State has a land mass of about 20,760km^2.As at 2014, the State has a projected population of 11,923,539 at annual growth rate of 3.2% (NPC, 2006). The State is agrarian, as more than 65 percent of the working adults are engaged in farming and farm related activities for their means of livelihood. The average annual rainfall is 700mm, with the mean daily maximum and minimum temperatures of $35^0$and 19^0 Celsius, respectively. The major crops grown in the State include rice, millet, maize, cowpea, vegetables and groundnut (NAERLS, 2012).

Kano State is bordered to the North and Northwest by Katsina state, to the east and northeast by Jigawa State, to the south by Bauchi State, and southwest by Kaduna state (Official Gazettes of the Federal Government of Nigeria, 2007). Agriculture is the main stay of the teaming populace which accounts for up to 70% of the source of livelihood of the population nearly 90 percent of the population work primarily in Agriculture (World Bank, 2000).

Urban part of Kano accounts for 37% of total population of the state and the city is undergoing rapid population growth of more than 6.5 percent per year accompanied by rapid development pressure with high demand for housing and infrastructure (2006, Census report). The impact of human activities (farming and grazing) and natural disasters (drought and flood) have degraded most of the vegetation covers. The main livelihood of the people is agriculture of which rice is among the most important crop both in production and consumption.

Finally, Kano State is divided into three (ADP) Zones, namely; Zone I :(Rano Zone comprising 14 LGAs); Zone II :(Danbatta Zo ne comprising 14 LGAs and Zone III :(Gaya Zone 16 comprising 16 LGAs)

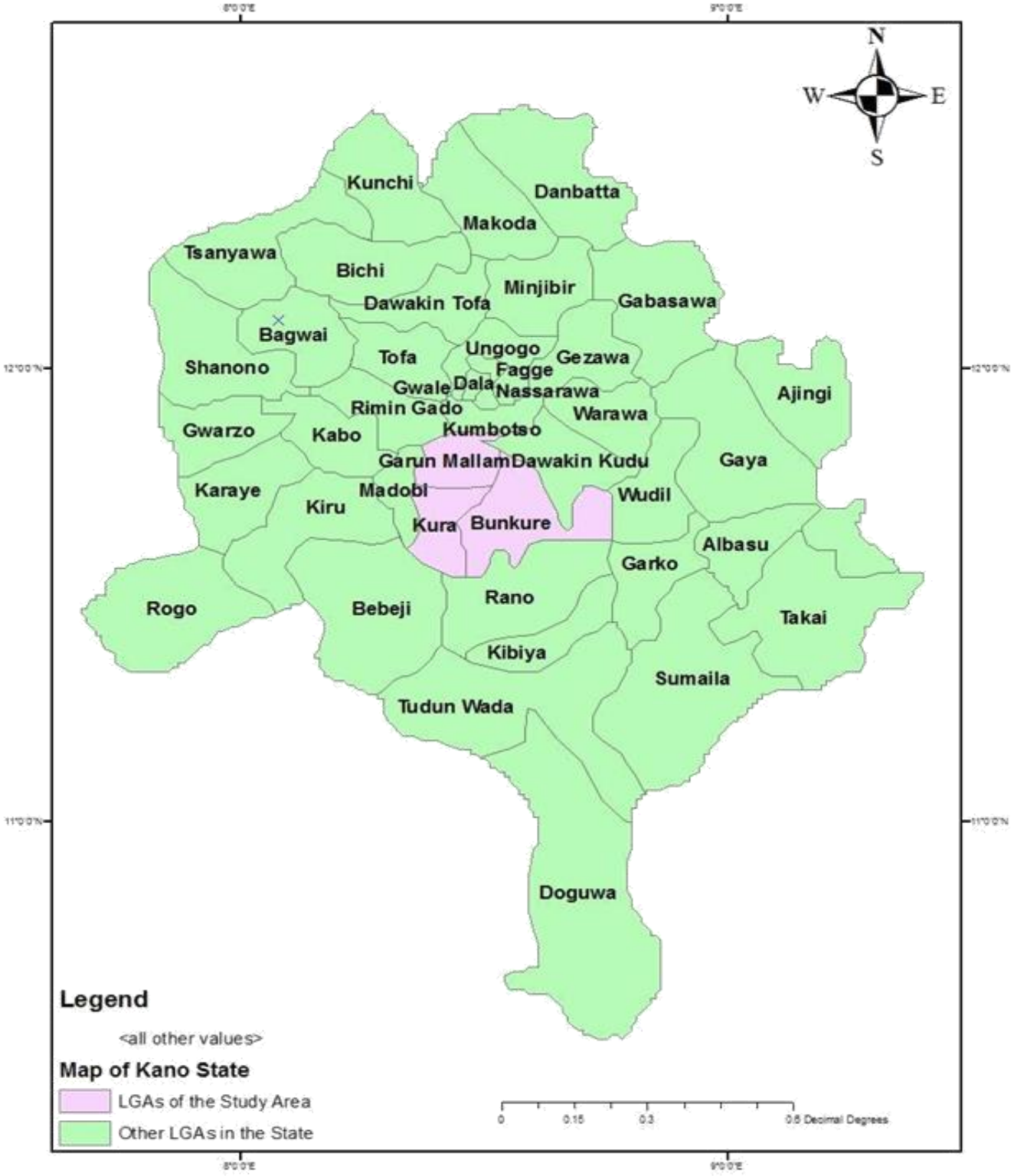


Figure 3.1: The Map of Kano State

3.2 SAMPLING TECHNIQUES

The study targeted smallholder rice farmers registered with rice farmers association of Nigeria (RIFAN) in Kano State. Multi-stage sampling procedures were used in deriving the samples for the study. Firstly, a purposive selection of Rano zone because of the intensification of rice farming in the area. Secondly, a purposive selection of three (3) LGAs namely; Bunkure, Kura and Garun Malam because they are major rice producing local governments in the zone. Thirdly, a random selection four major rice producing communities from each LGA which makes a total of 2025 farmers. Finally, quota sampling was used to select 20 farmers across the 12 communities in the 3 LGAs randomly making a total of 240 farmers. This was determined at a confidence level of 90%, and response distribution of 50% using Raosoft sample size calculator.

Table 3: Summary of sample frame and sample size

LGAs	**Selected Communities**	**Name of Cooperative**	**Sample Frame**	**Sample Size**
Kura	Kurunsumau	Imamai Central Young Farmers	199	20
	Kura	Gurguzu Farmer's society	178	20
	Dan Hassan	Danhassan Rice/Tomato Farmers	177	20
	Butalawa	Butalawa sauki farmer	156	20
Sub total			**710**	**80**
Garun	Garun-Babba	Kofar Gabas Fadama Farmers	184	20
Mallam	DorawarSallau	Nata'ala Rice farmers	168	20
	Yadakwari	Raje Yadakwarifadama farmers	156	20
	Chiromawa	Fegin malufadama III farmers	148	20
Sub total			**656**	**80**
Bunkure	Kulluwa	Unguwar luku kulluwa farmers	179	20
	Bunkure	Bunkure Rice Farmers.	168	20
	Gafan	Gafan II water users	160	20
	Gurjiya	Gurjiya Dankoro Rice Farmers	152	20
Sub total			**659**	**80**
Total			**2024**	**240**

Source: RIFAN, 2017

3.3 DATA COLLECTION

The main source of data for this study was primary source. The data were collected through a field survey of the selected smallholder rice farmers using a well-structured questionnaire with the help of trained enumerators. The questionnaire was designed to capture information on the socio-economic characteristics of the smallholder rice farmers in the study area, the amount of different inputs employed in the production, total output realized, the farmer's food security status, factors responsible for food insecurity and coping strategies employed in the event of food shortages.

