ECONOMIC ANALYSIS OF SMALL SCALE RAIN-FED LOWLAND RICE PRODUCTION IN SELECTED LOCAL GOVERNMENT AREAS OF NIGER STATE, NIGERIA

BY

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS.

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DECLARATION

I hereby declare that this dissertation titled "**Economic Analysis of Rain-Fed Lowland Rice Production in Selected Local Government Areas of Niger State, Nigeria"** has been written by me and it is a record of my research work. No part of this dissertation was previously presented for another degree or diploma at this or any other institution. All borrowed information have been duly acknowledged in the text and a list of references provided.

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CERTIFICATION

This dissertation titled '**Economic Analysis of Rain-Fed Lowland Rice Production in Selected Local Government Areas of Niger State, Nigeria',** by Ganiyu Binuyo meets the regulations governing the award of the Degree of Master of Science of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

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

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TABLE OF CONTENTS

Content **Page**

Title Page……...i

Declaration ……ii

Certification……..…iii

Dedication……..…iv

Acknowledgements……v

Table of contents……...vii

List of Tables……..…x

List of Figures……xi

List of Appendices……xii

Abstract……..xi

CHAPTER ONE…….…...1

INTRODUCTION……..…1

1.1 Background of the Study……...1

1.2 Problem Statement…….4

1.3 Objectives of the Study…….6

1.4 Justification of the Study……...7

CHAPTER TWO……..8

LITERATURE REVIEW……8

2.1. Economic Importance of Rice……8

2.2 Rice production Systems…….……...9

2.3. Concept of Efficiency……...11

2.4. Approaches for Measuring Production Efficiency……....13

2.5. Measurement of Profitability…….16

2.6. Empirical Study……..17

CHAPTER THREE ……..25

METHODOLOGY……....25

3.1. Description of the Study Area……25

3.2. Sampling Procedure……..……..25

3.3. Data Collection……..26

3.4. Analytical Techniques……27

3.5. Measurement of Dependent and Independent Variables ……..30

CHAPTER FOUR……...36

RESULTS AND DISCUSSION……36

4.1. Socio-economic Characteristics of Rain-fed Lowland Rice Farmers……..36

4.1.1 Age distribution of lowland rice farmers…….37

4.1.2 Household size of lowland rice farmers…….37

4.1. 3 Educational level of lowland rice farmers.....38

4.1. 4 Membership of cooperative society of lowland rice farmers…….39

4.1. 5 Extension contact of lowland rice farmers……....40

4.1. 6 Farm size of lowland rice farmers……..41

4.1. 7 Amount of credit for lowland rice farmers……...42

4.2. Costs and Returns of Lowland Rice Production…….43

4.3. Estimates of Technical Efficiency of Lowland Rice Production…….42

4.3.2. Estimated Stochastic Frontier Cost Function……47

4.3.3 Frequency distribution of lowland rice farmers according to technical, allocative and economic efficiency……..50

4.4. Constraints of Lowland Rice Production……..52

CHAPTER FIVE……...54

SUMMARY, CONCLUSION, & RECOMMENDATIONS ……54

5.1. Summary……..54

5.2. Conclusion……...55

5.3. Contribution to knowledge……..56

5.4. Recommendations……57

REFERENCES……...58

LIST OF TABLES

Table **Page**

Table 1: Rice production shares in West Africa…….. 3

Table 2: Average rice yields and growth, 1990–2011……. 4

Table 3.1: Distribution of rice farmers in the study area…….26

Table 4.1: Age distribution of rain-fed lowland rice farmers……..33

Table 4.2: Distribution of lowland rice farmers according to their household size….34

Table 4.3: Distribution of rice farmers according to their level of education……..35

Table 4.4: Distribution of rice farmers according to years spent in the cooperative association…….36

Table 4.5: Distribution of lowland rice farmers according to extension visit……37

Table 4.6: Distribution of low land rice farmer according to their farm size 38

Table 4.7: Distribution of lowland rice farmers according to credit obtained……..39

Table 4.8: Summary of input utilized and output realized in lowland rice Production……..40

