

**ANALYSIS OF RICE FARMERS' ACCESS TO OUTPUT MARKET AND
PROFIT EFFICIENCY IN KANO STATE, NIGERIA**

BY

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JUNE, 2015

DECLARATION

I hereby declare that this thesis titled “**Analysis of Rice Farmers’ Access to Output Market and Profit Efficiency in Kano State, Nigeria**” has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another Degree or Diploma at any institution. All citations and sources of information are duly acknowledged by means of references.

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CERTIFICATION

This thesis titled ‘**Analysis of Rice Farmers’ Access to Output Market and Profit Efficiency in Kano State, Nigeria**’, by Maryam Mustapha **ABDULLAHI** meets the regulations governing the award of the Degree of Master of Science in Agricultural Economics, Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to Almighty Allah (SWT) who created the universe and all creatures.

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Abstract

This study focused on an analysis of rice farmers' access to output market and profit efficiency in Kano State, Nigeria. Three villages were randomly selected from three local Government Area and 164 farmers selected in the area. The result of the analysis shows that 42% of the respondents fall within the age range of 30-39years. Majority of the farmers (84%) were married; 65% of the farmers do not have formal education. The household size ranged from 1- 10 persons with 87% of the farmers having that size. About 71% had farming experience between 1-5 years. 90% did not have access to extension service, 76% of the farmers had a farm size between 0.1 – 5 hectares while 79% were not members of any cooperative society. The result of the study revealed that about 82% of the rice farmers sold their produce to rural assemblers, 5% of the rice farmers sold to wholesalers, 6% of them sold to retailers while 7% sold their produce to processors. The ordered probit model was used to estimate parameters of the determinants of farmers' choices among alternative rice output market outlets by rice farmers in Kano state. The pseudo R-squared value indicates that 51% of the variation in the farmers' choices among alternative rice output market outlets by rice farmers was explained by the independent variables. Farmers' choices among alternative output market outlets was significantly determined by educational status of the household head, access to credit, cooperative membership, distance to market, quantity of output produced by the farmers and market price of rice. The result of the Ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to each identified market outlet of rice farmers showed that quantity of rice produced, educational status, distance to market and market price were factors that significantly influences each of the identified market outlets. The maximum likelihood estimates of the parameters of the stochastic profit frontier model for each identified market outlet revealed that rural assembler market outlet had the best profit efficiency. 58% of the variation in actual profit from maximum profit (profit frontier) among rice farmers was due mainly to differences in farmers' practices rather than random variability. The major constraints identified on production and marketing in the study area were inadequate supply of improved seed (78%), inadequate capital (54.3%) while marketing of rice was faced with activities of middlemen (50%) and high taxes during transportation (19%). Profit efficiency were significantly determined by education, farming experience, amount of credit borrowed and extension contact. Therefore, it was recommended that government and Non-Governmental Organisations (NGOs) should provide basic amenities such as good road network for the farmers to have access to the urban markets where they can sell their produce in order to improve the socio-economic status of the rice farmers especially in the study area.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Nigeria's domestic economy is partly determined by agriculture which accounted for 40.9% of the Gross Domestic Product (GDP) in 2010 (CBN, 2011). Agriculture has been an important sector in the Nigerian economy in the past decades and is still a major sector despite the oil boom. Basically it provides employment opportunities for the teeming population, alleviates poverty and contributes to the growth of the economy (Izuchukwu, 2011). Despite these however, the sector is still characterized by low yields, low level of inputs and limited areas under cultivation (Izuchukwu, 2011).

Rice is an annual crop and the most important staple food crop in the tropical countries. Commercially, the crop is the most important cereal after wheat (Gnanamanickam, 2009). It is widely consumed and there is hardly any country in the world where it is not utilized in one form or the other. In Nigeria, rice is one of the few food items whose consumption has no cultural, religious, ethnic or geographical boundary. It is available in five-star hotels in the big cities and towns, as well as in the "most local" of the eating places in the remotest villages throughout the country (Gnanamanickam, 2009). It is highly priced and widely accepted for festivity. In some rural areas, it is so adored that it is eaten only on Sundays and sometimes on market days (Omofonmwan and Kadiri, 2007).

Local rice demand is growing quickly due to population growth and urbanization. Nigeria's estimated annual rice demand is put at 4.8 million metric tonnes while annual production on the average, was about 2.8 million tonnes of milled rice product

leaving a deficit of 2 million tonnes which is bridged by importation (Uchei, 2014). Domestic demand for rice is projected to rise to 7.5 million tons by 2013, on the assumption that demand rises at 10% per annum, with demand for local rice growing at half the rate of the imported rice (NRDS, 2009). This increase in demand is because rice has changed from being an elitist to a staple food for many Nigerians (KNARDA, 2007). Many local dishes are prepared with rice because of its relative ease in terms of storage and preparation. In terms of local production, rice is now one of the main cereals produced by Nigerian farmers; it is cultivated in virtually all the agro-ecological zones of Nigeria. It covers both the upland and the swamps, depending on the variety (KNARDA, 2007).

Agricultural marketing assumes greater importance in the Nigeria economy because the excess production from the farm must be disposed off in order to earn some income with which farmers can purchase their goods and services not produced by them (Oladapoet *al.*, 2007). The link between the producers and the consumers is the market. Marketing therefore plays a central role in the development process. However, the marketing system of Nigeria's food and staple failed to address price stability from time to time due to information asymmetry (Oladapoet *al.*, 2007).

Marketing plays a significant function in the performance of supply chains. Farmers require relevant and reliable infrastructure, labour, technology and coordinated markets in order to effectively market their agricultural products. Farmers benefit from markets if their participation minimizes transaction costs, hence they should focus on production, which they have a comparative advantage (Porter, 1985).

Farmers not only need to be more efficient in their production activities, but also need to be responsive to market indicators, so that scarce resources are utilized

efficiently to increase productivity as well as profitability, and ensure supply to the urban market. In Nigeria, rice is important, not only as food crops but even more as a major source of income for rural households. Efficiency in the use of financial resources in growing crops is an important factor. This can be expanded by emphasizing the need to market the crops in such a way as to maximize returns (Harper, 1999).

It is against this background the present administration under the leadership of Dr. GoodluckEbeleJornathan has instituted the National Economic Transformation Agenda whose aim is to diversify the economy from reliance on oil, assure food security and create jobs, especially for the youths (FMARD, 2012). In line with this, the Federal Ministry of Agriculture and Rural Development has implemented an Agricultural Transformation Agenda (ATA) that will promote agribusiness, attract private sector investment in agriculture, reduce post-harvest losses, add value to local agricultural produce, develop rural infrastructure and enhance access of farmers to financial services and markets (Akinwunmi, 2011). Rice is one of the commodities being promoted under the present administration's Agricultural Transformation Agenda (ATA).

1.2 Problem Statement

Rice is one of the most important cereals globally. It constitutes the main food grain for over 750 million people who live in the semi-arid tropics of Africa, Asia, and Latin America (FSD, 2004). Rice producers in Nigeria are smallholder farmers who are left entirely on their own to keep the sub-sector afloat against so many odds being

poor in resources. Most of rice farmers have only minimum access to production inputs and improved credit facilities for their purchase (FSD, 2004; USAID, 2009). Even when this crop is produced, farmers face further challenges to get buyers for their produce, resulting in production surplus and subsequently wastage (FSD, 2004). This marketing problem has taken some farmers out of commercial rice production. Most of the agricultural programmes and policies focused more on increasing output with little or no emphasis on marketing strategies.

Market access proponents argue that for smallholders to thrive in a global economy there is the need to shift the focus from production based programmes to that of marketing interventions (Barham and Chitemi, 2009). A reduction in formal market participation, in turn, makes it difficult for smallholder rice farmers to shift into commercial farming and thus, a reduction in economic development. Although several studies have been conducted on production and marketing of rice and other crops in Nigeria, most of the studies focused on efficiency of farmers in terms of resources use, structure, conduct and performance of market (Odok, 2000; Ohen, 2008). Specifically information on the extent to which institutional, socio-economic, and technical factors influence the marketing channel decisions among rice farmers is lacking. Yet these types of studies are very essential for reliable assessment and formulation of appropriate rice production and marketing policies.

Markets and improved market access are critical and important to rural poor households as a pre-requisite for enhancing agriculture based economic growth by improving the competitiveness of farming enterprise and improving rural incomes. Despite these, participation of smallholder farmers in rice market remains low due to a range of constraints (Makhura, 2001; Ohen, Etuk and Onoja, 2013).

Based on the foregoing, the study attempts to answer the following questions;

- (i) what are the socio-economic characteristics of rice farmers in the study area?
- (ii) what are the available rice output market outlets accessible to rice farmers?
- (iii) what are the factors influencing farmers' choices among alternative rice output market outlets?
- (iv) what are the factors affecting quantity of rice supplied to each identified market outlets?
- (v) what is the profit efficiency and its determinants for each identified market outlet?
- (vi) what are the constraints of farmers in rice production and marketing in the study area?

1.3 Objectives of the study

The broad objective of this study is to examine rice farmers' access to output market and profit efficiency in Kano state. The specific objectives are to:

- (i) describe the socio-economic characteristics of the rice farmers in the study area;
- (ii) identify the available output market outlets accessible to rice farmers;
- (iii) determine the factors influencing farmers' choices among alternative rice output market outlet;
- (iv) assess the factors affecting quantity of rice supplied to each identified market outlets;

(v) determine the profit efficiency and its determinants for each identified market outlet;

(vi) describe the constraints facing farmers in rice production and marketing in the study area.

1.4 Justification of the Study

Rice demand is growing quickly due to population growth and urbanization. Nigeria's estimated annual rice demand is put at 5 million metric tons while annual production on the average, was about 2.21 million tons of milled rice product leaving a deficit of 2.79 million tonnes which is bridged by importation (NRDS, 2009). Domestic demand for rice is projected to rise to 7.5 million tons by 2013, on the assumption that demand rises at 10% per annum, with demand for local rice growing at half the rate of the imported rice (NRDS, 2009). Increased rice production in Nigeria will translate directly into higher consumption, better nutrition and enhanced trading for maximum benefits.

Increasing utilization of rice production and marketing through development of added-value rice food products will improve the livelihoods of the people growing rice. Also, strategic linkages between geographic areas and competitive market chains are essential. Local actors, linked to primary production, must collaborate with those actors who are able to enter the market with products and services that are valuable to consumers and profitable to all involved in the production process for those actors based in rural areas. The study will be useful to the government of Kano state, as a basis for rational and empirical policy formulation for rice production and marketing in the state. Finally, it is hoped that this work will be of assistance to researchers who will identify other areas for further studies on rice farming.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin of Rice

Rice (*Oryza sativa L.*) belongs to the Gramineae family, which are the most important of all cultivated crops (Simon, 1992). There have been plenty of debates on the origins of the domesticated rice. In 2011, genetic evidence published in the proceedings of the National Academy of sciences of the United States of America (PNAS) shows that all forms of Asian rice, both indica and japonica, spring from a single domestication that occurred 8,200-13,500 years ago in China of the Wild rice *Oryzarufipogon*. The precise date of the first domestication is unknown, but depending on the molecular clock estimate used by the scientists, the date is estimated to be 8,200 to 13,500 years ago. This is consistent with known archaeological data on the subject (Longtau, 2003).

Average rice yields are 1.4 tonnes/hectare in tropical Africa, 4.4 tonnes/hectare in Asia and 4.0 tonnes/hectare in the world in general. Yields are generally higher during the dry season than during the wet season and higher in lowland rice than in upland rice (Brink and Belay, 2006). The yield of upland rice varies between 0.5 and 1.5 tonnes/hectare in tropical Africa but may reach 4 tonnes/hectare in Latin America. Rain-fed lowland rice is higher yielding than upland rice but may suffer a drastic reduction in years with drought or floods. In a rain-fedbunded lowland rice area in Tanzania, yields are 3-4 tonnes/hectare in good years but can drop to 0.5 tonne/hectare in bad years. Yields of irrigated lowland rice in tropical Africa are generally 3-6 tonnes/hectare. Yields in the deep-water rice areas are generally low

(0.6-1.2 tonnes/hectare), but they are more stable than in the upland rice areas of tropical Africa (Brink and Belay, 2006).

2.2 World Production and International Trade in Rice

According to FAO estimates, the average annual world production during 1999-2003 was 593 million tonnes paddy (unhusked grain) from 153 million hectares. Asia accounts for 90 percent of the world production and area. During 1999-2003, tropical Africa produced on average 11.9 million tonnes paddy (2 percent of world production) annually on 7.7 million hectare (5 percent of world area); these data include African rice (*Oryzaglaberrima*), which occupies less than 20 percent of the rice area in West Africa (Brink and Belay, 2006). The annual world paddy production increased steadily from 241 million tonnes per year in 1961-1965 to 593 million tonnes in 1999-2003, and the harvested area from 121 to 153 million hectare. In the same period the annual paddy production in tropical Africa increased from 3.6 to 11.9 million tonnes per year, and the harvested area from 2.8 to 7.7 million hectares (Brink and Belay, 2006).

The main producers are Nigeria (3.5 million tonnes from 2.9 million hectares), Madagascar (2.6 million tonnes from 1.2 million hectares) and Cote d'Ivoire (1.1 million tonnes from 0.5 million hectares) (Brink and Belay, 2006). Only 5% of the world's rice production enters into international trade. Thailand is the world's largest exporter of milled rice (26 percent of world trade during 1998-2002) followed by Vietnam, India, the United States, China and Pakistan (Brink and Belay, 2006). All countries in tropical Africa are net importers of milled rice and during 1998-2002 an average of 4.8 million tonnes milled rice was imported annually(Brink and Belay, 2006). This means that more than one third of the rice consumption in tropical Africa

is satisfied through imports (Brink and Belay, 2006). Main rice importers are Nigeria, Senegal and Cote d'Ivoire. Per capita annual milled rice consumption in tropical Africa varies tremendously between 0.15 kg and 95 kg with an average of about 18 kg for the period 1998-2002 (Brink and Belay, 2006).