3.4 ANALYTICAL TOOLS

The analytical tools used in analyzing the objectives of this study include; Descriptive statistics (objective i), Stochastic frontier production function Model (objective ii) to determine the economic efficiencies in rice production, Household Food Security Survey Model to assess the farmers food security status (objective iii) and Likert scale to identify the factors responsible for food insecurity and coping strategies in the event of food shortages (objective iv and v), respectively.

3.4.1 Descriptive Statistics

Descriptive Statistics deals with the presentation of numerical facts, or data, in either tables or graphs form, and with the methodology of analyzing the data. The Descriptive tools employed include frequency, simple percentage, mean and standard deviation, and charts were used in analyzing the data to describe the socio-economic characteristics of the smallholder rice farmers in the study area.

3.4.2 Stochastic Frontier Production Function

Microeconomic theory states that the objective of firms is to produce the maximum output utilizing given inputs, to minimize costs at given outputs, or to efficiently allocate input and output in order to maximize profits. A frontier defines the maximum feasible output in an environment characterized by a given set of random factors. The stochastic components describe random shocks affecting production. Each producer

faces a different shock, but it is assumed that the shocks are random and they are described by a common distribution, (Kent and Vu, 2009).

The result was estimated using the maximum likelihood method. The stochastic frontier production function is written as:

$Yi = f(X: \beta) + ei$ …… (7)

$ei = Vi - Ui$ ……(8)

where;

Yi = Output of the ith farm

Xi = Vector of inputs used by the ith farm

B = A vector of the parameters estimated

ei = Composite error term

Vi = Random error outside farmer's control

Ui = Technical inefficiency effects

Therefore, this study specifies the stochastic frontier production function using the Cobb-Douglass frontier production function. The model is specified as;

$lnYi = \beta o + \beta 1 lnX1 + \beta 2 lnX2 + \beta 3 lnX3 + \beta 4 lnX4 + \beta 5 lnX5 + Vi - Ui$ …… (9)

where;

ln= Natural Logarithm

Yi = Quantity of rice produced (kg)

X1 = Farm size devoted to rice production (ha)

X2 = Quantity of seed used (kg)

X3 = Labor input used (both family and hired labor) (man days)

X4 = Quantity of fertilizer (kg)

X5 = quantity of herbicides (Liters)

Vi = Error term which are random variables

Ui = Error term which are non-random variables or technical inefficiency effect

βo= Intercept

β1-β5 = Regression coefficients

3.4.2.1 Technical Inefficiency

The Technical inefficiency model is specified as;

$Ui = \delta o + \delta 1Z1 + \delta 2Z2 + \delta 3Z3 + \delta 4Z4 + \delta 5Z5 + \delta 6Z6 + \delta 7Z7 + ei$ …… *(10)*

Where;

Ui = Technical inefficiency effect of the ith farm

Z1 = Age (years)

Z2 = Household size (Number of persons)

Z3 = Education (years of formal education)

Z4 = Access to credit (amount borrowed in ₦)

Z5 = Extension contact (Number of visit per year)

Z6 = Membership of association (Years of participation)

Z7 = Farming experience (years)

δ1-δ7 = Parameters to be estimated; and

ei= Error term.

3.4.2.2 Allocative Efficiency

The allocative efficiency also known as cost efficiency was determined using the cost frontier dual to the production frontier expressed as follows; the allocative efficiency was calculated using the Cobb-Douglas stochastic frontier cost function specified as follows:

$lnCi = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + Vi+Ui$ …… *(11)*

where;

Ci = Total cost of rice produced (N)

βo= intercept or constant

$\beta 1$-$\beta 4$= Parameters to be estimated

$X1$ = cost of renting land (₦)

$X2$ = Cost of seed (₦)

$X3$ = Cost of fertilizer (₦)

$X4$ = Cost of agrochemicals (₦)

$X5$ = Cost of labor (₦)

Vi = Error term which are random variables

Ui = Error term which are non-random variables or technical inefficiency effect

3.4.2.3 Economic Efficiency

Economic efficiency is the product of technical (TE) and allocative efficiency (AE) (Coelli, 1996; Coelli *et al.,* 2005). Economic efficiency (EE) is also defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost. It is equal to the product of technical efficiency and allocative efficiency expressed as;

$$EEi = TEi * AEi \quad \ldots\ldots (12)$$

Where;

EEi = Economic efficiency

TEi = Technical efficiency and

AEi = Allocative efficiency.

3.4.3 Household Food Security Survey Model

The USDA Household Food Security Survey model (HFSSM) is a measure of the severity of household food access problems. It is based on self-reported behaviors, experiences, and conditions collected by interviewing one member of each household using a standardized survey instrument (Bickel, Nord, Price, Hamilton and Cook, 2012).

This model categorizes households using a constructed food security scale. This scale is a number continuum in a linear scale that ranges between 0 and 18. The scale measures the degree of food insecurity/hunger experienced by households in terms of a single numerical value. These questions capture four kinds of situations or events all related to the general definition of food security. These include both qualitative and quantitative aspects of households' food supply as well as household members' psychological and behavioral responses. It reflects the households' situation over the 12 months before the interview (USDA, 2012).

A household is classified into one of the food security status- level categories on the basis of its score on the food security scale, while the households' scale score is determined by its overall pattern of response to a set of indicator questions. For instance, a household with a scale value of 6 has responded affirmatively to more questions that are indicators of food insecurity than for a household with a scale value of 3. A household that has not experienced any of the conditions of food insecurity covered by the core questions will be assigned a scale value 0, while a household that has experienced all of them will be scored scale values close to 18. In general, the set of questions works symmetrically together to provide a measurement tool for identifying the level of hunger experienced in a household, (Jensen, Rabbitt, Gregory and Singh, 2015).

Ibok (2012) carried out a study on analysis of food security and productivity of urban crop farmers in Cross River State and he used household food security survey model to determine the food security status of the respondents. Fakayode, Rahji, Oni and Adeyemi (2009) used household food security survey

model to analyze farm household's food security in Ekiti State.

Therefore, HFSSM model used coding survey responses for food security scale: each household's response was assessed from the food security continuum. To do this, their response to each of the questions as either affirmative or negative was coded. These questions have three response categories namely; often true, sometimes true; and never true.

Also, in terms of severity, USDA (2012) further categories the households into 4 namely:

i. **High food secure households**: these are households that had no problems, or anxiety about, consistently accessing food. The group's value is 0 on the food security scale.

ii. **Marginal food secure households:** Households had problems at times, or anxious about accessing adequate food, but the quality, variety and quantity of their food intake were not substantially reduced. Therefore, they show adjustments in their daily food management. This group's value ranges from 1 to 2 on the food security scale.

iii. **Low food secure households:** These groups of households reduce the quality, variety and desirability of their diets but, the quantity of food intake and normal eating patterns were not substantially disrupted. The group's value ranges from 3 to 7 on the scale.

iv. **Very low food secure households:** For this group of households, at times during the year, eating patterns of one or more members were disrupted and food intake reduced because the household lacked money and other resources for food. The group's value on the food security scale ranges from 8 to 18.