Table 4.9: Average costs and returns per hectare of lowland rice production……... 42

Table 4.11: Results of Maximum Likelihood Estimates of Stochastic Frontier Production Function of Rice production…….……..45

Table 4.12: Results of Maximum Likelihood Estimates of Stochastic Frontier Allocative (Cost) Function of Rice production……...49

Table 4.13: Frequency Distribution of Technical, Allocative and Economic Estimates from the Stochastic Frontier Model of Lowland Rice Farmers..52

Table 4.14: Constraints associated with rice production.....53

LIST OF FIGURES

Figure **Page**

Figure 1: Map of Niger State Showing the Study Areas**……** 26

ABSTRACT

The study evaluated the Economic of Rain-Fed Lowland Rice Production in Selected Local Government Areas of Niger State, Nigeria. Primary data were collected from rice producers through the use of structured questionnaires. This study was carried out in three Local Government Areas in Niger State, Nigeria during the 2013/2014 cropping season. Purposive and random sampling techniques were employed to select respondents for the study. The tools of analysis used were; descriptive statistics, net farm income and stochastic frontier production function (SFPF). The study showed that 43% of the respondents fall within the age range of 30 to 39 years, majority of the farmers (33%) had secondary education. The household size fall within the range of 1-10 persons while majority of the farmers (50%) were not members of a cooperative society. Variables included in the model for the efficiency effects were seed, fertilizer, labour and agrochemical. The parameters of the stochastic frontier production function were estimated simultaneously with those of the model of inefficiency effects. Results indicated that farm size, fertilizer and labour were significant ($p<0.01$). The mean technical and allocative efficiencies were 63% and 62% respectively. Findings further revealed that none of the sampled rice farms reached the frontier threshold. However, the average economic efficiency of the rice farmers was 39%. This indicates that rice farmers were economically inefficicient. Also, household size, educational status, farming experience and cooperative membership were the socio-economic variables responsible for the variation in technical efficiency of the rice producers. It was therefore recommended that timely and adequate supply of fertilizer and labour should be made available to the farmers at an affordable price in order to enhance the production of rice in Niger State

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture has been an important sector in the Nigerian economy in the past decades and is still a major sector despite the oil boom. Basically it provides employment opportunities for the teeming population, eradicates poverty and contributes to the growth of the economy. Despite these however, the sector is thus characterized by low yields, low level of inputs and limited areas under cultivation (Izuchukwu, 2011). It involves small scale farmers scattered over wide expanse of land area, with small holding ranging from 0.5 to 3.0 hectare per farm land. It is characterized by rudimentary farm systems, low capitalization and low yield per hectare (Kolawale and Ojo, 2007). The roles of agriculture remain significant in the Nigerian economy despite the strategic importance of the oil sector. Agriculture provides primary means of employment for Nigeria and accounts for more than one third of total Gross Domestic Product (GDP) and labour force (Ismaila*et al*., 2010).

The Contribution of agriculture to Nigeria's Gross Domestic Product (GDP), which stood at an average of 56% in 1960-1964 declined to 47% in 1965-1969 and further declined to 35% in 2002-2004 with crop production accounting for an estimated 85% of this total. The agricultural sector provides a livelihood for the bulk of the rural population (Amaza and Maurice, 2005); Provides up to 70% active labour force (Bello, 2004; Ayinde, 2008), supplies raw materials required by the industrial sector and generate foreign exchange through export. In spite of this, agricultural production has failed to meet the food needs of the country's rapid growing population (Ayinde, 2008).

According to FAO (2010), the Nigerian rice sub-sector witnessed a remarkable increase in output from 2.5 million metric tonnes in 1990 to about 4.2 million metric tonnes in 2008. This increase in output of rice over the years was as a result of increase in thehectarageculti vated. However, there has been a fall in the yield of rice in Nigeria from 2069.54kg per hectare in 1990 to 1754.40kg per hectare in 2008 (FAO, 2010). This fall in yield of rice led to supply deficitsituation in the country.