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). Considering its important position, 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). Rice grains are used as food all over the world (Abdulrahman, 1989). 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. Rice is relatively non-allergic, which means that cases of hypersensitivity to it are rare. Broken rice grains are used in making starch, which is used in industries, cosmetics and textile industries. The husk can be used as fuel. The

straw can be used as feed to livestock, for thatching houses, mat and hat making (Onwueme and Sinha, 1991).

2.4 Factors Affecting Access to Output Market

Access to output markets, ranging from small village-level markets to sophisticated export processors, is the key for small farmers to earn more from the sale of their produces. Poor farmers in remote areas appear to have limited access to output markets for their products. However, by assessing transport costs and focusing on multiple high value storable crops, opportunities emerge to create output market linkages with a rate of return that is very attractive to poor families (International Development Enterprises, 2008).

A study by Mathyeet *al.* (2000) addresses the choice of marketing channels for smallholder farmers producing bananas and mangoes in some areas of the Limpopo Province and found that not all farmers sell their products. Those who do sell tend to use different channels such as a fresh produce market, an achaar (a product made of mango) market and direct sales to consumers. Different factors affect the choice of the market channel, but the study found that problems of transport, searching for markets and education tend to influence participation (Makhura, 2001). According to Heinemann (2002), rural people in Africa, especially the poor, often say that one reason they cannot improve their living standards is because they face difficulties of accessing markets where they can obtain agricultural inputs and consumer goods and sell the produce that they grow. A major reason why even those farmers who can produce a surplus remain trapped in the poverty cycle is lack of access to profitable markets. All too often farmers are forced to sell to the buyer of convenience at whatever price that buyer dictates (IITA, 2001).

In addition, most of the literature related to smallholder agricultural marketing, for example: Dorward *et al.* (1998), Freeman and Silim (2001), IFAD (2003), Jayne *et al.* (2002), Kherallah and Kirsten (2002) and Killick *et al.* (2000), reiterates that the problem of market access is linked to the following constraints: price risk and uncertainty, difficulties of contract enforcement, insufficient numbers of middlemen, cost of putting small dispersed quantities of produce together and the inability to meet standards. Other problems related to physical market access like physical infrastructure include roads, market facilities, power and electricity. In rural areas, for example, small holders are often geographically dispersed, roads and communications are poor and the volumes of business are insufficient to encourage private sector service provision.

According to IITA (2001), to overcome these problems, farming communities have formed cooperatives, collective marketing associations, and other mutual alliances to increase their buying and selling power in the market place. Larger commercial farmers have also been active, forming mutually beneficial alliances with farmers supplying marketable products at agreed prices. Clearly, it is only by such means that most developing country farmers can move from a poverty cycle to an income cycle, and begin to make a real contribution to overall economic development.

One of the major constraints to the growth of small holder agriculture in African countries is high transaction costs (Machethe, 2004), largely attributable to poor infrastructure. This situation is no exception in South Africa, particularly the former homelands (DBSA, 2005). A large proportion of rural households continue to lack access to basic services (Stillwell and Makhura, 2004). Access to road transportation determines households' demand for production and consumption of goods and

services (Wanmali, 1992). If agricultural inputs and output markets are more accessible rural households will tend to use these services more, leading to improved productivity (Kamara, 2004). Deficiencies in rural infrastructure services result in poorly functioning domestic markets with little spatial and temporal integration, low price transmission, and weak international competitiveness (Pinstrup-Anderson and Shimokawa, 2006). Economic activities in most rural areas tend to be concentrated around areas where there are banks, postal services, retail outlets and suppliers of inputs. Poor road conditions, high transport costs and distant markets have been identified as factors that hamper improved market access for emerging farmers in South Africa (Makhura and Mokoena, 2003; Nieuwoudt and Groenewald, 2003), and also contribute towards failing input markets. Factors that determine access to input and output markets include distance to the markets, the state of the roads, the cost of transportation and the frequency of visits to these markets.

In another study conducted by Jooste (2001), he concluded that the transition of the small scale sector towards commercial production will ultimately be determined by its access to markets. According to Stroebel (2004), several constraints affect the efficient marketing of livestock in the Eastern Cape Province of South Africa, chiefly of which, are poor marketing infrastructure, lack of marketing herd size, high transaction costs and low purchasing power of buyers. This implies that marketing of livestock is probably one of the most complex policy issues to be addressed for enhancing sustainable smallholder agriculture (Jooste, 2001). Historically, the small scale communal cattle producers have found themselves in a difficult market position because individually they lack sufficient volumes of uniform cattle to attract buyers to their farms (Jooste, 2001). Although a number of market outlets do exist in the

province, Nkosi and Kirsten (1993) pointed out that small scale communal farmers sell their cattle through informal marketing channels which in most cases have low purchasing power and as a result farmers get relatively low prices for their animals. Thus the challenge to livestock farming in communal areas is making use of marketing channels that offers the best cattle prices and hence highest returns. Benson *et al.* (2001) indicated that these decisions require reliable information about cattle prices, the right selling time, the channels available, cattle breeds and the age of cattle that give the highest returns.

2.5 Factors Influencing Farmers' Choices among Alternative Outlets

The literature on market outlet choices has been thin, especially in developing countries where significant frictions make this question most salient. Goetz (1992) studied participation of Senegalese agricultural households in grain markets. He used probit model to analyze household's discrete decision either to participate in a market or not which was followed by a second-stage regression model to analyze the extent of market participation. Key *et al.* (2000) developed a structural model to estimate structural supply functions and production thresholds for Mexican households' participation in maize market, based on a censoring model with an unobserved censoring threshold. Holloway *et al.* (2005) used a Bayesian double-hurdle model to study participation of Ethiopian dairy farmers in milk market when non negligible fixed costs lead to non-zero censoring, as in Key *et al.* (2000), but distinguishing between discrete participation and continuous volume marketed, as in Goetz (1992). Some others studied livestock and livestock products marketing in parts of Ethiopia (Holloway *et al.*, 2000; Yigezu, 2000; Muriuki and Thorpe, 2001; Tsehay, 2001;

Mohammed *et al.*, 2004; Woldemichael, 2008). Similar study undertaken by Agarwal and Ramaswami (1992); Williamson (2002) and Brewer (2001) have identified factors related to price, production scale and size, farm household characteristic, behavioral aspects such as (trust, risk, and experience), and market context (distance and purchase condition) affect producer market outlet choice. Furthermore, Zuniga-Arias (2007) found out that factors such as price attributes, production system, farm household characteristic, and market context could affect market outlet decision of farmers in mango supply chain in Costa Rica. Hobbs (1997) found out that age, education, farm profit and transaction cost are some factors that influence farmers channel choice decision in livestock marketing. The same study also indicated that the mode of payment, long standing relationship with the buyer, and the price received as the most important reasons for selling to a particular buyer in the livestock sector. A study conducted by Sourgiannis (2008) found out that farm and farm characteristics, volume of milk production, farm income, debt, sales price, speed of payment and loyalty have a significant effect on market channel choice of sheep and goat farmers in the region of east Macedonia in Greece.

Misra (1993) found out that factors related to price and non-price factors affecting selection decision of milk producer farmers. According to Royer (1995) risks that agricultural producers face are linked with decisions about the prices, quantity, quality, and the timing of delivery. It also aims to explore the association between the factors that influence the farmers to adopt a particular marketing strategy and their selection of a particular distribution channel. According to Gong (2007) there are significant relationships between economic and social variables and marketing

channel selection for cattle distribution in China. They argued that transaction cost has a significant impact on marketing channel selection.

2.6 Factors Affecting Farmers' Participation in Markets

Research work on market participation are scanty; more especially in developing countries where important functions make this question paramount (Bellemare and Barrett, 2006). The factors, drawing from literature on the determinants of market participation and sales, include transaction costs (distance to roads, markets and towns, transport availability, labour and population density), human capital (age, education, gender, extension training), physical capital (number of livestock producing stock, farmland) and financial capital (crop income, non-farm income, credit). Agricultural market participation is, therefore, the integration of subsistence farmers into the input and output markets of agricultural products with a view to increasing their income level hence reduce poverty (Ehui and Holloway, 2002).

In a study conducted in Ethiopia (Holloway *et al.*, 2000) on livestock farmers, it was found out that farmers with lower transaction cost participated in markets and sold more because they were likely to recover their production and marketing costs. In this way, farmers living closer to roads, markets or towns with means of transportation or more labour were found to participate and sell more livestock products. Farmers in more densely populated areas faced greater demand for their farm produce hence had lower search cost, hence population density positively affected market participation and sales (Holloway and Simeon, 2002; Balint and Wobst, 2005). Other authors who are of the view that poor infrastructure often increases the transaction costs of smallholder market participation are Bellemare and Bareth (2006) and Laparet *al.* (2003). The descriptive analysis influence of institutional factors on market

participants (Holloway *et al.*, 2000; Mukhura 2001; Renkow *et al.*, 2002; Laparet *al.*, 2003; Balint, 2006), show that high transaction cost which is the major institutional factor, emerges as a result of inadequate restructuring of the input and output markets, reinforced by low production factor endowment, which hinder sales. Lapar and Lucila (2002) reported that better access to roads, markets or towns might increase the opportunity cost of labour and capital in agricultural production and marketing (especially where alternative opportunities exist and the return to labour and capital are higher) and might in turn reduce (hence negative effects) participation and sales. Several authors (Laparet *al.*, 2003; Holloway *et al.*, 2005) studied market participation based on the assumption that market participation and volume choices are made sequentially or simultaneously; farmers initially decide whether or not to participate in the market, then decide on the volume purchased or sold, conditional on having chosen market participation; farmers make market participation decision simultaneously with the decision as to volume purchased or sold.

Oduro *et al.* (2004) reported that age and gender have negative and positive effects on market participation respectively. Older people tend to have more dependents and more subsistence activities hence low market participation while female-headed households and households with more female members, especially with respect to dairy products tend to be primarily involved in these production activities hence positively affect market participation. Infrastructure and services are important defining parameters of market proximity and therefore effective market participation (Holloway *et al.*, 2000).

2.7. Factors Affecting Market Supply

The market supply refers to the amount actually taken to the markets irrespective of the needs for home consumption and other requirements. Whereas, the marketed surplus is the residual with the producer after meeting the requirement of seed, payment in kind, and consumption by farmer (Wolday, 1994 and Muhammed 2011). An important aspect of supply chain is that they consist of some associated but distinct flows. One is the physical flow of the commodity and another is flow of money realized from final sale back to the producer and all the enterprises that have been involved in processing and marketing. The efficiency and effectiveness of the practices and procedures that govern this latter flow are as important as technical efficiency with which the commodity is produced, processed and marketed (Westlake, 2005).

Marketing of agricultural products consists primarily of moving products from production sites to points of final consumption. In this regard, the market performs exchange functions as well as physical and facilitating functions. The exchange function involves buying, selling and pricing. Transportation, product transformation and storage are physical functions, while financing, risk-bearing and marketing information facilitates marketing (Urgessa 2011).

A number of studies investigated about factors that mainly affect marketable supply of agricultural commodities. The main factors which determine market supply could be divided into economic factors which include product price, provision of consumer goods, production cost and market supply costs and political factors which include the level of government intervention (Maro, 1986; Wolday, 1994). One of the expected important variables which influence the behavior of the market

supply of producers is price. If price increases, producers will gain high revenue and would be motivated to increase the market supply (Wolday, 1994). Bellemare and Barrett (2006) estimated factors affecting sell of animals in Kenya and Ethiopia. They observed that the net purchase and net sales volume choices depend on expected market participation. The household head sex (female headed), age, family size, herd size, female TLUs, encumbered males, and small stock (sheep and goat) had significant and negative influence on number of animals sold. Unlikely, assets, land holding, other income, encumbered females, and average price of larger stock (camels and cattle) had correlated positively with number of animals sold.

A study made in AlabaSiraro district by Wolday (1994), pointed out the major factors that influenced the marketable supply of teff, maize and wheat at AlabaSiraro district using cross sectional data and he investigated the relationship of farm level marketable supply of cereals to capture the influence of the independent variables on the marketable supply of food grain, he adopted multiple regression analysis with both dummy and continuous variables as explanatory variables. He identified that size of output (teff, maize and wheat) significantly and positively affected teff, maize and wheat supplied. On the other hand, access to market significantly and negatively affected volume of sale of teff and maize. Poor accesses to the market negatively affected maize sold while positively affected teff and wheat sold. Family size also significantly and positively affected quantity supplied of teff and wheat while it negatively affected quantity supplied of maize.

A study by Wolelaw (2005) found out the major factors that affect the marketable supply of rice at Fogera district using multiple linear regression model. He

investigated the relationship between the determinant factors of supply and the marketable supply of rice and the study revealed that current price, lagged price, amount of rice produced at farm level and consumption at household level had influenced marketable supply of rice at the district.

Similar study undertaken by Kinde (2007) indicated that, the major factors that affect marketable supply of sesame in Metema district by using cross-sectional data with dummy and continuous explanatory variables. In his study he implemented multiple linear regression model to identify the relationship between the marketable supply of sesame and the hypothesized explanatory variables, hence his study acknowledged that amount of sesame productivity, use of modern inputs, number of language spoken by the household head, number of oxen owned, sesame area and time of selling of sesame influenced marketable supply of sesame positively. Another related study by Rehima (2006) identified that the key factors that affecting marketable supply of red pepper at Alaba and Siltie districts of SNNPRS using cross-sectional data with both dummy and continuous independent variables. In her study, she employed Tobit model and came up with the finding that distance to the market, frequency of contacts with extension agents, quantity of pepper produced and access to market information influenced marketable supply of pepper positively at the district. Recent studies commonly used regression models to estimate the supply function.

2.8 The Concept of Profit Efficiency

The question of how to measure efficiency has received considerable attention in economic literature. A profit function is an extension and formalization of the production decisions taken by a farmer. According to production theory, a farmer is

assumed to choose a combination of variable inputs and output that maximize profit subject to technology constraint (Sadoulet and De Janvry, 1995). Following the work of Farrell (1957), efficiency can be defined as the ability to produce a given level of output at lowest cost. The concept of efficiency has three components: technical, allocative and economic efficiency.

Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficiency decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost. Technical and allocative efficiencies are components of economic efficiency (Abdulai and Huffman, 1998).

Lau and Yotopoulos (1971) and Yotopoulos and Lau (1973) therefore popularized the use of the profit function approach, in which farm-specific prices and levels of fixed factors are incorporated in the analysis of efficiency. The advantage of using this approach is that input and output prices are treated as exogenous to farm household decision making, and they can be used to explain input use.

Profit efficiency is the ability of a firm to achieve potential maximum profit, given the level of fixed factors and prices faced by the firm (Adesina and Djato, 1996). Aigner *et al.* (1977), however, showed that profit function models do not provide a numerical measurable of firm-specific efficiency and popularised the use of the translog production frontier approach. The stochastic frontier approach has gained popularity in firm-specific efficiency studies. Example of recent application includes (Ali and Flinn, 1989; Kumbhakar and Bhattacharyya, 1992; Ali *et al.*, 1994).

The stochastic profit frontier function is an extension of incorporating farm level prices and input use in the frontier production function. The incorporation of the farm specific level prices leads to the profit function approach formulation (Ali and Flinn, 1989; Wang *et al.*, 1996). A production approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowment (Ali and Flinn, 1989). Hence the use of stochastic profit functions to estimate farm specific efficiency directly (Ali and Flinn, 1989; Ali *et al.*, 1994; Wang *et al.*, 1996). The profit function approach combines the concepts of technical, allocative and scale inefficiency in the profit relationships and any errors in the production decision translate into lower profits or revenue for the producer (Rahman, 2003). Profit efficiency is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm and profit inefficiency in this context is defined as the loss of profit from not operating on the frontier (Ali and Flinn, 1989).

In agriculture, a farmer has to pay attention to relative prices of the inputs such that the production is undertaken at the point where the isoquant is tangent to isocost line. If that is not done, economic efficiency is not achieved. The farmer may be able to achieve technical efficiency but not allocative efficiency. This inefficiency could arise from a number of sources, which include access to appropriate information in a timely manner or lack of skills to take advantage of modern agricultural inputs.

Basically, what is being referred to here is the managerial ability of the farmer. The farmer should be able to make decisions that lead to optimal utilization of resources and this requires accurate information on availability of the new varieties, the inputs, and access to markets.

2.9 Empirical Studies

2.9.1 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 theirricebetween 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-Lawalet *al.* (2009) also reported that 82.73% of the youth in agriculture are male.Chikezieet *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.

Abdullahiet *al.* (2012), which reported that in Ikara Local Government Area of Kaduna State, majority of the sampled respondents were middle aged farmers. This result suggests that majority of rice farmers in the study area are young farmers who are within the age bracket in which people are innovative and active at work (Asiabaka, 1998). Similarly, this finding is in line with Okwocheet *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 Asogwaet *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 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 Asogwaet *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 (Nkanget *al.*, 2009). Educational level plays a good role in adoption of new policy and undertaking risks.

2.9.2 Cost and returns analysis

Cost- return analysis is usually form the basis for farm profitability analysis, it involves itemizing the cost and returns of production and use them to arrive at such estimates as the return to one unit of the resources used, the gross margin, as well as the gross and net returns. Daniel *et al.*,(2010) revealed that farmers incurred an average cost of ₦46, 046.75 per hectare; and within the same period they had average estimated returns of ₦56, 224.90 per hectare. This implies that the farmers made a profit of ₦10, 178.15 per hectare.

The Gross Ratio (GR) of the farm was 0.54 which showed that 54% of the gross income went for total cost. A ratio less than 1 is always desirable for any farm business. The lower the ratio the higher the returns on naira invested (Olukosi and Erhabo, 1988). The returns on naira invested in cotton production by the farmers were ₦0.22 that is 22%.

Akimi, (1976) who examined the economic analysis of peasant rice farming in Kelantan, Malaysia. The profitability of rice farming is measured by cost and return analysis. They reported that most of farmers recorded a negative profit net profit from their rice farming. The average of net profit of \$107.49 per acre and only three

farmers or 5.5% of farmers had a net profit. This negative profit was due to comparatively high production cost and low productivity per acre.

Alamet *al* (2013) average costs and returns of cotton farmers in the study area. The average revenue from cotton output was found to be ₦58, 801.12 per hectare. The total cost incurred in cotton production was ₦37, 629 per hectare. Labour cost has the highest percentage (21%) of the total cost of production. The total variable cost constituted 95% while fixed cost constituted just 5% of the total cost. The enterprise had an average net farm income of ₦21, 172.12.

The result of the study further revealed that returns on Naira invested by farmers in the study area was ₦0.56, meaning that a farmer gain 56 Kobo in every one naira invested in cotton production. The result of the study clearly indicated that cotton production is a profitable venture and so farmers in the study area should be advised to venture into because it is profitable enterprise. This finding is in conformity with the result of Ibrahim (2008) who conducted a research on the economics of sole cotton production in Lau Local Government Area of Taraba State and came out with a similar result (that is, returns on investment of ₦0.76

2.9.3 Profit efficiency

Ogunniyi (2008) opined that profit efficiency ranged between 0.000187 and 0.429 with an average of 0.12. The average profit efficiency score of 0.12 implies that the average farm producing rice could increase profits by 88% by improving their technical and allocative efficiency. Farmers exhibit a wide range of profit inefficiency ranging from 57.1% to 99.9%.

Ohajianya (2005) reported mean profit efficiency level of 0.32 for cocoyam producers in Nigeria. Rahman (2003) reported mean profit efficiency level of 0.77 for Bangladesh rice farmers. The result shows that majority (35%) of the respondents have profit efficiency less than 0.05 while just 2.5% had between 0.36 and 0.45 profit efficiency. They reported that there is a significant and negative relationship between experience and loss of profit. This implies that cocoyam farmers with more years of experience exhibited significantly more loss of profit than farmers with less years of experience. Farmers with more family size exhibited significantly less loss of profit than farmers with less family size. Large farms did not exhibit a significantly higher profit loss than smaller farms, a finding consistent with those of (Saleem, 1978; Bravo, 1984; Ohajinya, 2005).

Hyuhaet *al.* (2007) who worked on the analysis of profit inefficiency in rice production in eastern and northern, Uganda. They reported that access to extension services and education was negative and statistically significant in the entire district and for the pooled data. This implies that to extension service and education reduce profit loss in all the three district (Tororo, Lira and Pallisa district). They also reported that access to credit for pooled data in Tororo and Pallisa district reduce inefficiency in rice profit. However, access to credit in Lira district for pooled data was negative but not statistically significant. Odoemenem and Inakwu (2011) who worked on economic analysis of rice production in Cross River State, Nigeria, reported that the gross margin per average rice farmer studied was N91338.26. This result implies that rice production is profitable enterprise in the study area.

Abdulrahmanet *al.*, (2015) who worked on the analysis of profit efficiency of cocoyam production in Kaduna State, Nigeria, reported that there is a significant and

negative relationship between experience and profit at 10% level of probability. This implies that cocoyam farmers with more years of experience exhibited significantly more profit than farmers with less years of experience. This could probably be explained by the fact farmers probably employ their experience over time as an opportunity to enhance more profit. This finding is consistent with (Ohajianya, and Onyenweaku, 2002). They also reported the profit efficiency score ranged between 0.13 and 0.98 with an average of 0.66. The average profit efficiency score of 0.66 implied that an average cocoyam farmer in the study area could increase profits by 34% by improving technical and allocative efficiency in cocoyam production. This result conformed to the findings of (Ojo et al, 2009) who reported mean profit efficiency levels of 0.77 for Bangladeshi rice farmers and 0.78 for Nigerian cowpea farmers respectively.

Abdulrahman *et al.*, (2015) reported that there is a significant and negative relationship between credit and profit at 10% level of probability. This implies that cocoyam farmers with access to credit exhibited significantly more profit than farmers with less credit. Credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. It also agrees with findings of (Nasiru 2010) who noted that access to microcredit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities. This finding also conform to the study of (Wozniak 1993) supported this fact by reporting in his study that credit increases the net revenue obtained from fixed inputs, market conditions and individual characteristics, while credit constraint decreases the efficiency of

farmers by limiting the adoption of high yielding varieties and the acquisition of information needed for increased productivity.

Abdulai and Huffman (2000) used translog profit frontier function and obtained inefficiency index about 0.27 for northern Ghana; and Ali, Parikh, and Shah (1994) obtained a mean profit inefficiency index about 0.28 for China. But Wang, Wailes, and Cramer obtained a mean profit efficiency measure of 0.61, implying that inefficiency accounts for an average 38.9% loss of profits in China.

2.9.4 Production constraints faced by small holder farmer

Research finding on the constraints to the effective performance of agricultural and rural development project revealed that, most past policies, strategies and interventions failed to achieve their objectives as a result of poor design (Tomoriet *al.*, 2005). In Nigeria, most of those policies were not successful due to “top down” policy in which development are forced on people regardless of their felt needs (Ijere 1992). Other factors that militate against project implementation (Wallace, 1979) included lack of understanding the socio-economic and socio cultural and religious factors of the beneficiary’s communities. Arokoyo (1995) opined that lack of understanding of the socio-economic and socio-cultural elements of the communities or participants by the programme implementers which are lack of appropriate institutional framework and linkages between the government agencies and research institutes charged with the responsibilities. Morardet *et al.* (2005) identified inappropriate technology as hindrance in the transfer of many technologies to farmers practicing irrigation. These factors according to them; land possession, village-family structure and income were the most important.

Ugbajah and Uzuegbuna (2012) revealed the four major problems, namely logistic, agronomic, marketing and socio-cultural problems should be remedied by the collective effort of the government, extension agents and the farmers. Unavailability of improved processing facilities, poor funding and lack of production inputs, Lack of improved cultivars lead to the continued use of low-yielding local cultivars as planting materials.

The most common rice plant diseases found in Nigeria include blast, which can be severe in drought-prone rainfed systems, and rice yellow mottle virus and leaf scald in irrigated and more humid areas (Longtau 2003). Common pests include birds and rodents. Labour: its high cost and scarcity at peaks of farm work during the farming season was also a major constraint reported. The labour problems perhaps explain why respondents cultivate small lowland rice plots. The results on the prominence of pests and diseases infestation of rice farms especially for the lowland rice farms agrees with Abdullahi (1980) that the continuous moisture of the lowland fadama farms provides favourable conditions for disease agents such as fungi and bacteria, particularly on cereals like maize and vegetables.

CHAPTER THREE

METHODOLOGY

3.1 Description of the study area

The study was carried out in Kano State which is located in the Northern part of Nigeria between latitudes 13° N and 11° S and longitude 8° W and 10° E. The State has a land mass of about 20760 square km (NAERLS, 2011). Based on NPC (2006), the State has a projected population of 11,716,688 at 2013. The State is considered to be agrarian as more than 55% of the working adults are engaged in farming and related activities as a means of livelihood. The average annual rainfall is 700mm with the mean daily maximum and minimum temperatures of 35° c and 19° c, respectively. The major crops grown in the State include rice, maize, millet, cowpea, groundnut and vegetables (NAERLS, 2011). The map of the study area is depicted in figure 1.

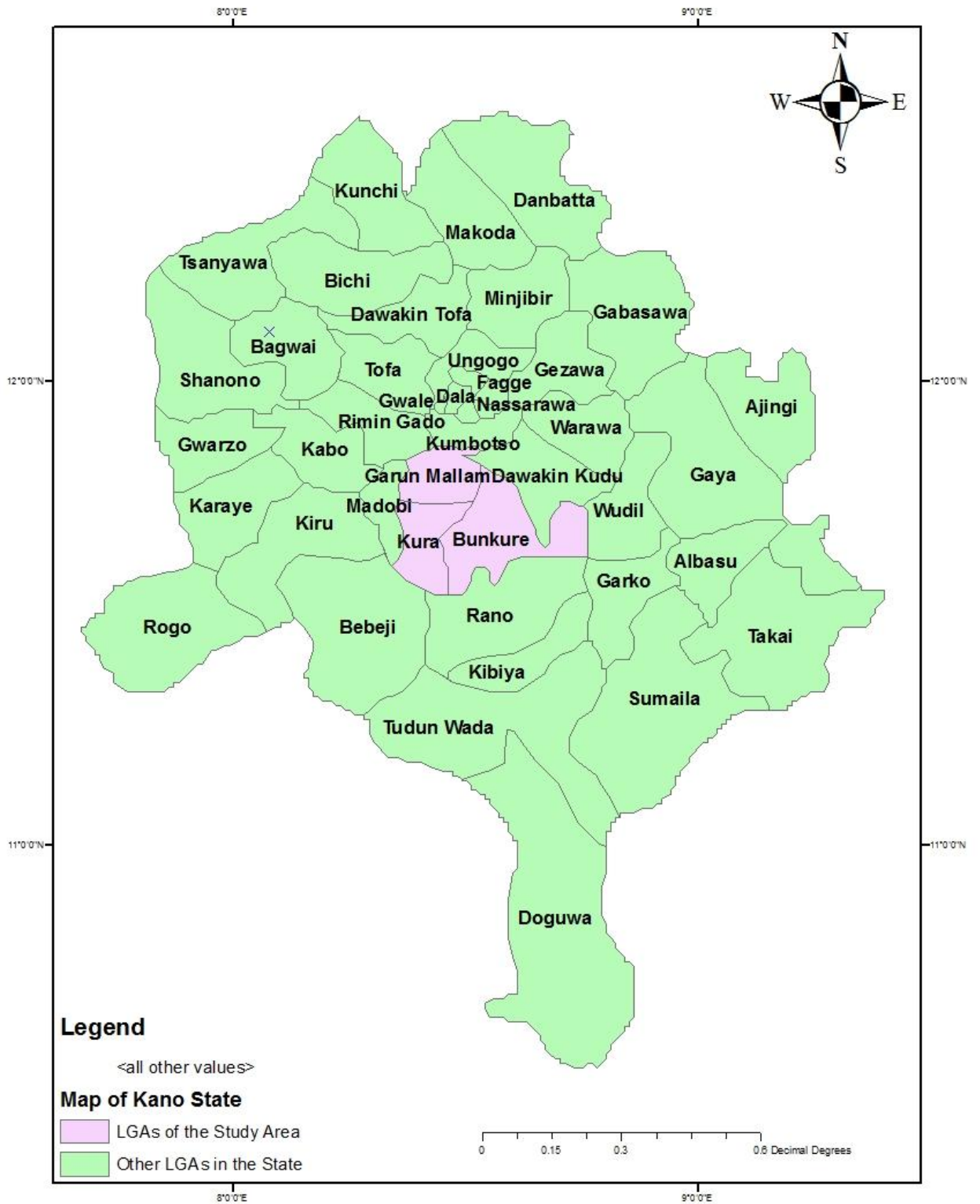


Fig. 1. Map of Kano State showing the selected LGAs

3.2 Sampling procedure and sample size

A multi-stage sampling technique was used to select the rice farmers. In the first stage, the three major rice producing LGAs (i.e. Kura, Garun Malam and Bunkure LGAs) were purposively selected out of 44 LGAs in the State. Secondly, a major and accessible rice producing village was purposively chosen from each LGA. Thirdly, 16% of the given sample frames of rice farmers in each chosen village was randomly selected using random numbers from the list of the farmers. The sample frame of each village was obtained during a reconnaissance survey with the help of HadejiaJama'are River Basin Development Authority (HJRBD) field staff. Thus, a total of 164 rice farmers served as the sample size for the study as shown in Table 3.1.