3.4.4 Likert Scale

A Likert Scale is a type of rating scale used to measure attitudes or opinions. With this scale, respondents are asked to rate items on a level of agreement. Once the respondents have answered, numbers are assigned to the responses. This enables you to assign meaning to the responses. Most Likert scales are

classified as ordinal variables. If you are 100% sure that the distance between variables is constant, then they can be treated as interval variables for testing purposes (Singletary, Emsy and Hill, 2011).

Therefore, this section dwelt on factors responsible for food insecurity among households. Here the respondents were requested to indicate the extent to which a list of factors were responsible for food insecurity of their households on a 5 point Likert type scale as: Strongly Disagree = 1, Disagree = 2, Undecided = 3, Agree = 4 and Strongly Agree = 5

Any factor with mean score greater than or equals 2.5 were regarded as factors affecting food insecurity of their household to a large extent while factors with mean scores less than 2.5 were regarded as factors not really responsible food insecurity. Thus, the mean score of the respondents was obtained as follows;

$$\Sigma fx/\Sigma x = 4+3+2+1 = 10 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$\Sigma fx/\Sigma x = 10/4,$$

$$\Sigma fx/\Sigma x = 2.5$$

On the other hand, this was used to achieve objective vii. The basic idea of using the coping-strategy index tool is to measure the frequency of the coping strategies. That is how often is the coping strategy used, as well as its severit and what degree of food insecurity does the strategy suggest (Maxwell *et al*., 2003). Therefore, 12 strategies or responses to food insecurity were identified on the basis of extensive literature survey in Nigeria. These are:

1. Buying from market
2. Eating less preferred food (e.g. fish for meat)
3. Borrow money or food from friends/relatives
4. Consumption of seed stock for next year
5. Reduced number of meals for adults
6. Work for food or money (cash for work)
7. Send out children for paid jobs

8. Sale of livestock

9. Gather wild food like hunting/scavenging

10. Sale of assets like land

11. Begging

12. Migrate to cities

The respondents were requested to indicate the coping strategy employed on a 5 point Likert type scale as: Never = 1, Hardly = 2, Sometimes =3, Often =4 and Always= 5.

3.5 DEFINATION OF VARIABLES

A. Age: This refers to the number of years of an individual attained from birth. It is a continuous variable and it was measured in years. The higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as production (Hofferth,2003).The estimated coefficient of age is expected to have negative relation to output produced.

B. Labour: Labour is the effort or strength exerted to accomplish work done which could be family or hired. Availability of labour is important in agricultural activities because it enhances the level of production, and it was measured in man-hour per day.

C. Education level: Education is generally considered an important variable that could enhance farmer's acceptance of new technologies. Level of education was measured by number of years spent in formal schooling. The estimated coefficient of education was expected to have negative relationship with output produced.

D. Farming experience: This is an experience gain with age while carrying out farming operations. As the age increases among the farmers, their years of experience also increase. This variable was measured in number of years the respondent has being into rice production. The estimated coefficient of farming experience is expected to have negative relation to output produced.

E. Household size: This is the number of people in a given house-old. Household size is the number of people eating from one pot (Ojuekaiye, 2001).The larger the family size the more favorably disposed will be the members to adopt the recommended rice production technology. The estimated coefficient of household size is expected to have negative relation to rice output.

F. Farm size: This refers to area or portion of land that is put into rice production. In other words, it is the total area of the farm land measured in hectares operated by the respondents in the study area. The estimated coefficient of farm size is expected to have positive relation to output produced.

G. Access to credit: Credit is a very strong important factor that is needed to acquireor develop farm enterprise (Ekong, 2003). Its availability could determine adoption of recommended rice production technologies. This was measured as amount received in naira. The estimated coefficient of credit obtained is expected to have negative relation to output produced.

H. Co-operative membership: Co-operative groups are organized for the promotion of special interest or meet certain needs that cannot be achieved by the individual efforts. They contribute to the dissemination of new ideas, practices and products as well as in sourcing for loan and farm input (Chikezie *et al*., 2012). This was measured in years of participation. The estimated coefficient of cooperative membership is expected to have negative relation to output produced.

I. Extension contact: Agricultural extension service constitutes a driving force for any agricultural development. The relationship between agricultural extension agent and the farmer is an important determinant in improving yield of rice as well as in ensuring food security (Chikezie *et al*., 2012). It was measured in terms of number contact made by an extension agent. The estimated coefficient of extension contact is expected to have negative relation to output produced.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF SMALLHOLDER RICE FARMERS

Socio-economic information of the farmers with regards to food security is very important as studies have shown that outstanding factors which include age of farmers, gender, level of education, household size, farm size, non-farm income, amount of credit obtained, membership of cooperatives, extension contact and extent of involvement in farming have been shown to affect the productivity of farmers and invariably their wellbeing (Sanni, 1991and Ojeleye, 2002). The socio-economic variables are presented in Tables 3.

Table 4: Educational status of smallholder rice farmers in Kano State

Variables	**Frequency**	**Percentage**
Qur'anic education	126	52.50
Primary education	56	23.33
Secondary education	29	12.10
Tertiary education	29	12.07
Total	**240**	**100**

Sources; Field survey, 2017

4.1.3 Educational status

This determines the level at which the head of the household is informed. The result presented in table 4 shows that 23.33% of the rice farmers acquired primary education, the rice farmers that acquired secondary and tertiary education had 12.10% and 12.07%, the majority of the respondents which had 52.50% acquired Qur'anic education. This low level of western education of the farmers makes it difficult for the farmers to acquire modern techniques of coping with plant diseases, which corroborate the findings of Barrett and Aboud, (2002) that formal education may enhance or at least signify latent managerial ability and greater cognitive capacity in the acquisition of new technology in the study area.

Table 5. : Age, Family size, Years of experience and Farm size of the rice farmers

Variable	Frequency(n=240)	Percentage	Min	Max	Mean	S.D
Age (years)						
30-36	18	7.5				
37-43	83	34.6				
44-50	92	38.3				
51-57	30	12.5				
58-64	17	7.1	30	61	45.64	7.324
Family size (No.)						
1-5	99	41.2				
6-10	129	53.8				
11-15	6	2.5				
16-20	3	1.2				
21 and Above	3	1.2	1	22	12.57	6.52
Years of experience						
11-18	33	13.8				
19-26	86	35.8				
27-34	76	31.7				
35-42	37	15.4				
43-50	8	3.3	6	44	27	8.64
Farm size (hectares)						
0.1-0.58	32	13.3				
0.59-1.07	57	23.8				
1.08-1.56	38	15.8				
1.57-2.05	75	31.2				
2.06-2.54	38	15.8	0.1	2.5	2.07	2.31
Total	**240**	**100**				

Source: Field survey, 2017

4.1.5 Age of the rice farmer

Table 5 reveals that the minimum age was 30 years and the maximum is 61 years, farmers that are within the age range of 30-36 covered 7.5%. The result also reveal that the farmers that are within the age range of 37-43 years were 83 (34.6%) of the total rice farmer respondent and 2 (38.3%) of the rice farmer respondents were within the age range of 44-50, 30 (12.5%) of the rice farmers are within the age range of 51-57, and the remaining 7.1 % are within the age ranges of 58-64.This show that most of the rice farmers in most community are young still strong and active for farming activities. This is related to the definition of FAO (2008) that those that are within the age ranges of (19-49) are economically productive in a population.