Rising consumer preference for rice has increased demand at a faster rate than population growth. Table 1 shows that per capita production has remained stagnant at about 28 kilograms (kg) since 1990 while per capita consumption has increased from about 18 kg to about 34 kg in the same period. This is in sharp contrast to Mali, Ghana, and Senegal, where per capita production has doubled or even tripled over the same period. As a result, while Nigeria contributes the most to total production share of rice in the region, its share has declined by 10 percent since the early 1990s, from 47.7 to 37.5 percent. Aside from Nigeria, the other major rice producers in the region are Mali, Guinea, Sierra Leone, Côte d'Ivoire, Senegal, and Ghana. Including Nigeria, these seven countries account for about 90 percent of total production in the region.

Table 1: Rice production shares in West Africa

Country	1990–1995	1995–2000	2000–2005	2005–2010	2010–2011
Production share (%)					
Nigeria	47.7	46.8	43.1	39.2	37.5
Mali	6.9	9.4	11.4	14.8	16.7
Guinea	13.7	15.0	15.7	14.6	12.4
Sierra Leone	7.5	4.8	5.9	8.4	8.7
Côte d'Ivoire	11.2	9.4	9.0	7.1	5.9
Senegal	2.9	2.5	2.9	3.6	4.2
Ghana	2.4	3.1	3.6	3.2	4.0
Total	92.3	91.0	91.5	90.8	89.4
Per capita production (kg)					
Nigeria	28	27	24	26	28
Mali	45	61	68	103	130
Guinea	124	128	132	149	148
Sierra Leone	115	82	93	150	177
Côte d'Ivoire	50	41	38	36	36
Senegal	22	19	21	31	40
Ghana	9	12	13	14	19
Total	31	31	29	34	39

Source: Authors' calculations based on FAOSTAT (FAO 2012).

The steady increases in rice production in Mali, Senegal, and Ghana can be partially attributed to rising yields over time, reaching between 2.5 and 3.9 tons/hectare (ha) in recent times, comparable to yields in South Asia a decade earlier (Table 2). Clearly the Nigerian rice economy has lagged behind that of these three countries and others in the region. This lag illustrates the general neglect of agriculture from previous periods of political instability and poor governance throughout the 1970s and 1980s. This can be attributed to a Dutch disease syndrome following the oil boom that began in the 1970s (Udoh and Egwaikhide, 2011). Arguably, the Dutch disease could have been avoided if the windfall revenue from oil exports had been used to invest in agriculture (Levy, 2006).

Table 2: Average rice yields and growth, 1990–2011

	Average yields					Yield growth rates		
Country/ Region	**1990–1995**	**1995–2000**	**2000–2005**	**2005–2010**	**2010–2011**	**1980–1990**	**1990–2000**	**2000–2011**
Asia								
Bangladesh	2.6	3.0	3.5	4.1	4.3	2.5	2.4	2.4
India	2.7	2.8	3.0	3.2	3.4	3.2	1.1	1.8
Thailand	2.2	2.5	2.8	2.9	3.0	0.7	2.1	0.8
West Africa								
Nigeria	1.8	1.6	1.4	1.6	1.8	0.3	-3.1	3.0
Ghana	1.8	1.9	2.2	2.2	2.5	7.7	1.4	1.3
Mali	1.6	2.0	2.0	2.8	2.7	4.7	3.5	3.3
Senegal	2.3	2.4	2.5	3.1	3.9	5.2	0.2	5.0
Regional								
West Africa	1.6	1.6	1.6	1.8	2.0	1.8	-0.2	2.6
South Asia	2.7	2.9	3.1	3.4	3.6	2.8	1.4	1.9
World	3.6	3.8	4.0	4.2	4.4	2.3	1.1	1.2

Source: Authors' calculations based on FAO 2013.

With insufficient growth in production to meet domestic demand and with rice imports growing at about 11 percent per year since 1990, Nigeria is facing a real policy challenge in reversing such trends. There is a need to understand the current circumstance before evaluating the country's policy options and the potential success of the ATA.