Table 3.1. Sample Procedures and Sample Size

LGAs	Villages	Sample frame	Sample size (16%)
Kura	Dan Hassan	312	50
Garun Malam	GarunBabba	378	61
Bunkure	Lautaye	332	53
Total		1022	164

Source: Reconnaissance survey, 2014

3.3 Methods of Data Collection

Primary data were obtained from the sampled rice farmers. The data were collected using a structured questionnaire. The information collected from the farmers include socioeconomic characteristics of rice farmers, cost and returns of rice production,

types of rice output markets, outlets available to the rice farmers, constraints to rice marketing in the study area.

3.4 Analytical Techniques

The data collected were analyzed using suitable techniques to achieve the objectives of the study. The tools of analyses used in this study are:

3.4.1 Descriptive statistics

Descriptive statistics such as the mean, standard deviations, frequency distribution and percentages were used to describe the socio-economic characteristics of the rice farmers and the accessible output market outlets of the sampled rice farmers as well as constraints faced by rice farmers. The descriptive statistics was employed to achieve objectives i, ii and vi of the study.

3.4.2 Market outlet choice model

Ordered probit model was applied to explain variation among the farmers in the choice of a specific marketing outlet. This study assumes that farmer's decision is generated based on utility maximization.

$$Prob(Choice_{ij} = j) = \frac{e^{\alpha_j X_i}}{\sum_{j=1}^j e^{\alpha_j X_i}} \dots \dots \dots (3.1)$$

Where:

i represents ith rice farmer, and $i=1,2,3,\dots,n$.

j represents different marketing outlets,

Prob represents the probability of rice marketing outlet j to be chosen by rice farmer i;

Choice_{ij} = j means that rice marketing outlet j is chosen by rice farmer i;

X_i is independent variables

Unbiased and consistent parameter estimates of the model in equation (3.1) require the assumption of independence of irrelevant alternatives (IIA) to hold. More specifically, the IIA assumption requires that the probability of using a certain output market by a given farmer needs to be independent from the probability of choosing another output market outlet. The premise of the IIA assumption is the independent and homoscedastic disturbance terms of the basic model in equation (3.1).

Therefore, the model was tested for the validity of the independence of the irrelevant alternatives (IIA) assumptions by using both the Hausman test for IIA and the seemingly unrelated post-estimation procedure (SUEST).

$$h_i = \ln \left\{ \frac{p}{1-p} \right\} = \alpha_0 + \beta_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \dots + \alpha_8 Z_8 + e_i \dots \dots (3.2)$$

h_i = It is measured by the probability of selling rice to either of the market outlets. The outlet choices might be along farmers' decision involving available alternative markets. It is represented in the model as h_0 for rice farmers who choose to sell rice mainly to wholesalers, h_1 for producers that mainly sell their rice output to assemblers, h_2 for producers who mainly sell rice output to retailers, h_3 for producers who mainly sell rice output for processors, h_4 for producers who mainly sell rice output to consumers and h_5 for producers who mainly sell rice output to many outlets.

h_i = market outlets

Z₁ = years of education (years)

Z_2 = Amount of credit obtained (₦)

Z_3 = Years of membership in farmers' cooperative

Z_4 = Distance to output market (km)

Z_5 = Quantity of rice produced (kg)

Z_6 = Price of rice (₦)

α_s = a vector of parameters to be estimated

e_i = disturbance term

The parameter estimates of the model provide only the direction of the effect of the independent variables on the dependent (response) variable, but estimates do not represent either the actual magnitude of change nor probabilities. Differentiating equation (3.1) with respect to the explanatory variables provides marginal effects of the explanatory variables given as:

$$\frac{\partial Prob_j}{\partial X_i} = Prob_j \left(\alpha_{ji} - \sum_{j=1}^{j-1} Prob_j \alpha_{ji} \right) \dots \dots \dots (3.3)$$

The marginal effects or marginal probabilities are functions of the probability itself and measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable from the mean (Green 2000; Koch 2007).

3.4.3 Market supply model

Multiple linear regression model was also used to analyze factors affecting total quantity of rice supplied to the market by farmers in the study area. Empirically, the market supply model is explicitly expressed as:

$$Y_i = \sigma_0 + \sigma_1 X_1 + \sigma_2 X_2 + \sigma_3 X_3 + \dots + \sigma_9 X_9 + e_i \dots \dots (3.4)$$

Where:

Y_i = It is a continuous dependent variable and it will be measured in kg of paddy rice supplied by rice farmer to each identified market outlet in the survey year.

X_7 = Qty of rice produced (kg)

X_3 = Years of schooling

X_6 = Years of rice production experience

X_9 = Amount of credit obtained (₦)

X_4 = Years of membership in farmers' cooperative

X_5 = Distance to output market (km)

X_8 = Price of rice in the market (₦)

σ_s = a vector of parameters to be estimated

e_i = disturbance term

3.4.4. The stochastic profit frontier model Specifications

Profit efficiency in this study is defined as profit gained from operating on the profit frontier, taking into consideration farm-specific prices and factors. Farm profit is measured in term of Gross Margin (GM) which equals the difference between the Total Revenue (TR) and Total Variable Cost (TVC). That is:

$$GM(\pi) = \sum (TR - TVC) = \sum (PQ - WX_1) \dots \dots \dots (3.5)$$

Empirically, according to Batenet *al.* (2009), the Cobb-Douglas functional form is preferred to other functional forms if there are three or more independent variables in the model. Hence, Cobb-Douglas stochastic frontier functions with four independent variables were applied in this study. For empirical estimation of profit efficiency model, the Cobb-Douglas stochastic profit frontier function model is specified as:

$$\ln\pi_i = \delta_0 + \delta_1 \ln X_1 + \delta_2 \ln X_2 + \delta_3 \ln X_3 + \delta_4 \ln X_4 + V_i - U_i \dots \dots \dots (3.6)$$

Where,

π_i = profit computed as total revenue less variable cost

X_1 = cost of seeds (₦)

X_2 = cost of fertilizer (₦)

X_3 = cost of labour (₦)

X_4 = cost of agrochemicals (₦)

V_i = are random variables associated with random factors

U_i = which are non-negative random variables which are assumed to account for technical inefficiency and

δ_s = vector of unknown parameters to be estimated

The sources of profit inefficiency effects U_i in equations (3.6) is modelled in terms of the farm's and farmer's characteristics and specified as:

$$U_i = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \beta_6 Z_6 + \beta_7 Z_7 + \beta_8 Z_8 \dots \dots \dots (3.7)$$

Where;

Z_1 = age of the farmer,

Z_2 = Household size,

Z_3 = years of education,

Z_4 = farming experience (years),

Z_5 = amount of credit used (N)

Z_6 = farm size (ha)

Z_7 = years of membership in farmers' cooperative

Z_8 = number of extension contact,

β_s = are unknown scalar parameters.

The computer program FRONTIER 4.1 (Coelli, 1996) was used to obtain the maximum likelihood estimates of the δ_s and β_s coefficients in equations (3.9) and (3.10) respectively.

3.5. Measurement of variables

i. **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. Hofferth (2003) argues that 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 greater experience of marketing activities. More also, older household heads are expected to have better access to land than younger heads, because younger men either wait for a land distribution, or have to share land with their families. The estimated coefficient of age is expected to have negative relation with output market and profit inefficiency.

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

iii. **Education level:** Education is generally considered an important variable that could enhance farmer's acceptance of new technologies. Ogunbameru (2001) posited that education will likely enhance the adoption of modern farm technologies by youth and thereby sustaining a virile farming population. The more educated farmers are, the more likely they adopt technology and also translate into marketing experience. 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 market and profit inefficiency.

iv. **Farming experience:** Farming experience is an experience gain with age while carrying out farming operations. Since the major occupation of the respondents is

farming, the length of time in farming can be linked with the age of the farmers. 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 was expected to have positive relationship with output market and profit efficiency.

v. **House-hold size:** This is the number of people in a given house-hold. Ojuekaiye (2001) defined household size as the number of people eating from one pot. It implies that the consumption unit is also the production unit. 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 was expected to have negative relationship with output market and profit inefficiency.

vi. **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 was expected to have positive relationship with output market and profit efficiency

vii. **Access to credit:** Credit is a very strong important factor that is needed to acquire or develop farm enterprise (Ekong, 2003). Its availability could determine adoption of recommended rice production technologies and the extent of production capacity. This was measured as amount received in naira. The estimated coefficient of credit obtained was expected to have negative relationship with output market and profit inefficiency.

viii. **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). Farmers that belong to a co-operative society are likely to adopt new technology easily than those not in any co-operative. This was measured in years of participation. The estimated coefficient of cooperative membership was expected to have negative with output market and profit inefficiency.

ix. **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). The more number of contacts of an extension agent to the farmers the greater the chance for them to adopt innovation. It was measured in terms of number contact made by an extension agent. The estimated coefficient of extension contact was expected to have negative with output market and profit inefficiency.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Rice Farmers

4.1.1 Age distribution of rice farmers

Age has been found to determine how active and productive the head of the household would be. Age has also been found to affect the rate of household adoption of innovations, which in turn, affects household productivity and livelihood improvement strategies (Dercon and Krishnan 1996; Amaza *et al* 2009).

The result presented in Table 4.1 shows that about 42% of rice farmers were within the age range of 30-39 years. The average age of rice farmers was found to be approximately 38 years with minimum of 20 years and maximum of 80 years. The average age of 38 years obtained for the rice farmers indicate that they were still in their active productive years which could lead to low level of profit inefficiency and this youthful age positively influence the respondents' participation in rice access to output market outlet. This agrees with the findings of Maurice (2004) and Yusuf (2005), that youthful age can influence the adoption of improved agricultural practices. The findings are also consistent with those of Nwanko *et al.* (2009) and Institute for Agricultural Research (2001), they reported that the most active farmers' age group engaged in agricultural production was within 31-50 years.

Table 4.1: Age distribution of rice farmers

Age (years)	Frequency	Percentage
20-29	29	17.7
30-39	70	42.7
40-49	34	20.7
50-59	21	12.8
60 and above	10	6.1
Total	164	100
Mean	38	
Minimum	20	
Maximum	80	
SE	0.91	

4.1.2 Household size of ricefarmers

The significance of household size in agriculture hinges on the fact that the availability of labour for farm production, the total area cultivated to different crop enterprises, the amount of farm produce retained for domestic consumption and the marketable surplus are all determined by the size of the farm household.

Table 4.2 shows the distribution of rice farmers by household size. Majority of the farmers 87.2% had household size that ranged from 1-10 persons in their family. The maximum family size observed was 32 persons with a minimum of 1 person and average of 6 persons (Table 4.2). This implies that the farmers in the study area might have advantage of familylabour availability if many household members participate in farm activities. However, the implication of large household size is that it will

increase household consumption expenditure which would compete with production for limited financial resources within the household. According to Okoruwa and Ogundele (2006) large family size does not necessarily translate to higher use of family labour because some of the young able bodied family member may prefer other jobs than farming. This finding is also in line with those of Solomon (2008) and Banmeke (2003) which indicate that large household size assisted more on farm and other household activities.

Table 4.2: Distribution of rice farmers according to their household size

Household size (number)	Frequency	Percentage
1-10	143	87.2
11-20	17	10.4
21-30	2	1.2
31-40	2	1.2
Total	164	100
Mean	6	
Minimum	1	
Maximum	32	
SE	0.40	

4.1.3 Educational level of rice farmers

The level of farmers' education is believed to influence the use of improved technology in agriculture and, hence, farm productivity. The level of education determines the level of opportunities available to improve livelihood strategies, enhance food security, and reduce the level of poverty. It affects the level of exposure

to new ideas and managerial capacity in production and the perception of the household members on how to adopt and integrate innovations into the household's survival strategies. The more a farmer is educated the higher the profit efficiency and the lower the profit inefficiency and the farmer will be better disposed to output market accessibility.

The result presented in Table 4.3 revealed that about 65% of rice farmers had no formal education, about 12% of the respondent had only primary education, and 7% had secondary education while about 16% had tertiary education. However, altogether about 65% of the farmers had no formal education. Illiteracy is believed to have a negative implication on efficient use of productive resources and adoption of farm innovation.

This indicates that the farmers' educational level is low. This finding is at variance with Amaza (2000), that education has a positive and significant impact on farmers' efficiency in production. Thus, literacy level will greatly influence the decision making and adoption of innovation by farmers, which may bring about increase in productivity.