4.1.6 Household size

Table 5 reveals that those that had family members from 1-10 were 40.4%, while those with family size of between 11-20 were 54.6% between 21-30 (2.5%), and between 31- 40 (1.3%), and those that have family size range of 41-50 are also 3 (1.2%). This shows that those that have 11-20 are the majority and produce more because of high needs of the family members and they even incurs low cost in production because the more the family size, the less the cost of production because family labour is by far cheaper than hired labour. Family size to a greater extent determines the level of rice productivity of the farmers, and also their capacity to adopt better coping strategies. Kehinde (2011) confirmed this saying that large household size increases the farmer's tendency to adopt new technology.

4.1.7 Years of Experience

Table 5 reveals that the rice farmers who fall within the years of experience 11-18 years are33 (13.8%) while those that have 19-26 years of experience are 86 (35.8%), 76 (31.7%) covers those that have 27-34 years of experience and those that have the experience of 35-42 years range are 37 (15.4%), the result also reveal that the remaining 8(3.3%) have years of working

experience of between the range of 43-50. The result shows that none of the rice farmer respondent had the farming experience of less than 11 years which is reflected in different coping strategies adopted by the rice farmers, because the more experience the farmer has, the more is the ability of the farmer to device more coping strategies, which is in consonance with the finding of Sadiq *et al* (2013).

4.1.8 Farm size

Table 5 also reveals that rice farmers that have the farm sizes of between 0.1-0.58 ha are 32(13.3%) of the total 240 rice farmers, 57(23.8%) out of the total rice respondent has farm that has the size of between 0.59-1.07/hectare, (15.8%) which is 38 of the total farmer respondents owned farms that are within the sizes of 1.08-1.56, and also 75 (31.2%) of the total rice farmer respondents have the farm size ranges of between 1.57-2.05 hectare, the remaining 38(15.8%) of the rice farmer respondents have farm size of between 2.06-2.54 hectare . This shows that 100% of the total rice farmers are smallholder who produces mainly for sale and consumption.

4.1.9 Years of Membership of Cooperatives

Figure 4.1 shows the distribution of the respondents by their years of membership of cooperatives. Membership of cooperatives influences adoption of improved technologies resulting in higher productivity and poverty alleviation (Amaza *et al*, 2009).

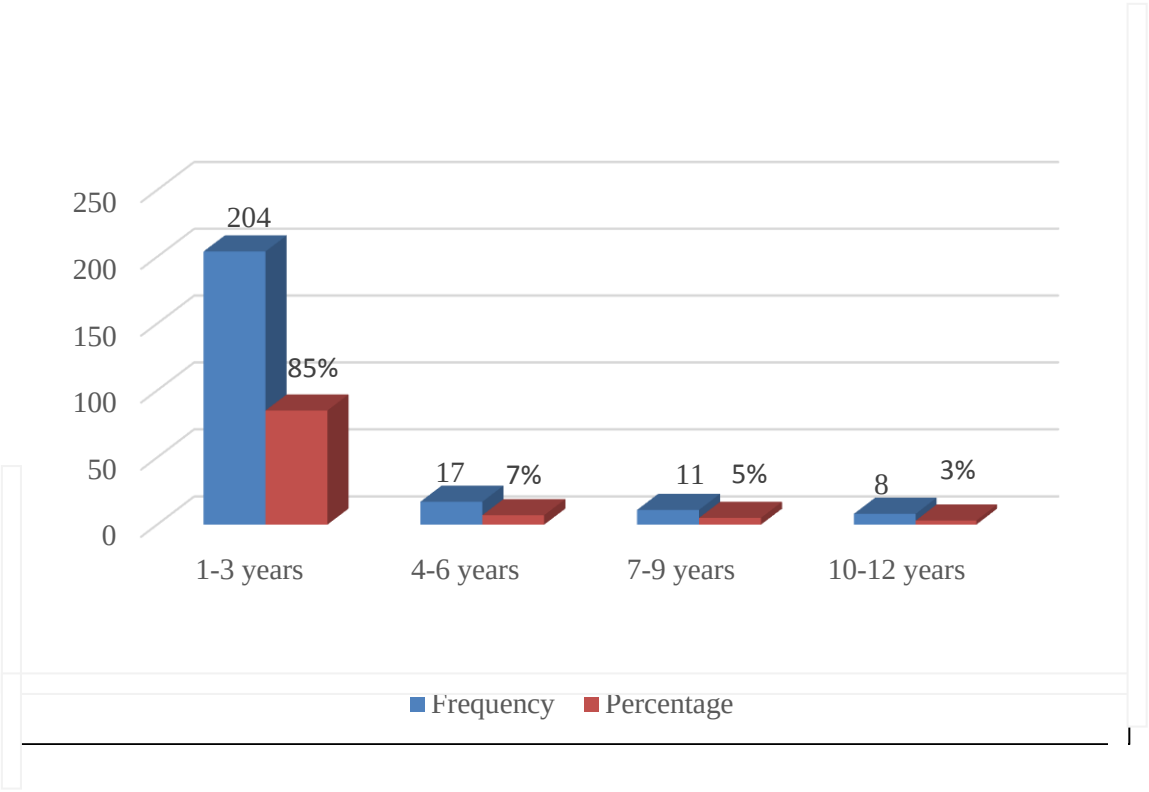


Figure 4.1: Years of membership in co-operatives

The results showed that 85% had between 1-3 years of cooperative membership, about 7% ha between 4-6 years, 5% between 7-9 years of membership and 3% between 10-12 years of membershi Average years of cooperative membership were 2 years. Agricultural Cooperative membership has effe t on food security. This supports the finding on the Role of Agric Cooperatives in Promoting Food Se urity and Rural Women's Empowerment in Ethiopia (Gibre, 2014).

4.1.10 Numbers of Extension contact

The ultimate aim of extension services is to enhance farmers‟ ability to efficiently utiliz resources through the adoption of new and improved methods used in rice production instead of using traditional methods which are inefficient, resulting to low yield.