1.2 Problem Statement

The Nigerian government has embarked on an ambitious plan to make the country self-sufficient in rice production by the year 2015 under its current Agricultural Transformation Agenda(ATA) (Adesina, 2012). This initiative is in response to the perceived threat of larger volumes of milled rice imports into Nigeria since the 1990s, potentially displacing local production. According to USDA–ERS (2012), local production has not been able to meet a growing appetite for rice consumption. The

share of domestic production having declined from 75 percent in the 1990s to 53 percent in 2012. By 2013, the import bill was close to US$2.2 billion (CBN, 2013). As elsewhere in West Africa, the rice import bill rose sharply following the 2008 global food price hikes, and Nigeria, like many other countries, was left feeling vulnerable to future shocks in global rice prices.

Despite rising global prices, domestic demand for rice has been growing at a rapid pace in Africa in general due to changing consumer preferences, rising incomes, and growing urban populations (International Food Policy Research Institute (IFPRI), 2013). As a result, in no African country has production been able to keep pace with demand, and countries instead have come to rely on imports to make up the difference. The growing dependency on rice imports threatens to deplete a country's scarce foreign currency reserves, increases its vulnerability to global price shocks, and raises overall concerns about food insecurity.

Per capita production of rice has remained stagnant at about 28 kilograms (kg) since 1990 while per capita consumption has increased from about 18 kg to about 34 kg in the same period. This is in sharp contrast to Mali, Ghana, and Senegal, where per capita production has doubled or even tripled over the same period. As a result, while Nigeria contributes the most to total production in the region, its share has declined by 10 percentage points since the early 1990s, from 47.7 to 37.5 percent (IFPRI, 2013).

The steady increases in rice production in Mali, Senegal, and Ghana can be partially attributed to rising yields over time, reaching between 2.5 and 3.9 tons5/hectares (ha) in 2012. Clearly the Nigerian rice economy has lagged behind that of these three countries and others in the region. This lag illustrates the general neglect of agriculture from

previous periods of political instability and poor governance throughout the 1970s and 1980s, sometimes attributed to a Dutch disease syndrome following the oil boom that began in the 1970s (Udoh and Egwaikhide, 2011). Essentially, the increase in incomes and the shift in terms of trade in favour of imports created disincentives for agricultural investments and reallocated factors of production away from it. With insufficient growth in production to meet domestic demand and with rice imports growing at about 11 percent per year since 1990, Nigeria is facing a real policy challenge in reversing such trends. The problem therefore identified centres on the efficiency levels at which farmers use resources on these rice farms. It also borders on how the various factors that explain efficiency in these rice systems can be examined so as to improve rice production in the country. This, therefore, raises the following research questions:

(i) What are the socio-economic characteristics of the lowland rice farmers in the study area?

(ii) How profitable is rice production in the study area?

(iii) What are the technical, allocative and economic efficiencies in lowland rice production in the study area?

(iv) What are the constraints associated with lowlandrice production in the study area?

1.3 Objectives of the Study

The broad objective of this study was to examine economic analysis of rain-fed lowland rice production in selected local government area of Niger State. The specific objectives were to:

(i) describe the socio-economic characteristics of rain-fed lowland rice production of rice farmers in the study area;

(ii) determine the profitability of rice production;

(iii) estimate the technical, allocative and economic efficiencies in upland rice production in the study area;

(iv) describe the constraints associated with rice production 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 tonnes while annual production on the average, was about 2.21 million tons of milled rice product leaving a deficit of 2.79 milliontonneswhich is bridged by importation (National Agricultural Extension and Research Liaison Services (NAERLS), 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 (NAERLS, 2009). Increased rice production in Nigeria will translate directly into higher consumption, better nutrition and enhanced trading for maximum benefits.

Productivity and efficiency studies are very important for provision of information on how to improve rain-fed rice output and enhance productivity and efficiency of resources of farms. In the economy where resources are scarce and opportunities are lacking, the efficiency studies can show whether it is possible to raise the productivity without increasing the resource base of the farmers in the study area. The findings of this study will provide additional empirical information on technical, allocative and economic efficiencies in rice production in the study area. The information from this study will also contribute to knowledge relevant for policy formulation that will create enabling environment for sustainable rice production in Niger State.