Table 4.3: Distribution of rice farmers according to their level of education

Education (years)	Frequency	Percentage
No formal education	106	64.6
Primary education	20	12.2
Secondary education	12	7.3
Tertiary education	26	15.9

4.1.4 Farming experience of rice farmers

The process of gaining knowledge and skills is termed experience. It is a measure of the period an individual farmer was involved in rice production. The more the number of years of production by rice farmer, the more knowledge and skills gained. Experience influences individual's perception and understanding of the management requirements and it is also an important factor determining both the productivity and the production level in farming and marketing of rice output.

The experience of the majority of the surveyed farmers in rice production shows that 71.3% of rice farmers had 1-5 years of experience. The maximum farming experience observed was 23 years with a minimum of 1 year and average of 5 years of experience in rice productions. This implies that majority of the farmers are relatively new entrants into rice production, as about 90% of them have less or equal to 10 years of experience in rice production and marketing (Table 4.4).

The implication of this result is that as one gets proficient in the methods of production, optimal allocation of resources is expected to be achieved. The more experienced one is the higher the profit and the lower the profit inefficiency. Thus, the average years of experience (5 years) obtained is an indication of the fact that the rice farmers in the study area were well experienced in farming, thus their level of profit inefficiency should be low due to their sound decisions making as regards resources allocation and management of their farms and better access to output market. This finding is in line with Ajani (2000) on productivity in food farming in

northern area of Oyo State which revealed that years of farming experience increased agricultural productivity among farming households in Nigeria.

Table 4.4: Distribution of rice farmers according to farming experience

Farming Experience	Frequency	Percentage
1-5	117	71.3
6-10	29	17.7
11-15	13	7.9
16-20	2	1.2
20 and above	3	1.8
Total	164	100
Mean	5	
Minimum	1	
Maximum	23	
SE	0.34	

4.1.5 Amount of credit obtained by rice farmers

Adequate funding is required by farmers to finance all rice production and marketing activities. The results presented in Table 4.5 indicate that the majority 89.6% of farmers had no access to credit to finance their rice production activities while those who had access to credit accessed between ₦10,000-₦40,000 which represent about 3.7% of the farmers. However, a large number of farmers had no access to funds to finance their crop production activities, which in turn reduce their level of profit efficiency. The result reveals that commercial banks are less patronized for financial support for farming in the study area. This may be due to avoidance of high interest rate on collected loan. Ekong (2003) asserts that credit is a very strong factor that is

needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. According to Tijani *et al*(2006), access to credit provides the farmer with a means of expanding and improving his farm. It also determines the ease with which he adopts new practices and technologies in his enterprise. Therefore, lack of credit facility will have a negative effect on profit efficiency. The study by Wozniak (1993) supported this fact by reporting in his study that credit increases the net revenue obtained from fixed inputs, market conditions and individual characteristics, while credit constraint decreases the efficiency of farmers by limiting the adoption of high yielding varieties and the acquisition of information needed for increased productivity.

Table 4.5: Distribution of rice farmers according to credit obtained.

Variable	Frequency	Percentage
No access to credit	147	89.6
10,000- 40,000	6	3.7
40,001- 80,000	7	4.3
80,001-120,000	4	2.4
Total	164	100
Mean	6,000	
MIN	1000	
MAX	100,000	
SE	1553.2	

4.1.6 Farm size of rice farmers

In traditional agriculture, the size of farm land determines the scale of operation of farmers and land is considered to be the most important factors of production. Farm size in this study refers to the land area that was actually used for rice production during the survey year.

Only about 4% of the farmers have farm sizes greater than 15 hectares (scattered in different locations). Majority (76%) of the rice farmers have farm size ranging from 0.1-5 hectares with an average of 4 hectares. This shows that farmers in the study area will not be able to enjoy economy of scale in production.

Positive relationship has been established between farm size and improvement in households' income and its profit efficiency (Jayne *et al.*, 2005; Deininger, 2003). The larger the farm size of the household, the higher the expected level of food production.

Table 4.6: Distribution of rice farmer according to their farm size

Farm size (hectares)	Frequency	Percentage
0.1-5.0	136	75.7
5.1-10.0	16	15.7
10.1-15.0	6	4.3
15 and above	4	1.43
Total	164	100
Mean	4	
Minimum	0.5	

Maximum	26
SE	0.32

4.1.7 Membership of cooperative society

Membership of cooperatives influences adoption of improved technologies resulting in higher productivity and poverty alleviation (Amazaet *al.* 2009). The result in Table 4.7 revealed that about 79% of rice farmers do not participate in any cooperative association with an average of 1 year. The average years of membership of cooperative society was 1 year. The effect of this result is that most of the rice farmers in the study area do not enjoy the assumed benefits accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit maximization. This finding is in line with Odebiyi (2010) that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually. According to Idionget *al.* (2007), membership of cooperative affords the farmers opportunities of sharing information on modern rice practices.

Table 4.7: Distribution of rice farmers according to years spent in the cooperative association

Cooperative association	Frequency	Percentage
Non members	130	79.3
1-3 years	15	9.1
4-6 years	9	5.5
7-9 years	8	4.9
10-12 years	2	1.2
Total	164	100
Mean	3	

MIN	1
MAX	10
SE	0.06

4.1.8 Numbers of extension contact

The ultimate aim of extension services is to enhance farmers' ability to efficiently utilize 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. The distribution of the sampled farmers based on numbers of extension visit is presented in Table 4.8.

The result presented in Table 4.8 revealed 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. According to Obwona (2000), extension service is very essential to the improvement of farm productivity and efficiency among farmers.

Table 4.8: Distribution of rice farmers according to extension visit

Extension Contact (Numbers)	Frequency	Percentage
No contact	147	89.7
1-3	15	9.1
4-6	2	1.2
Total	164	100
Mean	2	

MIN	1
MAX	6
SE	0.05

4.2 Output Market Outlets Accessible to Rice Farmers

Output market in this study refers to the first stage of buying paddy rice from the farmers. It is the most competitive stage of the rice output, where key players intensively compete in terms of price and the timing of purchasing from the farmers. These key players include wholesalers who operate input and output shops, rural assemblers, retailers and large processing companies.

The result in Table 4.9 shows that about 82% of the rice farmers sell their produce to rural assemblers. This may be the fact that rural assemblers pay the farmers immediately upon delivery. This is a preferred option for farmers that tend to be in desperate need for cash, even when the price offered is lower than the prevailing market price. Sometime, the farmers receive the cash even before harvesting the rice. In such arrangements, it is the traders that determine when to buy, at what price to buy, and to a greater extent, the quantity bought from farmers. This category of assemblers tends to maintain large market shares. They have over the years established markets beyond the domestic rural market, through business partnership with other traders in the neighbouring states. This finding agrees with Rhoda (2013).

In Katete district, for example, one large-scale agro-input/output trader bought up to 10% of the rice produced in the district in 2011.

From the result presented in Table 4.9, about 5% of the rice farmers sold their produce to wholesalers in the study area and these wholesalers assemble the paddy rice from the farmers using different methods. The most common method of acquisition is for farmers to deliver the paddy rice directly to the wholesalers' shop. The second method is for these wholesalers to buy paddy rice from intermediaries who purchase the paddy rice in the villages.

The result presented in Table 4.9 revealed that about 6% of the rice farmers sold their produce to retailers. This may be due to the fact that retail outlet, which comprises mainly of local shops, provides significant markets for both unprocessed and processed rice products. Other than the supermarket channel, local retail shop owners also provide market for paddy rice and locally processed rice. The paddy rice bought directly from the farmers is repacked into small plastic bags, which are later sold to the consumers in the retail shops.

The result from Table 4.9 revealed that about 7% of the rice farmers sold their produce to processors. After harvesting, paddy rice goes through a process of boiling and shelling. Shelling is a form of value addition although the value-added is minimal. There is a higher demand for shelled paddy rice than for unshelled paddy rice because most buyers do not want to invest in the high labour demand and cost of shelling in the study area.

The results show that about 3% of the produce produced by emerging farmers is sold to the family and friends market as well as local fresh produce market while the rest is

sold to the public stores. Whilst some of the farmers use more than one channel of marketing, not all produce was sent to the market, but some was retained for home consumption.

Table 4.9: Output market outlets accessible to rice farmers

Outlet markets	*Frequency	Percent
Rural assembler	135	82.3
Whole sellers	8	4.9
Retailers	10	6.1
Processors	11	6.7
Combination of outlet	5	3.0
Total	169	100

* Multiple responses,

NB: Combination of outlet (family and friends market, local fresh produce market, public stores)

4.3 Determinants of Farmers' Choices among Alternative Rice Output

Market Outlets

The orderedprobit model was used to estimate the parameters of the determinants of farmers' choices among alternative rice output market outlets by rice farmers in Kano state. The Pseudo R-squared value indicates that 51 percent of the variation in the farmers' choices among alternative rice output market outlets by rice farmers is explained by the independent variables. The relatively small value may be due to measurement errors in the explanatory variables. The significant chi-square value of 50% indicates that the explanatory variables jointly influence the farmers' choices among alternative rice output market outlets (Table 4.10). Farmers' choices among

alternative rice output market outlets is significantly determined by educational status of the household head, access to credit, cooperative membership, distance to market, quantity of output produced by the farmers and market price of rice. Numerically and statistically, quantity of output produced by the farmers, market price and education were the most significant determinant of farmers' choices among alternative rice output market in the study area.

Education was positively associated with the probability of farmers' choices among alternative rice market outlets. For household heads that are educated, the probability of farmers' choices among alternative rice market outlets was higher than uneducated household heads by 0.06. This implies that the educated farmers use his educational advantages in making choice of alternative market to maximize his profit. The result is in line with the findings by Tambo and Abdoulaye, (2011); Enete and Igbokwe, (2009). According to them, education enhances access to information processing for technology uptake and higher farm productivity.

Access to credit is associated with a positive effect on farmers' choices among alternative rice output market outlets. This enable the farmers to choose from alternative market outlet that will yield better opportunities in terms of price advantage, due to his financial capability. The result is consistent with the findings by Asante *et al.*, (2011); Nzomo *et al.*, (2007) and Musse *et al.*, (2001). Access to credit enables farmers to overcome their financial constraints associated with production and adoption of innovations and transportation of produce to available markets.

The results presented in Table 4.10 show that cooperative membership was negatively associated with lower probability of farmers' choices among alternative rice market

outlets and not significantly influence the choice of market by rice farmers in the study area. Low participation (76%) in cooperative activities by farmers could be attributed to the insignificant influence on the choice of outlet market. This finding is at variance with Odebiyi (2010) who found that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually.

The distance to the output market is an important factor since the interaction of the farmers with the output market is crucial in making information available. Long distances to the market can be a disincentive to farmers who want to commercialize. Compared to other output markets, the rural assemblers market is located furthest to a paddy rice farmer. That is, paddy rice farmer is located 10 km away from the retailer market with the closest paddy rice farmer being located about 1 km while the furthest processor was located 200 km away.

In contrast the retailers seem to be the closest to paddy rice farmer. This is not surprising as rural assemblers are the main output market for the farmers that are located mainly in the rural areas. The closest rural assembler is about a kilometer away while the furthest is about 25 km away. Processors are located at about 13 km away from paddy rice farmer. The closest processor was about 6 kilometers away while the furthest about 150 km away.

The results presented in Table 4.10 shows that distance to market significantly influence the choice of market by rice farmers in the study area. This is because distance enables the farmers to choose from alternative market outlet that will maximize his profit through reduction in transportation cost. The negative sign will lead to a reduction in the odds in favour of the farmers choosing a distance market outlet due to its cost implication. The result is consistent with the finding of Nzomo *et al.*

al., (2007) who opined that distance to market significantly influence choice of an individual farmers/marketers in terms of transportation of produce to available market outlet.

Quantity of output produced by rice farmers was associated with a positive effect on farmers' choices among alternative rice output market outlets. A unit increase in farmers output of rice results in an increase in the probability of choosing from the alternatives outlets by 0.03. Farmers output is the most influential determinant of farmers' choices among alternative rice output market, an outlet market with promising relative higher price will influence farmers choice to supply more of his output because output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income.

Market price was associated with a positive effect on farmers' choices among alternative rice market outlets. A unit increase in the market price of rice results in an increase in the probability of choosing from the alternatives outlets by 0.06. According to economic theory, output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income. Studies by Olwande *et al.* (2010), Enete and Igbokwe (2009) and Omiti *et al.* (2009) support this theory. A major challenge of the farmer is to produce to meet the demands of the market. Higher market price guarantees the income of the household head. In order to take advantage of the market price, household heads may choose from alternative market based on higher market price.

Table 4.10: Ordered Probit Estimates of Determinants of farmers' choices among alternative rice output market outlets

Variable	Coefficient	Standard error	T-value	Marginal effect
Constant	-19.625	11.376	-1.725*	0.083
Education	0.151	0.059	2.559***	0.066
Credit	0.319D-05	0.538D-05	0.378	0.705
Cooperative membership	-0.644	0.6531	-0.819	0.413
Distance	-0.301	0.101	-2.980***	0.795
Output	0.549D-05	0.224D-05	3.851***	0.031
Price	0.0045	0.0024	1.875*	0.063
Numbers of observation		164		
Log likelihood function		-113.401		
Restricted log likelihood		-117.128		
McFadden Pseudo R-square		0.51		
Chi-square χ^2		7.25		
DF		7		
Prob (chi-square > value)		0.503		

***p<0.001**p < 0.05 and *p < 0.10

4.4 Determinant of Quantity of Rice Supplied to Each Identified Market Outlet

4.4.1 Determinant of quantity of rice supplied to rural assemblers market outlets

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to rural assemblers' is presented in Table 4.11. The adjusted R square of 0.67 implies that 67 percent in the variability in the quantity of rice supplied to rural assembler in the study area is explained by the explanatory variables (quantity of rice produced, education, farming experience, credit, distance to market and price of rice) specified in the model. The F statistics of 202.580 is statistically significant at 1% probability level and this indicates the joint significance of the specified variables on the quantity of rice supplied to rural

assembler in the study area suggesting that the model has a good explanatory power on the variation in the model. The factors that had significant influence on quantity of rice supplied to rural assemblers in the study area were quantity of rice produced, education, distance to market and price of the rice while farming experience, credit and membership of cooperative were not statistically significant.