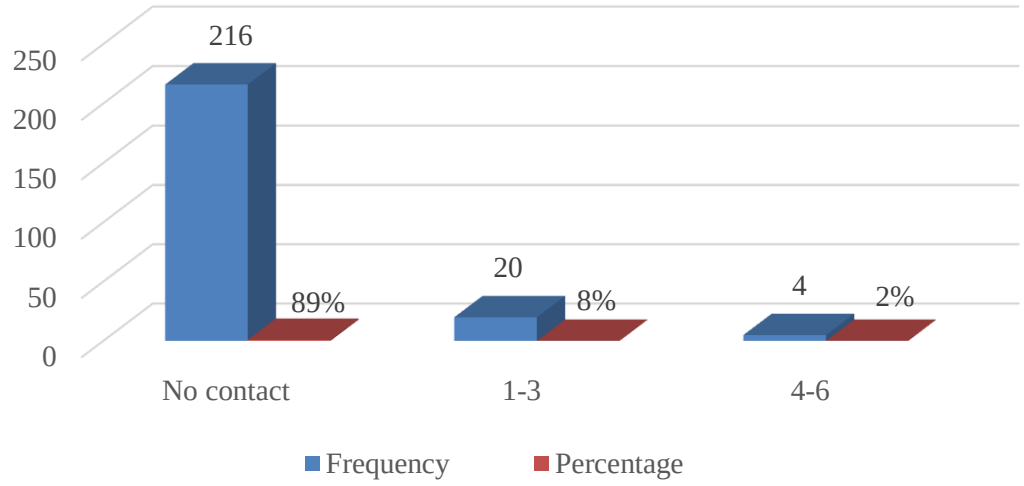


Figure 4.2: Extension Contacts among rice farmers

The result presented in figure 3 below reveals that 89.7% of rice farmers in the study area had no contact to extension service. The maximum extension services observed was 5times with a minimum of 1time and with average of 1 time per year extension service in rice productions. This could be attributed to low extension agent-farmers ratio in the study area. Extension service is very essential to the improvement of farm productivity and efficiency among farmers (Obwona, 2000).

4.2 ESTIMATION OF TECHNICAL EFFICIENCY OF RICE PRODUCTION

The Maximum likelihood estimates and inefficiency determinants of the specified frontier are presented in Table 5.Cobb-Douglas production function was selected as lead equation or line of best fit. However, the estimated coefficients of seed, labour, fertilizer and agrochemicals were positive and significant at different levels of probability. Hence, they play a major role in rice production in the study area. The average technical efficiency for the farmers was 0.76 implying that, on the average the respondents were able to obtain 76% of output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (24%) of increasing the efficiency, by adopting the best practice in irrigated production.

The study revealed that the generalized log likelihood function was -123.215. The log likelihood function implies that inefficiency exist in the data set.

The estimated coefficient for seed was 0.440 which is positive and statistically significant at 1% level of probability. The estimated 0.440 coefficient of seed implies that increasing seed by 1% will increase rice output by less than 1% which means, all things being equal the output is inelastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. This finding agrees with that of Sani *et al* (2007) in their study on economics of rice production in Bauchi Local Government Area, Bauchi State, where they found the coefficient of seed to be positive (1.021) and significantly related to rice output

The coefficient of labour was negative (-0.096) and significant at 5% level of probability. This implies that a unit increase in the quantity of labour will decrease the output of the farmers by -0.096 and this could be attributed to over utilization of these resources. Therefore, labour becomes negative because the farmers want to reduce the cost of labour. This result is similar to that of Omotesho *et al*. (2010) who, in their study on the economics of small-scale rice production in Patigi and Edu Local Government Areas of Kwara State, found the coefficient of labour to be negative (-0.038) as a result of limited available resources.

Table 6: Maximum Likelihood Estimates of Stochastic Frontier Production Function

Variables	Parameters	Coefficients	Std. error	T-Value
Production Function				
Constant	β_0	5.114	0.563	9.08***
Land	β_1	-0.2698	0.5665	-0.4763
Seed	β_2	0.440	0.040	11.00***
Labour	β_3	-0.096	0.071	-1.99**
Fertilizer	β_4	0.455	0.093	4.88***
Agrochemicals	$\beta 5$	0.128	0.068	1.86*
Inefficiency model				
Constant	Z_0	-0.5965	2.4264	-0.246
Age	Z1	0.0181	0.0440	0.407
Household size	Z2	-0.2046	0.3195	-0.640
Education	Z_3	-0.0303	0.0624	-0.487
Amount credit borrowed	Z_4	-0.0448	0.0950	-0.471
Extension contact	Z_5	-0.0402	0.0211	-1.908*
Cooperative association	Z_6	-0.00003	0.00006	-0.484
Farming experience	Z_7	0.0102	0.1652	0.0615
Diagnostic Statistic				
Sigma-squared	(σ^2)	0.7694	0.6679	1.152
Gamma	(γ)	0.8318	0.0836	9.725***
Log likelihood function	*L/f*	-123.215		
LR test	12.1372			
Total	**240**			
Mean efficiency	**0.76**			

Note: ***P<0.01, **P<0.05 and *P<0.10 level of probability

Sources; Field survey, 2017

The production elasticity of output with respect to quantity of fertilizer was 0.0455which is positive and statistically significant at 1% level of probability. This implies that a 1% increase in quantity of fertilizer will increase the rice output by about 0.05%. Fertilizer is a major land augmenting input because it improves the quality of land by raising yields per hectare. This finding agrees with that of Sani *et al*. (2010) in their work in rice production under small-scale irrigation in Bunkure Local Government Area of Kano State, where they found the coefficient of fertilizer to be positive (0.059) and significant at 1% level of probability.

The coefficient for agrochemicals was positive (0.128) and statistically significant at 10 percent level of probability. This implies that an increase in the use of agrochemicals will increase output of rice. This result agrees with that of Sani *et al*. (2007) in their work on economics of rice production in Bauchi Local Government Area, Bauchi State where they found that the coefficient of agrochemicals to be positive (0.387) and significant at 10% level of probability.

The estimated result of the inefficiency model is contained in Table 6 The results show that all the technical inefficiency variable except extension contact were not statistically different from zero, and generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency.

The estimated coefficient of extension contact (-0.0402) has a negative sign related to inefficiency and significantly different from zero at 10% level of significance. This implies that increase in extension contact will reduce technical inefficiency. This is a significant determinant of technical efficiency.

4.2.1 Estimated Stochastic Frontier Cost Functions (Allocative Efficiency)

The Maximum Likelihood (ML) estimates of the stochastic frontier translog cost parameters for irrigated rice are presented in Table 6 For the cost function, the sigma (σ^2= 0.16) and the gamma (γ=0.58) are quite high and highly significant at 1% and 5% level of probability respectively. The high and significant value of the sigma square (σ^2) indicate the goodness of fit and correctness of the specified assumption of

the composite error terms distribution. The gamma (γ =0.58) shows that 0.6% of the variability in the output of irrigated rice farmers that are unexplained by the function is due to allocative inefficiency.

The estimated coefficients of the parameters of the cost function are positive except that of cost of renting farm size which is negative and agrochemicals which is positive and both not significantly different from zero as shown in the results of stochastic frontier cost function for rice farmers in Table 6.

Table 7: Maximum Likelihood Estimates of Stochastic Frontier Cost Function for rice

Variables	**Parameters**	**Coefficients**	**Std. error**	**T-Value**
Production Function				
Constant	$\beta 0$	7.8142	0.6144	12.7184***
Seed	β_2	0.3571	0.0840	4.2512***
Fertilizer	β_3	0.3727	0.0468	7.9637***
Agrochemicals	$\beta 4$	0.0268	0.0710	0.3775
Labour	β_5	0.0546	0.0169	3.2308***
Output	B_6	0.2672	0.0407	6.5651***
Diagnostic Statistic				
Sigma-squared	(σ^2)	0.1648	0.0151	10.9139***
Gamma	(γ)	0.5834	0.2823	2.0665**
Log likelihood function	*L/f*	-56.1762		
LR test		22.1343		
Total	**240**			
Mean efficiency	**0.69**			

Note: *** P<0.01, ** P<0.05 and *P<0.10 level of probability

Sources; Field survey, 2017

The coefficient of seed, fertilizer and insecticides are positive and Significant at 1% level of probability. This implies that they are important in the production of rice. The estimated coefficient of the variable output was positively signed and statistically significant at 1% level indicating that if there is an increase in rice output the total cost of production will increase. This shows that the cost of production is influenced by the quantity of output realized. The result of this research agrees with the findings of Mohammed, (2011) where he reported direct effect of output on cost of production in their study on

economics of rain-fed and irrigated rice production under upper Benue River Basin Development Authority Scheme, Dadinkowa, Gombe State.