CHAPTER TWO

LITERATURE REVIEW

2.1 Economic Importance of Rice

Rice has shaped the cultures, diets and economies 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, the failure of the rice crop has also led to wide spread famine, death and political instability in many countries, especially in Africa (Baba, 2003). The various uses to which rice can be put makes the crop very important. Rice grains are used as food all over the world (Abdulrahman, 1989). It could be prepared into " tuwo", "alkakki", "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 in combination with beans, pears, potatoes and yams (Allu, 1994). The husked grains of*Oryzapunctata*are sometimes eaten as a famine food in Sudan and Kenya. In Sudan they are consumed after boiling with milk or water. The grain of*Oryzapunctata*contains: crude protein 13.9g, fat 4.og, soluble carbohydrate 74.8g, crude fibre 2.9g, ca 40mg, Mg 270mg, p 550mg, Fe 16.8 and Zn 3.9mg. The essential amino acid composition per 100g protein (16g N) is: Iysine 3.6g, methionine 2.2g, phenylalanine 5.2g, threonine 3.4g, valine 5.8g, leucine 8.6g and isoleucine 4.1g.

The rice grain is cooked by boiling or steaming, and eaten mostly with pulses, vegetables, fish or meat. Flour from rice is used for breakfast foods, baby foods, bread and cake mixes and cosmetics. Starch made from broken rice is used as laundry starch

and in foods, cosmetics and textile manufacture, beers, wines and spirits are made fromrice. (Brink and Belay, 2006). The husk or hull is used as fuel, bedding, absorbent, packing material and as carrier for vitamins and drugs, it is also made into building board.

Rice bran or meal obtained in pearling and polishing is a valuable livestock and poultry feed. Oil is extracted from the bran. Crude rice bran oil is expressed into solidified oil, stearic and oleic acids, glycerine and soap. Processed bran oil is used for cooking, antirust and anti-corrosive agents, textiles and leather finishers, and in medicine (Brink and Belay, 2006).

Rice straw is used for animal feed and bedding, for the manufacture of straw boards and pulp for paper, for the production of compost and mushroom growing medium, for mulching vegetable crops, for making ropes, sacks, mats and hats, for roof thatching and to make plastering material (mixed with clay mud) for the construction of houses, and for incorporation into the soil or burning on the field as a way to maintain/improve soil fertility (Brink and Belay, 2006).

Several traditional medicinal applications of rice have been reported from tropical Africa: leaf dressing is applied to ulcers and grain decoctions are drunk to treat diarrhoea, as a diuretic and as an emollient. Rice powder is applied against itch in Senegal. In DR Congo decoctions of the roots, leaves and husks is taken against madness and beriberi. (Brink and Belay, 2006).

2.2 Rice production System

2.2.1 Upland rice cultivation

This is also known as dry-land rice cultivation or hill rice cultivation. Upland rice is grown as a rain-fed crop where there is adequate rainfall (at least 750mm) for three to four months. Upland rice production is much less important in Asia as it covers only 10% of the total rice area, but it is very important in Africa where upland rice production account for 75% of the total rice area. As irrigation facilities are becoming increasingly available, there is good scope for lowland rice cultivation in tropical Africa.

Upland rice is cultivated in a similar manner to other rain-fed, small-grained cereals where flooding is not needed. The water requirement for upland rice is almost half or even less than that of lowland rice. As a rule it is generally accepted that upland rice production requires a rainfall of about 50 to 60mm over ten days period during 3 to 4 months of the growing season. Upland rice is usually grown in hilly regions and also where shifting cultivation is practiced. The land is not well prepared in the traditional method of rice cultivation in West Africa. The land is normally incompletely cleared, often by burning, without uprooting the tree stumps, and the soil is lightly scrap with a hoe. The seeds are broadcast at the rate of 30 to 40 kilogrammes per hectare.