Quantity of rice produced was found to have a direct relationship with the quantity of rice supplied to rural assembler market outlets and significant at 1% probability level. This implies that as the quantity of rice produced by rice farmers increases by one unit, their quantity of rice supplied to rural assembler will also increase *ceteris paribus*. A plausible explanation for this is that farmers output is the most influential determinant of farmers' choices among alternative rice output markets, an outlet market with promising relative higher price will influence farmers choice to supply more of its output because output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income.

The coefficient of Education variable was found to have a direct relationship with the quantity of rice supplied to rural assembler market outlets and significant at 1% probability level. This implies that as the level of education of rice farmers increases by one unit, their quantity of rice supplied to rural assembler will also increase *ceteris paribus*. A plausible explanation for this is that higher educational level leads to higher rate of improved technology and techniques of production adoption. Also, educated farmers are likely to be more successful in gathering information and understanding new practices and marketing information on their produce.

The coefficient of distance to market was found to have a direct relationship with the quantity of rice supplied to rural assembler market outlets and significant at 1%

probability level. This implies that as the distance to rice market outlet increases by one kilometer, their quantity of rice supplied to rural assembler will also increase *ceteris paribus*. A plausible explanation for this is that rural assemblers pay the farmers immediately upon delivery. This is a preferred option for farmers that tend to be in desperate need for cash, even when the price offered is lower than the prevailing market price. Sometime, the farmers receive the cash even before harvesting the rice.

The coefficient of price variable was found to have an inverse relationship with the quantity of rice supplied to rural assembler market outlets and significant at 5% probability level. This implies that as the quantity of rice supplied to rural assembler market outlets increases by one unit, the market price will decrease *ceteris paribus*. The farmer's response to price changes for specific products aimed at many conditions. this finding is in line with Darmawi (2005) who also asserted that in any business activity, especially in agribusiness, the business is always face with situation of risk and uncertainty and hence marketing information is highly essential.

Table 4.11: Determinants of quantity of rice supplied to rural assemblers market outlets

Variable	Coefficient	Standard error	T-value
Constant	-5450.69	2793.02	-1.952*
Quantity of rice produced	1.03	0.126	8.165***
Education	12.29	2.89	4.253***
Farming experience	-33.51	91.23	-0.367
Credit	-0.003	0.006	-0.547
Membership of cooperative	117.17	253.98	0.461

Distance to market	597.41	234.27	2.550***
Price of rice	2.41	1.13	2.134**

$R^2=0.693$
 R^2 Adjusted=0.671
 F-value= 202.580***

4.4.2 Factors affecting quantity of rice supplied to wholesaler market outlets

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to wholesale market outlet of rice farmers is presented in Table 4.12. The adjusted R square of 0.60 implies that 60% in the variability in the quantity of rice supplied to wholesaler in the study area is explained by the explanatory variables (quantity of rice produced, education, farming experience, credit, distance to market and price of rice) specified in the model. The F statistics of 139.20 is statistically significant at 1% probability level and this indicates the joint significance of the specified variables on the quantity of rice supplied to rural assembler in the study area suggesting that the model has a good explanatory power on the variation in the model. The factors that had significant influence on quantity of rice supplied to wholesaler in the study area were Quantity of rice produced, distance to market and price of the rice output while education, farming experience, credit and membership of cooperative were not statistically significant.

The coefficient for quantity of rice produced was found to have a direct relationship with the quantity of rice supplied to wholesaler market outlets and significant at 10% probability level. This implies that as the quantity of rice produced by rice farmers increases by one unit, their quantity of rice supplied to wholesaler will also increase *ceteris paribus*. A plausible explanation for this is that farmers output is the most influential determinant of farmers' choices among alternative rice output market, an

outlet market with promising relative higher price will influence farmers choice to supply more of its output because output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income.

The coefficient of distance to market was found to have a direct relationship with the quantity of rice supplied to wholesaler market outlets and significant at 1% probability level. This implies that as the distance to rice market outlet increases by one kilometer, their quantity of rice supplied to wholesaler market outlet will also increase *ceteris paribus*. A plausible explanation for this is that rural assemblers pay the farmers immediately upon delivery. This is a preferred option for farmers that tend to be in desperate need for cash, even when the price offered is lower than the prevailing market price. Sometime, the farmers receive the cash even before harvesting the rice.

The coefficient of price variable was found to have a direct relationship with the quantity of rice supplied to wholesaler market outlets and significant at 5% probability level. This implies that as the quantity of rice supplied to wholesaler market outlets increases by one unit, the market price will increases *ceteris paribus*. This is because higher market price guarantees the income of the household head. This finding is in line with Omiti *et al.* (2009) who opined that major challenge of farmers is to produce to meet the demands of the market and however, higher market price guarantees the income of the household head.

Table 4.12: Determinants of quantity of rice supplied to wholesaler market outlets

Variable	Coefficient	Standard error	T-value
Constant	23424.511	11547.51	2.029**
Quantity produced	1.09	0.04	22.273***
Education	-11.46	146.60	-0.078
Farming experience	-17.10	56.32	-0.304
Credit	0.008	0.013	0.0657
Membership of cooperative	-36.92	114.76	-0.322
Distance to market	180.07	105.47	1.707*
Price of rice	5.38	2.75	1.958**

$R^2=0.713$

R^2 Adjusted=0.601

F-value= 139.24***

4.4.3 Factors affecting quantity of rice supplied to retailer market outlets

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to retailer' market outlet of rice farmers is presented in Table 4.13. The adjusted R square of 0.58 implies that 58% in the variability in the quantity of rice supplied to retailer in the study area is explained by the explanatory variables (quantity of rice produced, education, farming experience, credit, distance to market and price of rice) specified in the model. The F statistics of 74.68 is statistically significant at 1% probability level and this indicates the joint significance of the specified variables on the quantity of retailer in the study area suggesting that the model has a good explanatory power on the variation in the model. The factors that had significant influence on quantity of rice supplied to retailer in the study area were education, distance to market and price of the rice output while

quantity of rice produced, farming experience, credit and membership of cooperative were not statistically significant.

The coefficient of Education variable was found to have a direct relationship with the quantity of rice supplied to retailer's market outlets and significant at 10% probability level. This implies that as the level of education of rice farmers increases by one unit, their quantity of rice supplied to retailers will also increase *ceteris paribus*. A plausible explanation for this is that higher educational level leads to higher rate of improved technology and techniques of production adoption. Also, educated farmers are likely to be more successful in gathering information and understanding new practices and marketing information on their produce.

The coefficient of distance to market was found to have a direct relationship with the quantity of rice supplied to retailer's market outlets and significant at 1% probability level. This implies that as the distance to rice market outlet increases by one kilometer, their quantity of rice supplied to retailers will also increase *ceteris paribus*.

The coefficient of price variable was found to have an inverse relationship with the quantity of rice supplied to retailer's market outlets and significant at 5% probability level. This implies that as the quantity of rice supplied to retailers market outlets increases by one unit, the market price will decrease *ceteris paribus*.

Table 4.13: Determinants of quantity of rice supplied to retailer market outlets

Variable	Coefficient	Standard error	T-value
Constant	199081.77	730378.99	0.273
Quantity produced	0.176	1.144	0.154
Education	4776.66	2490.71	1.918*
Farming experience	1197.53	1139.72	1.051
Credit	-0.2677	0.6432	-0.416
Membership of cooperative	-485.91	3349.04	-0.145
Distance to market	7743.18	1523.02	5.084***
Price of rice	-173.55	48.72	-3.562**

R²=0.589
R² Adjusted=0.521
F-value= 74.68***

4.4.4 Factors affecting quantity of rice supplied to processors market outlets

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to processors market outlet of rice farmers is presented in Table 4.14. The adjusted R square of 0.46 implies that 46 percent in the variability in the quantity of rice supplied to retailer in the study area is explained by the explanatory variables (quantity of rice produced, education, farming experience, credit, distance to market and price of rice) specified in the model. The F statistics of 62.43 is statistically significant at 1% probability level and this indicates the joint significance of the specified variables on the quantity of processors in the study area suggesting that the model has a good explanatory power on the variation in the model. The factors that had significant influence on quantity of rice supplied to processors in

the study area were quantity of rice produced, farming experience and credit while quantity of rice produced, education, distance to market, price of the rice output and membership of cooperative were not statistically significant.

The coefficient for quantity of rice produced was found to have a direct relationship with the quantity of rice supplied to processors market outlets and significant at 1% probability level. This implies that as the quantity of rice produced by rice farmers increases by one unit, their quantity of rice supplied to processors will also increase *ceteris paribus*. A plausible explanation for this is that farmers output is the most influential determinant of farmers' choices among alternative rice output market, an outlet market with promising relative higher price will influence farmers choice to supply more of its output because output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income.

The coefficient of farming experience was found to have a direct relationship with the quantity of rice supplied to processors market outlets and significant at 1% probability level. This implies that as the farming experience increases by one unit, their quantity of rice supplied to processors will also increase *ceteris paribus*.

The coefficient of credit variable was found to have a direct relationship with the quantity of rice supplied to processors market outlets and significant at 5% probability level. This implies that as the amount of credit received by rice farmers increases by a unit, the quantity of rice supplied to processors market outlets will increase *ceteris paribus*.

Table 4.14: Determinants of quantity of rice supplied to processor market outlets

Variable	Coefficient	Standard error	T-value
Constant	-5450.69	2793.02	-1.952*
Quantity produced	1.03	0.126	8.165***
Education	-12.29	205.89	-0.060
Farming experience	91.23	33.51	2.722***
Credit	0.006	0.003	2.001**
Membership of cooperative	117.17	253.98	0.461
Distance to market	234.27	597.41	0.392
Price of rice	1.13	2.41	0.469

$R^2=0.536$

R^2 Adjusted=0.461

F-value= 62.43***

4.5 Profit Efficiency and its Determinants for each Identified Market Outlet

4.5.1 Profit efficiency and its determinants for rural assembler's market outlet

The maximum likelihood estimates of the parameters of the stochastic profit frontier model for rural assembler market outlet are presented in Table 4.18. The study revealed that the generalized log likelihood function was -142.820. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.3 and it was highly significant at 1% level of probability. This is consistent with the theory

that true γ -value should be greater than zero. This implies that 30% of random variation in the profit of the farmers was due to the farmers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the farmer, reducing the influence of the effect of γ will greatly enhance the profit efficiency of the farmers and improve their profit. The value of sigma squared (σ^2) was significantly significant at 1% level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the profit inefficiencies of rice farmers.

However, the estimated coefficients of all the parameters of profit function (cost of seed, cost of fertilizer, cost of agrochemical and cost of labour) were significant except cost of fertilizer only which is not statistically significant and hence play a major role in rice profit efficiency of rice farmer in the study area. The average profit efficiency for the farmers was 0.58 in the study area. This suggest that an average of 58% of potential maximum profit is gained due to production efficiency while the remaining short fall of discrepancy between observed and frontier profit function. Thus, in a short run, there is minimal scope (42%) of increasing the efficiency, by adopting the technology and techniques used by the best rice farmer.

The estimated coefficient for cost of seed was negatively signed and significant at 1% level of probability. This implied that a unit decrease in the cost of seed will lead to an increase in the profit obtainable from rice production by 58%. This finding is at

variance with Abdulrahman *et al.*, (2015) who opined that the coefficient for cost of seed was positively signed and significant at 1% level of probability, implying that for 1% increase in the use of seed, the profit obtainable from cocoyam production will increase by 52%.

The estimated parameter for cost of labour was negative and significant at 1% level of probability. The negative sign of labour may be due to high cost of a hired labour among the resource-poor rural farmers because the consumption of additional hired labour is meant to supplement available family labour such that as the availability of family labour decreases, additional hired labour is consumed. Due to the high cost of hired labour if additional hired labour must be consumed then additional cost must be incurred and hence, resulting in decrease in profit efficiency of rice farmers.

The coefficient for cost of agrochemical was negatively signed and significant at 10% level of probability. This implied that a unit increase in the prices of agrochemical will lead to decrease in profit efficiency of rice farmers.

The results further showed that the profit efficiency of the rice farmers was positively influenced by age, household size, cooperative membership and extension contact (Table 4.18). This result is in agreement with Lockheed *et al.* (1980), Ali and Flinn (1989), Abdulai and Huffman (1998) and Sharma *et al.* (1999). Thus, investments in rural education through effective extension delivery program and provision of credit will boost farmers' efficiency. However the analysis of inefficiency models shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer.

The result showed that there is a significant and positive relationship between age and profit at 10% level of significant. This implies that rice farmers with more age exhibited significantly less profit than farmers with less age. This finding is at variance with Abdulrahman *et al.*, (2015) who found that age negatively influence profit inefficiency, implying age of the farmer increases farmers profit.

The result showed that there is a significant and negative relationship between educational status of the farmer and profit inefficiency. This implies that rice farmers with higher educational status exhibited significantly more profit than farmers with less educational status. This could probably be explained by the fact farmers probably employ their educational advantage as an opportunity to enhance more profit. This finding is in line with Abdulrahman *et al.*, (2015).

The result in Table 4.18 showed that there is a significant and negative relationship between credit and profit efficiency. This implies that rice farmers with access to credit exhibited significantly more profit than farmers with less credit. Credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. It also agrees with findings of Nasiru (2010) who noted that access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities.

The result also showed that there is a significant and positive relationship between extension contact and profit efficiency. This implies that rice farmers with more extension contact exhibited significantly less profit than farmers with less extension contact. The results further showed that the profit efficiency of the rice farmers was positively influenced by access to extension services. This result is in agreement with

Lockheed et al. (1980), Ali and Flinn (1989), Abdulai and Huffman (1998) and Sharma et al.(1999). Thus, investments in rural education through effective extension delivery program and provision of credit will boost farmers' efficiency.