The coefficient of the cost of seed was 0.3571 which is positive and significant at 1% level of probability. This implies that seed are important in rice crop production. The implication of this is that 1% increase in the cost of seed will give rise to 0.36% increase in the cost of rice production. Similar results were reported by Idiong *et al* (2006) in a study of comparative analysis of technical efficiency in swamp and upland rice production systems in Cross River State, Nigeria.

The coefficient of cost of fertilizer was 0.3727 which is positive and significant at 1% level of probability. This implies that an increase in the quantity of fertilizer used will increase the cost of rice production by about 0.37%. Also, the cost of labour was 0.0546 which is positive and significant at 1% significance level. This implies that 1% increment in cost of labour will increase the cost of rice production by 0.05%. Mohammed *et al*., (2009) confirms it in their study on comparative study of rain-fed and irrigation methods of rice Production in Dadin kowa Gombe State, Nigeria.

4.2.2 Frequency distribution of technical efficiency estimates

The general distribution of the technical efficiency estimates of rice farmers' efficiencies presented in Table 8 shows that about80% were operating at technical efficiency level between 0.61 and 1.00 while about 21% of the farmers operated at <0.61 technical efficiency levels. The farmer with the best and least practice had technical efficiencies of 0.91 and 0.32 respectively. This implies that on the average, output fell by 9% from the maximum possible level attainable due to inefficiency. The study also suggest that for the average farmer in the study area to achieve technical efficiency to be most efficient, he could realize about26% (1-0.76/0.91*100) cost savings while on the other hand, the least technically efficient farmers will have about 75% (1-0.32/0.91*100) cost savings to become the most efficient farmer. This finding is in line with the findings of Taru *et al* (2010) who observed that average groundnut farmer in Adamawa State would enjoy cost saving.

4.2.3 Distribution of rice farmers according to allocative efficiency estimates.

The allocative efficiency estimates presented in Table 8 indicate that it ranged from 0.01 to 1.00; most of the farmers (59%) operate at allocative efficiency of >0.61 while 41% operate at <0.61, the mean allocative efficiency was 0.69. The result also indicates that average rice farmer would enjoy cost saving of about 36% (1-0.69/0.86*100) if he or she is to attains the level of the most efficient farmer among the respondents. The most allocative inefficient farmer will have an efficiency gain of about 73% (1-0.37/0.86*100) in rice production if he or she is to attain the efficiency level of most allocative efficient farmer in the study area.

4.2.4 Distribution of rice farmers according to economic efficiency estimates.

The economic efficiency estimates for the farmers in the study area is obtained from the stochastic frontier model is presented in Table 8. It was observed that about 18% of the farmers operate at >0.61 efficiency level while about 82% operate between 0.61 and 1.00 efficiency level. The mean economic efficiency of the farmers in the study area was 0.51. The farmer with the best and least practice had economic efficiencies of 0.77 and 0.29 respectively. The study also suggests that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he could realize about 63%(1-0.51/0.77*100) cost savings while on the other hand, the least technically efficient farmers will have about 92% (1-0.29/0.77*100) cost savings to become the most efficient farmer. However, the average economic efficiency of the rice farmers was 51%. This indicates that rice farms were economically inefficient. This is in line with the findings of Okpe *et al.* (2012).

Table 8: Distribution of Technical, Allocative and Economic Estimates

Efficiency Level	Technical Frequency	%	Allocative Frequency	%	Economic Frequency	%
0.01- 0.20	0	0	17	8.5	21	10.5
0.21-0.40	12	6.0	24	12.0	33	16.5
0.41-0.60	29	14.5	42	21.0	111	55.5
0.61-0.80	105	52.5	98	49.0	30	15.0
0.81-1.00	54	27.0	19	9.5	5	2.5
Total	**240**	**100**	**240**	**100**	**240**	**100**
Minimum	0.32		0.37		0.29	
Maximum	0.91		0.86		0.77	
Mean	0.76		0.69		0.51	

Source: Survey data, 2017

4.3 FOOD SECURITY STATUS OF SMALLHOLDER RICE FARMERS

Based on the food security analysis results derived using the Household Food Security Survey model. Table 9 shows that very few farm households (10.5%) were marginally food secure, while most of them (89.5) were food insecure at different levels of food insecurity. This result agrees with Ibok (2012) which indicated that 1.84 % of the country's households were food secured and 98.16% were food insecure.

Table 9: Distribution of respondents according to food security status

Food security status	Scale	Frequency	Percentages
Marginal food security	1-2	25	10.5
Low food security	3-7	71	30
Very low food security	8-18	145	60.5
Total		**240**	**100**

Source: Field survey, 2017

4.4 FACTORS RESPONSIBLE FOR FOOD INSECURITY

Results in Table 10 shows that all the listed factors were perceived to be responsible for food insecurity in the state. The major factors that are perceived to food insecurity were climate change (84.58%), high cost of farm inputs (80.41%), low level of production (82.08 %), Poor farm mechanization (79.16%) and Incidence of pests and diseases infestations (78.33%) are considered to be seriously causing food insecurity in the state. These factors could hinder effective attainment off the desired food security in Kano State. This agrees with Agada (2012) on her opinion on food security, that food security is a multidimensional phenomenon covering climate change, civil unrest and disaster along with food production, access and utilization.

Table 10: Respondents opinions on the factors responsible for food insecurity

Factors	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**	**Rank**
Climate change	0 (0)	3(1.25)	11(4.58)	23(9.58)	203(84.58)	240	1st
Poor mechanization	2(0.83)	2 (0.83)	8(3.33)	38(15.83)	190(79.16)	240	4th
Low level of production	1(0.41)	4(1.66)	10(4.16)	28(11.66)	197(82.08)	240	3rd
Poor infrastructures	3(1.25)	8(3.33)	25(10.41)	39(16.25)	165(68.75)	240	9th
Farmers/herders Conflict	2(0.8)	18(7.5)	40(16.66)	23(9.58)	157(65.41)	240	11th
Poor Government policy	0(0)	6(2.5)	31(12.91)	57(23.75)	146(60.83)	240	12th
Poor market access	1(0.41)	10(4.16)	28(11.66)	32(13.33)	169(70.41)	240	8th
Inflation	0(0)	5(2.08)	21(8.75)	52(21.66)	162(67.5)	240	10th
High cost of farm inputs	1(0.41)	7(2.91)	8(3.33)	31(12.91)	193(80.41)	240	2nd
Low access to credit	2(0.8)	6(2.5)	12(5)	30(12.5)	190(79.16)	240	6th
Poor storage facilities	9(3.75)	10(4.16)	10(4.16)	41(17.08)	170(70.83)	240	7th
Incidence of pests and diseases infestations	2(0.82)	6(2.5)	13(5.41)	31(12.91)	188(78.33)	240	5th
Rice Farmers (n=240)							

Note: Rice Farmers (n=240): Figures in Parenthesis are percentages.
Source: Field survey, 2017.