2.2.2 Lowland rice cultivation

This is also known as swampy rice, wet rice, or flooded rice cultivation. The rice is grown on flooded or irrigated land. It is the most important cultivation system of rice in Asia and is now becoming popular in Africa. In this system the land is inundated and the crop is grown in water from the time of planting until the approach of harvest. The

depth of flood water does not exceed 50cm. there are two methods of lowland rice cultivation. The direct sowing method and the transplanted method.

Direct sowing method: First of all bunds are constructed or repaired around the field to be cultivated. The method of cultivation is like that practiced under upland conditions. The soil is prepared in May-June after the first rain. The rice stubble should be ploughed under soon after the harvest of the crop and before the soil dries up. It is better to plough to a depth of about 10-15cm.

Transplanted rice cultivation: This method of rice cultivation consists of raising the seedlings by sowing seeds in well-prepared and raised nursery beds, and then transplanting the seedlings in a well-puddled and leveled field.

2.3 The Concept of Efficiency

Efficiency has to do with the relative performance of the processes that turn input into output. Olayide and Heady (1982) defined production efficiency as the index of the ratio of the total farm output used in farm production. According to Olukosi and Erhabor(2005), efficiency is the quantity of output per unit of input used in the production process. That is, the average physical product. In economies literature, efficiency of a farm firm consists of three components, namely: technical, allocative and economic.

2.3.1 Technical efficiency

Technical efficiency is defined as the ability to produce a given level of output with minimum quantity of inputs under a certain technology. It reflects the ability of a farm to obtain maximum output from a given level of inputs. Omotosho*et al.,* (2008) pointed

out that technical inefficiency arises when actual or observed output from a given input mix is less than the maximum possible. Okoruwa and Ogundele (2008) maintained that the technical efficiency of a farm is characterized by the relationship between observed (actual) production and some ideal or potential production. The measurement of firm-specific technical efficiency is based upon deviation of observed output from the best production or efficient production frontier. Accordingly, if a firm's production point lies on the frontier, the firm is perfectly efficient; if it lies below the frontier, it is technically inefficient, with the ratio of the actual to the potential defining the level of efficiency of the farm-firm (Okoruwa and Ogundele, 2008). Technical efficiency can occur in any of the following situation; (i) where it is possible for a firm to produce with the given know-how, a larger amount of output from the same inputs; and (ii) the same output with less of one or more inputs, without increasing the amount of other inputs (Yusuf and Adenegan, 2007).

2.3.2 Allocative efficiency

This refers to the ability of the farm firm to choose optimum input levels for given factor prices (Ogundari and Ojo, 2006; Okoruwa and Ogundele, 2008). It is the ability to choose the level of inputs that maximizes profits, given factor prices. According to Olukosi and Ogundele (1989), allocative efficiency is the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to the cost of the factor or input. Allocative efficiency is achieved at the point where the marginal value product (MVP) equals the marginal factor cost (MFC) (Olukosi and Erhabor, 2005). The MVP is calculated for the respective regression coefficients using appropriate level of output price, depending on the lead equation of the functional form. The MFC is the market price of one unit input.

An efficiency ratio of unity means economically optimum allocative efficiency. A ratio of less than one implies that the input is being over-utilized while a ratio greater than one means the inputs is under-utilized (Olukosi and Ogungbile 1989)

Farrell (1957) defines allocative efficiency as the ability to choose optimal input levels given factor prices. According to Kalarijan and Shand (2004), the willingness and ability of an economic unit to equate its specific marginal value product is referred to as allocative efficiency. In effect, allocative efficiency refers to the adjustment of inputs and outputs to reflect relative prices (price efficiency) under a given technology (Ellis, 1988)

Unlike technical efficiency concept that only consider the process of production, allocative efficiency concepts pertain to the idea that society is concerned with not only how an output is produced, but also with what outputs and balance of output are produced.

2.3.3 Economic efficiency

This is the product of technical and allocative efficiencies (Mijindadi, 1980). An economically efficient input-output combination would be both on the production frontier and the expansion path (Ogundari and Ojo, 2006). Economic efficiency is concerned with the relative value of unit output to unit cost of resources used in production. It exists where the marginal value product achieve maximum profit.