The result of this study has clearly shown that rural assembler market outlet (58%) had the highest profit efficiency and also meets the a priori expectation while wholesaler (52%), processors (32%) and retailer market outlet (37%). Thus, it be concluded that rural assemblers market outlet is more profitable and opportunities exist in rice production. Therefore, engaging in rice production could be one sure way that would assist resource poor farm household to increase their income levels thereby reducing poverty in the country.

Table 4.15: Estimates of the parameter of the stochastic profit function for paddy rice in rural assembler's market

Variables	Parameters	Coefficients	Std. error	T-Value
Profit Function				
Constant	β_0	15.497	1.517	10.213***
ln cost of seed	β_1	-0.576	0.162	-3.563***
ln cost of Fertilizer	β_2	0.194	0.236	0.823
ln cost of Labour	β_3	0.276	0.108	-2.551***
ln cost of Agrochemical	β_4	-0.375	0.204	-1.831*
Inefficiency variable				
Constant	Z_0	0.082	0.451	0.181
Age	Z_1	0.019	0.010	1.911*
Household size	Z_2	0.002	0.015	0.131
Educational status	Z_3	-0.548	0.291	-1.887*
Farming experience	Z_4	-0.005	0.019	-0.286
Credit	Z_5	-0.00009	0.00005	-1.789*
Farm size	Z_6	0.9701	0.673	0.104
Cooperative association	Z_7	0.025	0.039	0.664
Extension contact	Z_8	0.00006	0.00003	1.881*
Diagnostic Statistic				
Sigma-square	(σ^2)	0.681	0.094	7.223***
Gamma	(γ)	0.301	0.097	3.105***

Log likelihood function	L/f	-142.820
LR test		31.633
Total number of observation		164
Mean efficiency		0.58

Asterisk indicate significance ***=1%, **=5% and *=10%.

4.5.2 Profit efficiency and its determinants for wholesalemarket outlet

The maximum likelihood estimates of the parameters of the stochastic profit frontier model for wholesaler market outlet are presented in Table 4.15. The study revealed that the generalized log likelihood function was -0.5405. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.9 and it was highly significant at 1% level of probability. This is consistent with the theory that true γ -value should be greater than zero. This implies that 90% of random variation in the profit of the farmers was due to the farmers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the farmer, reducing the influence of the effect of γ will greatly enhance the profit efficiency of the farmers and improve their profit. The value of sigma squared (σ^2) was significantly different from zero level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the

inefficiency effects make significant contribution to the profit inefficiencies of rice farmers.

However, the estimated coefficients of all the parameters of profit function (cost of seed, cost of fertilizer, cost of agrochemical and cost of labour) were significant at 1% and 5% level of probability except cost of agrochemical which is not significant and hence play a major role in rice profitability in the study area. The average profit efficiency for the farmers was 0.52 in the study area. This suggests that an average of 52% of potential maximum profit is gained due to production efficiency while the remaining is short fall of discrepancy between observed and frontier profit function. Thus, in a short run, there is minimal scope (48%) of increasing the efficiency, by adopting the technology and techniques used by the best rice farmer.

The estimated coefficient for price of seed was positively signed and significant at 1% level of probability. This is against the expected sign. This shows that a higher price of seed means that farmers use higher qualities seed. Therefore, it is rational to obtain a higher profit. This finding is in line with Long Van and Mitsuyasu (2012) who worked on Impact of Environmental Factors on the Profit Efficiency of Rice Production in Vietnam's Red River Delta also find out a positive relationship between cost of seed and profit efficiency.

The estimated coefficient for cost of fertilizer was negatively signed and significant at 1% level of probability. This implied that a unit decrease in the prices of fertilizer will lead to increase in profit of rice farmer in the study area by magnitude of 1.793.

The estimated parameter for cost of labour was negative and significant at 5% level of probability. The negative sign of labour may be due to high cost of a hired labour among the resource-poor rural farmers because the consumption of additional hired

labour is meant to supplement available family labour such that as the availability of family labour decreases, additional hired labour is consumed. Due to the high cost of hired labour if additional hired labour must be consumed then additional cost must be incurred and hence, resulting in decrease in profit efficiency of rice farmers.

The parameters estimates for determinants of profit efficiency were reported in the lower part of Table 4.15. However the analysis of inefficiency models shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer.

The results further showed that the profit efficiency of the rice farmers was negatively influenced by age, household size and farm size while farming experience, credit, farm size, cooperative membership and extension contact were positively influenced profit efficiency and none of the determinant factors significantly influences profit efficiency (Table 4.15). This result is in agreement with Lockheed *et al.* (1980), Ali and Flinn (1989), Abdulai and Huffman (1998) and Sharma *et al.* (1999). The result of this study has clearly shown that opportunities exist in rice production.

Table 4.16: Estimates of the parameters of the stochastic profit function for paddy rice in wholesale market

Variables	Parameters	Coefficients	Std. error	T-Value
Profit Function				
Constant	β_0	51.858	0.971	53.418***
ln cost of seed	β_1	2.905	0.461	6.294***
ln cost of Fertilizer	β_2	-1.793	0.617	-2.907***
ln cost of Agrochemical	β_3	0.281	0.397	0.707
ln cost of Labour	β_4	-0.797	0.367	-2.17**
Inefficiency variable				
Constant	Z_0	-0.107	0.112	-0.109
Age	Z_1	0.017	0.385	0.156
Household size	Z_2	0.195	0.385	0.505
Educational status	Z_3	-0.599	0.860	-0.697
Farming experience	Z_4	-0.691	0.893	-0.774
Credit	Z_5	-0.225	0.004	-0.482

Farm size	Z_6	0.262	0.513	0.511
Cooperative association	Z_7	-0.306E-07	0.999	-0.306E-07
Extension contact	Z_8	-0.765E-08	1.000	-0.765E-08
Diagnostic Statistic				
Sigma-square	(σ^2)	0.800	0.465	1.720*
Gamma	(γ)	0.966	0.137E-06	0.730E+07***
Log likelihood function	L/f	-0.5405		
LR test	16.077			
Total number of observation	8			
Mean efficiency	0.52			

*Asterisk indicate significance ***=1%, **=5% and *10%.*

4.5.3 Profit efficiency and its determinants for retail market

The maximum likelihood estimates of the parameters of the stochastic profit frontier model for wholesaler outlet market are presented in Table 4.16. The study revealed that the generalized log likelihood function was 2.777. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.9 and it was highly significant at 1% level of probability. This is consistent with the theory that true γ -value should be greater than zero. This implies that 90% of random variation in the profit of the farmers was due to the farmers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the farmer, reducing the influence of the effect of γ will greatly enhance the profit efficiency of the farmers and improve their profit. The value of sigma squared (σ^2) was significantly different from zero level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the

production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the profit inefficiencies of rice farmers.

However, the estimated coefficients of all the parameters of profit function (cost of seed, cost of fertilizer, cost of agrochemical and cost of labour) were not significant except cost of fertilizer only which is statistically significant at 1% level of probability and hence play a major role in rice profitability in the study area. The average profit efficiency for the farmers was 0.37 in the study area. This suggest that an average of 37% of potential maximum profit is gained due to production efficiency while the remaining short fall of discrepancy between observed and frontier profit function. Thus, in a short run, there is minimal scope (63%) of increasing the efficiency, by adopting the technology and techniques used by the best rice farmer.

The estimated coefficient of fertilizer price shows a positive effect on profit efficiency which is statistically significant at 1% level of probability. The reason is that the chemical fertilizers are mixed. Therefore the price is estimated by the average price of all fertilizers per kg. This shows that a higher price of fertilizer means that farmers use higher qualities of fertilizer and yield will be indirectly increased. Therefore, it is rational to obtain a higher profit. However, the coefficient for cost of fertilizer with positive coefficient of 3.85 appears to be the most important variable determining profit efficiency of rice farming in Kano State. This finding is in line with Long Van and Mitsuyasu (2012) who worked on Impact of Environmental Factors on the Profit Efficiency of Rice Production in Vietnam's Red River Delta also find out a positive relationship between cost of fertilizer and profit efficiency.

The parameter estimates for determinants of profit efficiency shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer. However none of the inefficiency variable significantly influences profit efficiency of the outlet.

Table 4.17: Estimates of the parameters of the stochastic profit function for retail market

Variables	Parameters	Coefficients	Std. error	T-Value
Profit Function				
Constant	β_0	-13.633	7.084	-1.924*
ln cost of seed	β_1	-0.101	0.271	-0.373
ln cost of Fertilizer	β_2	3.853	0.951	4.051***
ln cost of Agrochemical	β_3	-0.603	0.717	-0.084
ln cost of Labour	β_4	2.040	2.386	0.855
Inefficiency variable				
Constant	Z_0	-2.217	9.523	-0.233
Age	Z_1	0.143	0.640	0.223
Household size	Z_2	-0.481	2.795	-0.172
Educational status	Z_3	0.861	2.606	0.331
Farming experience	Z_4	-0.193	0.505	-0.383
Credit	Z_5	-0.89E-06	0.764E-04	-0.012
Farm size	Z_6	0.9701	0.673	0.104
Cooperative association	Z_7	-0.128	1.093	-0.117
Extension contact	Z_8	-0.269E-10	1.000	-0.269E-10
Diagnostic Statistic				
Sigma-square	(σ^2)	0.028	0.105	0.261
Gamma	(γ)	0.999	0.190E-03	0.524E+04***
Log likelihood function	Lf	2.777		
LR test		21.558		
Total number of observation		10		
Mean efficiency		0.37		

Asterisk indicate significance ***=1%, **=5% and *10%.

4.5.4 Profit efficiency and its determinants for processors market

The maximum likelihood estimates of the parameters of the stochastic profit frontier model for processor's outlet market are presented in Table 4.17. All the cost of inputs

was found to negatively relate to profit except the coefficients for seed that had positive effect on profit efficiency.

The estimated sigma squared (σ^2) was significantly different from zero at 10% level, implying that the Cobb-Douglas stochastic profit frontier model is an adequate representation of the data. This conforms to (Sharma et al. 1999; Rahman 2003). In addition, the estimated gamma parameter (γ) of 0.9 was significant at 1 percent level of significance (Table 4.17), indicating that about 90 percent of the variation in actual profit from maximum profit (profit frontier) among rice farms was due mainly to differences in farmers' practices rather than random variability.

However, the estimated coefficients of all the parameters of profit function (cost of seed, cost of fertilizer, cost of agrochemical and cost of labour) were significant at 1% level of probability except cost of seed and agrochemical which is not significant and hence play a major role in rice profitability in the study area. The average profit efficiency for the farmers was 0.32 in the study area. This suggests that an average of 32% of potential maximum profit is gained due to production efficiency while the remaining short fall of discrepancy between observed and frontier profit function. Thus, in a short run, there is minimal scope (68%) of increasing the profit efficiency, by adopting the technology and techniques used by the best rice farmer.

The estimated coefficient for cost of fertilizer was negatively signed as expected and significant at 1% level of probability. This implied that a unit decrease in the prices of fertilizer will lead to increase in profit efficiency of rice farmer in the study area by magnitude of 1.793 *ceteris paribus*.

The coefficient for cost of agrochemical was negatively signed and significant at 1% level of probability. This implied that a unit increase in the prices of agrochemical will

lead to decrease in profit efficiency of rice farmer in the study area by magnitude of 0.155 *ceteris paribus*.

The parameter estimates for determinants of profit efficiency shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer. However, only farming experience had significant influence on profit efficiency of the processors market outlet.

The result showed that there is a significant and negative relationship between experience and profit. This implies that rice farmers with more years of experience exhibited significantly more profit than farmers with less years of experience. This could probably be explained by the fact farmers probably employ their experience over time as an opportunity to enhance more profit.

Table 4.18: Estimates of the parameters of the stochastic profit function for paddy rice sold to processors

Variables	Parameters	Coefficients	Std. error	T-Value
Profit Function				
Constant	β_0	7.869	0.994	7.912***
ln cost of seed	β_1	0.440	0.356	1.235
ln cost of Fertilizer	β_2	-2.288	0.904	-2.531***
ln cost of Agrochemical	β_3	-0.155	0.058	-2.665***
ln cost of Labour	β_4	-0.108	0.704	-0.153
Inefficiency variable				
Constant	Z_0	-0.042	0.995	-0.043
Age	Z_1	-0.013	0.078	-0.171
Household size	Z_2	0.198	0.256	0.771
Educational status	Z_3	-0.034	0.919	-0.367
Farming experience	Z_4	-0.466	0.255	-1.821*
Credit	Z_5	0.127E-04	0.359E-04	0.355
Farm size	Z_6	0.642	0.494	1.299
Cooperative association	Z_7	-0.452	0.824	-0.548
Extension contact	Z_8	0.633	0.880	0.720
Diagnostic Statistic				
Sigma-square	(σ^2)	1.678	0.947	1.771*
Gamma	(γ)	0.999	0.101	9.900***

Log likelihood function	<i>L/f</i>	15.979
LR test		5.089
Total number of observation		11
Mean efficiency		0.32

*Asterisk indicate significance ***=1%, **=5% and *10%.*

4.6. Constraints Associated with Rice Production and Marketing in the Study Area

4.6.1 Production problems associated with small scale rice farmers in the study area

The problems faced by rice farmers in the study area were ranked according to their magnitude as stated by the farmers (Table 4.19). Unavailability of improved seed is ranked first (78.7%) by rice farmers in the study area. According to the respondents they make use of seeds from their previous harvest which is not reliable and can jeopardize improved and sustainable productivity. This finding is in line with Zulu (2004), opined that most farmers have little or no access to improved seeds and continues to recycle seeds that have become exhausted after generations of cultivation.

About 54.3% of the rice farmers indicated inadequacy of capital and credit facilities which rank second. This affects rice production in the study area, because the meager savings the farmers might have made or the funds generated from relatives is not sufficient to satisfy various activities in rice production. Most of the farmers also complained of not having enough money to purchase chemicals to combat these diseases, although the economic advantage of spraying could lead to increase yield thereby justify the costs, the invested. Also the efficacy of spraying may not be quickly obtained as there are a lot of fake chemicals in the market. This emphasizes

the need for more extension activities on integrated pest management that will reduce the number of spray.