4.5 FOOD COPING STRATEGY ANALYSIS

Results in Table 10shows that 92.08%of the respondents employed the strategy of buying from market to combat food shortage,90.83%of the respondents Borrow money/food from friends and relatives, 85.83% of the respondents are eating less preferred food,82.5% Work for food or money and82.08%Send out children for paid jobs. This is similar to a study conducted in South Africa as 61.4 % of the respondents were found to employ the strategy of buying from market and 26% eating less expensive food to cope with food shortage from own production (Mjonono *et al.,* 2009).

Also in a study of livelihood shocks and coping strategies in Bangladesh households found out that 75.3% of the respondents adopted maladjustments strategy against coping with food shortage (Rashid *et al,* 2006).

Table 10: Coping Strategies Commonly Used among Households

Coping Strategies	**Never**	**Hardly**	**S/times**	**Often**	**Always**	**Total**	**Rank**
Buying from market	2(0.8)	4(1.66)	5(2.08)	8(3.33)	221(92.08)	240	1st
Eating less preferred food	0(0)	8(3.33)	12(5)	14(5.83)	206(85.83)	240	3rd
Borrow money/food from friends and relatives	1(0.41)	5(2.08)	8(3.33)	9(3.75)	218(90.83)	240	2nd
Consumption of seed stock	0(0)	6(2.5)	26(10.83)	30(12.5)	178(74.16)	240	8th
Work for food or money	0(0)	6(2.5)	18(7.5)	18(7.5)	198(82.5)	240	4th
Send out children for paid jobs	1(0.41)	8(3.33)	11(4.58)	23(9.58)	197(82.08)	240	5th
Sale of livestock	0(0)	6(2.5)	31(12.91)	8(3.33)	195(81.25)	240	6th
Rent out assets like land	37(15.41)	0(0)	39(16.25)	8(3.33)	155(64.58)	240	9th
Begging	25(10.41)	16(6.66	33(13.75)	10(4.16)	156(65)	240	7th
Migrate to cities	59(24.58)	30(12.5	7(2.91)	6(2.5)	138(57.5)	240	10th
Rice Farmers (n=240)							

Note: Rice Farmers (n=240): Figures in Parenthesis are percentages.

Source: field survey, 2017.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSSION AND RECOMMENDATIONS

5.1 SUMMARY

This study focuses on the analysis of production efficiency and food security in Kano state, Nigeria. Four villages were randomly selected from three LGAs and 240 farmers were selected in these areas. The objectives of the study were to: describe the socioeconomic characteristics of smallholder rice farmers, determine the technical, allocative and economic efficiencies of rice production, determine the food security status of the smallholder rice farmers, ascertain the factors responsible for food insecurity and describe the coping strategies employed by smallholder rice farmers to minimize food insecurity in Kano State. Primary data were collected from 240 respondents using a structured questionnaire. The statistical tools used to analyze the data were descriptive statistic, stochastic frontier production function model, household food security survey model and five type Likert scale.

The results of the socio-economic characteristics of the farmers revealed that majority all (100%) of the rice farmer were male and married, about 52.5% of the total farmer acquired only informal education. 82.1% of the total rice farmer solely depend on agricultural activities as their major sources of income. Majority of the rice farmer were relatively not literate in western education, however, most of the rice farmer were within the economically active members of the communities fallen within the age range of 40-49 years with 37.9%, as well as number of farming experience that none has below 11 years of working experience. Majority of the farmers (54.6%) also had family size of between 31 to 40.

Moreover, the results of production function analysis for rice production showed that seed was positive (0.440) and significant at 1% level of probability, farm size (0.128) and fertilizer (0.455) were positive and significant at 5% level of probability and agro-chemicals (0.128) were positive and significant at 10% level of probability implying that increases in seed, farm size, fertilizer and agro-chemicals would

lead to increases in output of rice. Labour was negative (-0.096) and significant at 5% level of probability, implying that an increase in the use of labour would decrease farm output in the study area.

Meanwhile, based on the food security analysis result, few rice farm households in the state (10.5%) were marginally food secure, while most of them (89.5%) were food insecure at different levels of food insecurity. The most severe factors to food insecurity was climate change (84.58%) followed by high cost of farm inputs (80.41%) and finally majority (92.08%) of the farmers employed the strategy of buying from market and (90.83%) of the respondents borrow money/food from friends and relatives to combat food shortage.

5.2 CONCLUSION

Based on the findings of this study, it could be concluded that rice farmers were economically inefficient. This is because the results of production function analysis showed that increases in seed, farm size, fertilizer and agro-chemicals lead to increases in quantity of rice produced and labour was negative(-0.096) which means an increase in the use of labour would decrease quantity of rice produced.

On the other hand, majority (89.5%) small scale farmers were not food secure, only 10.5% were food secure. Moreover, the most severe factors resulting to food insecurity were climate change (84.58%) and high cost of farm inputs (80.41%), and finally majority (92.08%) of the smallholder rice farmers employed the strategy of buying from market and borrows money/food from friends and relatives to combat food shortage.

5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Farm inputs such as farm size, seed, fertilizer and agro-chemicals positively and significantly influenced the production of rice in the state. Therefore, adequate supply of inputs should be made available to farmers at affordable price in order to enhance the production of this crop by the Government and non-Government organizations.
2. Since extension contact was significantly determinant of technical efficiency, rice farmers should through RIFAN make arrangements for an extension agents to be visiting at least twice a month, so as to be able to benefit from the farm advisory services.
3. Non-registered rice Farmers in Kano state should be encouraged to form cooperatives and join RIFAN thereby creating awareness about Government policies towards boosting rice production more especially the current programmes by both the Federal and State government.
4. Educational level of household head was a significant determinant of food security status of the farm households. Hence, there is need for formal education to be promoted as a means of improving food security as it opens up more income–earning opportunities for the farm households especially in the non-farm sector.
5. Policies of the Government especially agricultural mechanization and should be given necessary funding so as to ensure food security in the State. Also, Government should ensure that agencies responsible for quality input regulations are functional.
6. There is need, therefore, to encourage income and occupational diversification and value chain in primary products. Households should be assisted to diversify their income sources and enhance their purchasing power so as to meet their minimum food requirements.

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APPENDIX I

QUESTIONNAIRE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

FACULTY OF AGRICULTURE

BAYERO UNIVERSITY KANO

Dear Respondent,

I am a student of the above named institution from Department of Agricultural Economics and Extension, faculty of Agriculture conducting research on the topic titled **"ANALYSIS OF SMALLHOLDER RICE PRODUCTION AND FOOD SECURITY IN KANO STATE, NIGERIA''.** The exercise is purely for Academic purposes and all information supplied will be treated with utmost confidentiality and will not be used for tax imposition. Thank you.

A. SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

1. Questionnaire number: …….

2. Name of respondent (optional): …….

3. Village……

4. L.G.A……

5. Marital Status: (a) Married [ ] (b) Single [ ] (c) Divorced [ ] (d) Widowed [ ]

6. Age……

7. Household size……

8. Status of respondent in the household? (a) Household head [ ] (b) Member of household [ ]

9. Educational level:

(a) Informal [ ]

b) Primary [ ]

(c) Secondary [ ]

(d) Tertiary [ ]

(e) Others.....

10. Is farming your major occupation? (a)Yes [ ] (b) No [ ]

11. If No, what is your major occupation? ……

12. Is rice production your major source of income? (a)Yes [ ] (b) No [ ]

13. What are your other sources of income?

(a) Trading [ ]

(b) Rice processing [ ]

(c) Civil Service

(d) Livestock rearing [ ]

(e) Others (specify)……

14. Are you a member of an agricultural organization?

(a)Yes [ ] (b) No [ ]

15. If yes, provide name of association……

16. What social or economic function does the association provide? .....

17. Where do you obtain agricultural information?

(a) Radio [ ]

(b) Extension Agent [ ]

(c) Other farmers [ ]

(d)) NGO [ ]

(e) Farmers' cooperative association [ ]

(e) Others (specify)……

18. State the number of contacts you had with an extension agent this season? ……

19. How long have you been producing rice? .....

20. Why did you go into rice production?

(a) Home consumption [ ]

(b) Commercial purpose [ ]

(c) Both a and b [ ]

(d) Others (specify)…….

21. Source of funds for farm operations:

(a) Personal Savings [ ]

(b) Relatives and friends [ ]

(c) Banks [ ]

(d) Others (specify)…….

22. What is/are the source(s) of your capital for re-investment in rice farming?

(a) Income from rice farming [ ]

(b) Income from secondary occupation [ ]

(c) Loan from informal source [ ]

(d) Loan from formal source [ ]

(e) Loan from cooperative group [ ]

(e) Others……

B. PRODUCTION CHARACTERISTICS OF RESPONDENT (COST AND RETURN):

23. What is your total farm size? …… (ha)

24. What is your total farm size under rice production……..... (ha)

25. What is the ownership structure of your farmland?

(a)Solely owned [ ]

(b) Rented [ ]

(c) Others (specify)……

26. What is the rent value of your farmland in N/ha? .....

27. What cropping pattern do you practice on your farm?

(a) Sole Rice [ ]

(b) Rice and Wheat [ ]

(c) Rice and vegetables [ ]

(d)Rice and maize [ ] (e)

Rice and sorghum [ ]

(f) Rice and millet [ ]

(e) Others…….

28. Provide information on costs associated with the following irrigation facilities:

Facility Cost (N)/hectare	**Cost (N)/hectare**
Water charges	
Pumping	
Fuelling of pumping machine	
Labour paid for pumping water	
Maintenance of pumping machine	

29. What kind of labour is used on farm?

(a) Family [ ]

(b) Hired [ ]

(c) Exchange [ ]

(d) Family and hired [ ]

(e) Others……

II. Tractor Service

1. Do you employ tractor services? (a) Yes [ ] (b) No [ ]

Tractor Service		**Unit**	**Days**	**Fee(₦)**	**Total (₦)**
Land Preparation	Harrow				
	Plough				
Total					

III. Labour Used (Hired and Family)

Hired and family Labour	**Number of Labors**			**Total Cost**
	Number	**Days**	**Fee(₦)**	
Planting				
Fertilizer Application				
Weeding				
Harvesting				
Packing				
Threshing and Bagging				
Transportation				
Total				

IV. Seed

18. What quantity of rice seed was used (kg)? ……..

19. What is the cost of rice seed per kg? N …….

20. What is the source of your seed?

(a) ADP [ ]

(b) Seed Company [ ]

(c) Market [ ]

(d) Own [ ]

V. Fertilizer				
TYPE	**Quantity (No of Bags/50kg)**	**Total Quantity (Kg)**	**Price per Bag (N)**	**Total Cost (N)**
N.P.K				
UREA				
Animal Manure				
Total				

VI. Agrochemicals		
Type	**Quantity(Liters)**	**Total Cost (₦)**
Herbicide		
Pesticide		
Total		

(VII) Transportation			
Type	**Distance (Km)**	**No. of bags(Kg)**	**Cost(₦)/Bag**
Seed			
Fertilizer			
Agrochemical			
Total			

VIII. Farm Output (Paddy Rice)			
Quantity Harvested (Bag of 100kg)	**Total Quantity (Kg)**	**Unit Price Per Bag (₦)**	**Total Revenue (₦)**

SECTION C: HOUSEHOLD FOOD SECURITY STATUS

Please select the appropriate answer

S/N	Questions	Often true (1-2)	Sometimes true (3-7)	Never True (8-18)
1.	Do you worry if your food stock will finish before you get another to eat?			
2.	Do you have enough resource to acquire enough food?			
3.	Could you afford to eat balanced meals?			
4.	Do you supplement your children's feed with low cost foods?			
5.	Can you afford to feed your children balanced meals?			
6.	Were your children not eating enough because you couldn't afford enough food?			
7.	Do adults in your household skip meals or cut the size of their usual meals?			
8.	Do you eat less than you feel you should?			
9.	Were you ever hungry but did not eat?			
10.	Did you lose weight because there was not enough food to eat?			
11.	Did you or other adults in your household ever not eat a whole day?			
12.	Did you ever reduce any of your children's meal because there wasn't enough food?			
13.	Did any of the children ever skip meals because there wasn't enough food to eat?			
14.	Did any of your children ever not eat for a whole day?			
15.	Were the children ever hungry but you just couldn't afford more food.			

27. How many times you (your family) used to eat per day in most of the years' time?

A). Once/day [ ]

(b). Twice /day [ ]

c). Three times/day [ ]

(d) More than four times [ ]

29. Is what you produce last year enough for your family? (a) Yes [ ] (b) No [ ]

i. If not for how long does it lasted. _____ Months

30. Do you think that your household is currently food secure? a) Yes [ ] b) No [ ].

SECTION 'D': FACTORS RESPONSIBLE FOR FOOD INSECURITY

32. Please indicate by ticking the extent of which the following factors are responsible for food insecurity. Values: 1,2,3,4 and 5

S/N	Factors	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Climate change					
2.	Poor mechanization					
3.	Low level of production					
4.	Inadequate infrastructures					
5.	Farmers/herders Conflict					
6.	Poor Government policy					
7.	Political instability					
8.	Poor market access					
9.	Inflation					
10.	High cost of farm inputs					
11.	Low access to credit					
12.	Poor storage facilities					
13.	High incidence of pests and diseases infestations					

SECTION 'E': COPING STRATEGIES

33. How did you fend for the household during the period(s) of food shortages?

S/N	Coping Strategies	Never	Hardly	S/times	Often	Always
1.	Buying from market					
2.	Eating less preferred food					
3.	Borrow money/food from friends and relatives					
4.	Consumption of seed stock					
5.	Work for food or money					
6.	Send out children for paid jobs					
7.	Sale of livestock					
8.	Gather wild food like hunting /scavenging					
9.	Rent out assets like land					
10.	Begging					
11.	Migrate to cities					

Note that you can mark more than one strategy used

34. What do you think can be done to avoid food shortages?

(a) Increase loans to farmers [ ]

(b) Government should intervene in food production [ ]

(c) Provision of improved technology at affordable prices [ ]

(d) Provision of more storage facilities [ ]

(e) Better healthcare facilities [ ]

(f) Improvement in extension services [ ]

(g) Others (specify) _____

Thanks for your time.