About 19.5% of the rice farmer indicate lack of labour as constraints in the study area. According to the farmers, during peak period of production-every household would have been engaged in his family farm work. The demand for labour is normally very high and expensive during the peak period of land clearing, ridging, harvesting, processing and weeding in the study area, these led to labour shoetage in rice farming in the study area .

High cost of fertilizer was ranked last with about 11.6% of the farmers attesting to this fact.According to the respondents fertilizer is made available when farmers are far into the production period, sometimes at the middle of the raining season.

Table 4.19: Constraints associated with rice production

Variable	*Frequency	Percentage	Rank
Inadequate supply of improved seed	129	78.7	1st
Inadequate capital	89	54.3	2nd
Labour shortage	32	19.5	3rd
High cost of fertilizer	19	11.6	4th
Total	269		

* Multiple response was allowed

4.6.2 Marketing problems associated with small scale rice farmers in the study area

The problems faced by rice marketers in the study area were ranked according to their magnitude as stated by the marketers (Table 4.20). Activities of middlemen was ranked first (50%) by ricemarketer in the study area. According to the respondents they suffer in the hands of unscrupulous middle men who often exploit and rob them of benefits of their effort. The problem is compounded because of lack of interference by government on matters affecting marketing and pricing of rice (Chikwenduet *al.*, 1993).

About 19% of the rice marketers indicated high taxes during transportation which rank second. High expenditure incurred by the marketers especially due to poor roads, high or multiple taxes during transportation increase the market costs which seriously reduce the market margin.

About 17% of the rice marketers indicate poor rural roads which rank third. Limited or poor-quality roads and rail transportation inhibit timely access to inputs, increase costs of inputs, and decrease access to output markets. Thus, investment in infrastructure contributes to agricultural productivity growth and marketing efficiency (Shane *et al.* 1998).

About 15% of the rice marketers indicate lack of central market in the study area while about 6% indicate insecurity as another constraint affecting them. The marketers attested to this fact that robbers usually rob them of benefits of their effort during and after the market.

Table 4.20: Constraints associated with rice marketing

Variable	*Frequency	Percentage	Rank
Middlemen activities	82	50.0	1st
high taxes during transportation	31	18.9	2nd
poor rural roads	27	16.5	3rd
lack of central market	24	14.6	4th
Insecurity	9	5.5	5th
Total	173		

* Multiple response was allowed

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study focused on an analysis of small scale rice farmer's access to output market and profit efficiency in Kano State, Nigeria. Three villages were randomly selected from three Local Government Area and 164 farmers were selected in this areas. The purpose of the study was to examine the small scale rice farmer's access to output market and profit efficiency in Kano state, Nigeria. The objectives of the study were to: describe the socio-economic characteristics of rice farmers in the study area, identify the available output market outlets accessible to rice farmers, determine the factors influencing farmers' choices among alternative rice output market outlets, assess the factors affecting quantity of rice supplied to each identified market outlets, determine the profit efficiency and its determinants for each identify outlet market and describe the constraints facing farmers in rice production and marketing in the study area

The primary data were collected from 164 respondents using a structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, ordered probit model analysis, regression analysis and stochastic frontier profit function model.

The result of the analysis shows that (48%) of the respondents fell within the age range of 30-39 years, the majority of the farmers (88.4%) were married; the majority of the farmers (65%) did not have formal education. the household size ranged from 1-10 persons with 87.2%. About 71% had farming experience between 1-5 years. About 90% did not have access to extension service, 76% of the farmers have a land size

between 0.1-5 hectares, (79.3%) were not members of a cooperative society while about 89.7% of the farmers did not have extension contact.

The result of analysis shows that about 82% of the rice farmers sold their produce to rural assemblers. About 5% of the rice farmers sold their produce to wholesalers, 6% of the rice farmers sold their produce to retailers while about 7% of the rice farmers sold their produce to processors.

The orderedprobit model was used to estimate the parameters of the determinants of farmers' choices among alternative rice output market outlets by rice farmers in Kano state. The Pseudo R-squared value indicates that 51% percent of the variation in the farmers' choices among alternative rice output market outlets by rice farmers was explained by the independent variables. farmers' choices among alternative rice output market outlets was significantly determined by educational status of the household head, access to credit, cooperative membership, distance to market, quantity of output produced by the farmers and market price of rice.

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the quantity of rice supplied to each identified market outlet of rice farmers revealed that education, farming experience, distance to market and price were factors that significantly influences each identify market outlet.

The maximum likelihood estimates of the parameters of the stochastic profit frontier model for each identified market outlet revealed that rural assemblers market outlet has the best profit efficiency with about 58% of the variation in actual profit from maximum profit (profit frontier) among rice farmers was due mainly to differences in farmers' practices rather than random variability.

Finally, among the major constraints identified on production and marketing in the study area were lack of improved seed (78.7%) and inadequate capital (54.3%) while marketing were activities of middle men (50%) and high taxes during transportation (19%).

5.2 Conclusion

Based on the findings of this study, it could be concluded that rural assembler's outlet market was more profitable having average profit efficiency of 58%. Despite increasingly competitive markets, pricing issues for rice remains a concern for farmers. For most farmers, the prices offered by the buyers were not attractive enough to engage into more production by investing in high yielding varieties.

Markets play an important role in improving the incomes of poor farmers. However, markets in Kano State are generally poorly organized and volatile, and often inaccessible to farmers and also market information that farmers need to negotiate good prices for their produce were inadequate. Even such basic information as current wholesale and retail prices were rarely available. Therefore, building efficient and well-integrated input markets (through which farmers can buy supplies), and output markets (enabling farmers to sell their harvest) is key to encouraging farmers' adoption of sustainable agricultural technologies.

5.3 Contribution of the study to knowledge

1. Based on the findings, about 82% of the rice farmers sold their produce to rural assemblers. This might be because rural assemblers pay the farmers immediately upon delivery which is a preferred option for farmers.

2. It was discovered that rural assembler's market outlet was more promising in terms of profit efficiency in the study area having profit efficiency of fifty-eight (58%).

5.4 Recommendations

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

- i. Extension service was found to positively influence profit efficiency. It is recommended that non-governmental organization and other donor agencies in agriculture should intensify to educate and encourage farmers to adopt modern cultural practices in order to reduce cost of inputs and promote efficient utilization of existing knowledge and skills to increase their yield and profit. Thus, investments in rural education through effective extension delivery program and provision of credit would boost farmers' efficiency.
- ii. Profit efficiency were significantly influenced by education, farming experience, amount of credit borrowed and extension contact. Therefore, it is recommended that Government and Non-Governmental Organizations (NGOs) should provide basic amenities such as good road network for the farmers to have access to the urban markets where they can sell their produce in order to improve the socio-economic status of the rice farmers especially in the study area.
- iii. Distant to markets as a result of poor road conditions and high transport costs were identified as factors that hamper improved market access for paddy rice farmers. Therefore, rural markets should be linked to the urban market to attract good value for rice products thereby enhancing profitability and living standard of the farmers especially those in the rural areas.

- iv. Majority of the farmers source their credit from personal savings and relatives which are mostly not adequate for appreciable production and is an important factor which significantly influences the production. Agricultural loan facilities should be made accessible to rice farmers to ensure timely and adequate utilization of agricultural inputs for improvement in farm production and profit efficiency.

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Agriculture, Ahmadu Bello University, Zaria. Nigeria.**

RICE FARMERS QUESTIONNAIRE

Dear Sir,

I am a student of the above named department conducting a study on “**Analysis of Rice Farmers’ Access to Output Markets and Profit Efficiency in Kano State, Nigeria**”. I would be grateful if you can provide the following information. All information given would be used strictly for the research purpose and treated confidentially.

IDENTIFICATION OF THE INTERVIEW

State.....LGA..... Village

Questionnaire No..... Date Name of Interviewer

Enumerator’s GSM No:.....

Farmer’s GSM No.....

SECTION A. BACKGROUND INFORMATION OF RICE FARMER.

1. Name of farmer (Optional)

2. Sex: i) Male () ii) Female ()

3. Age years

4. Marital status: a) Married () b) Single () c). Widow () d) Divorced ()

5. Total Household size persons:
- a) Number of children (1 – 15 years) b) Number of adults (15 – 50 years) c) Number of adults above 50.....
6. Educational qualification:
- a) Non formal education () b) Quranic education () c) Adult education () (d) Primary education () e) Secondary education () f) Tertiary/University education ()
7. Give total years of formal schooling years
8. Do you belong to any farmers’ cooperatives/associations? Yes No
9. Give three major activities of the cooperative/association:
- i.....
- ii.
- iii.
10. Give the number of years spent as a member in the cooperative..... years
11. Do you have access to extension visits? Yes No

SECTION B. FARMING ACTIVITIES

12. Number of years spent in general farmingyears
13. Number of years spent in rice production years
14. Did you have access to credit? Yes () No ()
15. What are the sources of the credit?

SOURCES	AMOUNT()	INTEREST RATE (%)

Commer cial bank		
Money Lenders		
Cooperat ives Society		
Family/fr iends		
Rural buyers		
NGOs		
Governm ent		
Others (specify)		

16. How much did you use in the last rice production season? N.....

17. What is the total size of land put to rice production? ha

18. How many rice farm plots do you have? Indicate and the size in the table below.

19. How did you acquire your land? (*Tick below*)

Plot	Plot size (ha)	Mode of Acquisition				
		(a) Inheritance	(b) Lease	(c) Borrowed	(d) Gift	(e) Purchased
1						

2						
3						

20. How much does it cost to rent one Hectare of land per season in your village?
 Naira

21. Did you do crop mixture? Yes () No ()

22. If yes, which crops did you plant with rice?.....

23. What was the planting pattern for the crop mixture?.....

Variable inputs (Last production Cycle)

(i)Seed (rice Kg)

Plot No	Quantity of Seed(Kg)	Cost (₦)	Quantity of seed (kg) for other crops	Cost (₦)
1				
2				
3				

(ii).Fertilizer.

Plot No	Fertilizer type	Quantity(Kg) for rice	Cost(₦)	Quantity(Kg) for other crop	Cost(₦)
1					
2					
3					

(iii). Agrochemical.

Plot No	Agrochemical type	Quantity(litres) for rice	Cost(₦)	Quantity(litres) for other crop	Cost(₦)
1					
2					
3					

(viii) Transportation

	Distance (km)	No. of bags(kg)	Cost(₦)/bag
Seed			
Fertilizer			
Agrochemical			

18. State the hired labour during the last cropping season in the following tables.

(i) Land preparation

Plot No.	Labour for rice			Labour for other crops (mixture)		
	No. of people	No. of hours	Cost(₦)	No. of people	No. of hours	Cost(₦)
1						
2						
3						

(ii) Planting

Plot No	Labour for rice	Labour for other crops

	No of people	No of Hours	Cost (₱)	No of people	No of Hours	Cost (₱)
1						
2						
3						

(iii) Fertilizer Application

Plot No	Labour for rice			Labour for other crops		
	No of people	No of Hours	Cost (₱)	No of people	No of Hours	Cost (₱)
1						
2						
3						

(iv) First Weeding

Plot No	Labour for rice			Labour for other crops		
	No of people	No of Hours	Cost (₱)	No of people	No of Hours	Cost (₱)
1						
2						
3						

(v) Second Weeding

Plot No	Labour for rice	Labour for other crops

	No. of people	No. of Hours	Cost(₦)	No. of people	No. of Hours	Cost (₦)
1						
2						
3						

(vi) Spraying

Plot No.	Labour for rice			Labour for other crops (mixture)		
	No. of people	No. of hours	Cost(₦)	No. of people	No. of hours	Cost(₦)
1						
2						
3						

(vii) Harvesting

Plot No	Labour for rice			Labour for other crops		
	No. of people	No. of Hours	Cost (₦)	No. of people	No. of Hours	Cost (₦)
1						
2						
3						

(viii) Irrigation

Plot No.	Labour for rice			Labour for other crops (mixture)		
	No. of	No. of	Cost(₦)	No. of	No. of	Cost(₦)

	people	hours		people	hours	
1						
2						
3						

24. CROP OUTPUT DATA

Plot No:

Crop	No of bags	Kg/bag	Price / bag	Total (N)
Rice				
Stalk				
Other by-products				
Quantity consumed				
Quantity given out as gift				

Plot No:

Crop	No of bags	Kg/bag	Price / bag	Total (N)
Rice				
Stalk				
Other by-products				
Quantity consumed				
Quantity given out as gift				

Plot No:

Crop	No of bags	Kg/bag	Price / bag	Total (N)
Rice				
Stalk				
Other by-products				
Quantity consumed				
Quantity given out as gift				

Plot No:

Crop	No of bags	Kg/bag	Price / bag	Total (N)
Rice				
Stalk				
Other by-products				
Quantity consumed				
Quantity given out as gift				

SECTION C: MARKETING INFORMATION

25. Who do you sell your rice to?

i) Consumers () ii) Assemblers iii) Retailers () iv) Wholesalers ()

- v) Processors () vi) Others (specify)
26. Why do you sell to the chosen outlet(s) in question (24) above?
27. Where is the buyer located?.....
28. What is the distance to the market where the buyer is located.....
29. What are your means of transportation to the market?.....
30. How much do you pay for transporting a specified unit (₦/bag).....
31. Are there formal transport tariffs related to the rice?.....
- If yes, how much?.....
32. Do you store your produce?.....
33. Where do you store your produce?.....
- If yes, how much per bag.....
34. Do you gain any profit after selling your output? Yes() No()
35. If No in question (32) above, state the factors that affects your profit gain:

SECTION D. CONSTRAINTS AND PROBLEMS OF THE FARMER

36. Did you encounter any problems in rice marketing last season?
- Yes () No ()
37. If yes, what are the natures of the problems?

.....
.....

38. Please rank the problems in order of importance.

- i.
- ii.
- iii.
- iv.
- v.vi.

39. What can you suggest for improvement with regards to the problems mentioned above?.....

.....

Thanks for your time