2.4 Approaches for Measuring Production Efficiency.

The measurement of efficiency in factor inputs has remained an area of important research, both in the developed and the developing countries, especially in developing agricultural economies where resources are meager and opportunities for developing and adopting better technologies are dwindling (Bamire*et al.,* 2007).

There are four major approaches to measure and estimate efficiency (Coelli*et al.,* 1998). These are the non-parametric programming approach, the parametric programming approach (Aigner and Chu, 1968), the deterministic statistical approach (Afriat, 1972; Schippers, 2000; Fleming *et al,* 2004) and the stochastic frontier production function approach (Aigner*et al*., 1977; Kirkley*et al.,* 1995). Among these, the stochastic frontier production function and non-parametric programming, known as data envelopment analysis (DEA), are the most popular approaches.DEA and stochastic frontiers are two alternative methods for estimating frontier functions and thereby measuring efficiency of production. DEA involves the use of linear programming whereas stochastic frontiers involve the use of econometric methods(Coelli, 1994).

Data envelope analysis (DEA) involves the use of linear programming method to construct a non-parametric piece-wise surface (or frontier) over the data. Efficiency measures are then calculated relative to this surface. Comprehensive reviews of the methodology are presented byLovell (1993), Ali and Seiford (1993) and Charnes*et al*., (1995).The piece-wise-linear convex all approach to frontier estimation, proposed by Farrell (1957), was considered by only a few authors in the two decades following Farrell's paper.Afriat (1972) suggested mathematical programming methods which could achieve the task, but the method did not receive wide attention until the paper by charnes, (1978), in which the term *data envelopment analysis* (DEA) was first used.

Since then there has been a large number of papers which have extended and applied the DEA methodology.

Charnes, (1978) proposed a model which had an input orientation and assumed constant returns to scale (CRS). Subsequent papers have considered alternative sets of assumption, such as Banker *et al.* (1984), in which a variable returns to scale (VRS) model is proposed.

Aigner*et al* (1977) and Meeusen and Van den Broeck (1977) independently proposed the stochastic frontier production function, in which an additional random error, $V_{i,}$ is added to the non-negative random variable, $U_{i,}$ in equation 1 below:

$$\ln(Y_i) = X_i\beta - U_i \quad i = 1,2\ldots\ldots, N \quad \ldots\ldots\ldots\ldots\ldots 1$$

$$\ln(Y_i) = X_i\beta + V_i - U_i \quad i = 1,2\ldots\ldots, N \quad \ldots\ldots\ldots\ldots\ldots 2$$

The error, V_i, accounts for measurement error and other random factors, such as the effects of weather, strikes, lucks, etc., on the value of the output variable, together with the combined effects of unspecified input variables in the production function. Aigner*et al* (1977) assumed that the V_is were independent and identically distributed (i.i.d.) normal random variables with mean zero and constant variance, σv^2, independent of the u_is, which were assumed to be i.i.d. exponential or half-normal random variables.

The model, defined by equation 3, is called the stochastic frontier production function because the output values are bounded above by the stochastic (random) variable, exp $(x_i \beta + v_i)$. The random error, $v_{i,}$ can be positive or negative and so the stochastic frontier outputs vary about the deterministic part of the frontier model, exp $(x_i \beta)$.

The parameters of the stochastic frontier production function, defined by equation 3 can be estimated using either the maximum-likelihood (ML) method or using a variant of the OLS method, suggested by Richmond (1974). The OLS approach is not as computationally demanding as the ML method, which requires numerical maximization of the likelihood function. This distinction, however, has lessened in recent years with the availability of computer software, such as the LIMDEP econometrics package (Greene, 1992) and the FRONTIER programme (Coelli, 1992, 1996a), both of which automate the ML method for estimation of the parameters of stochastic frontier models.

The ML estimator is asymptotically more efficient than the OLS estimator, but the properties of the two estimators in finite samples cannot be analytically determined. The finite-properties of the half-normal frontier model were investigated in a Monte Carlo experiment in Coelli (1995a), in which the ML estimator was found to be significantly better than the OLS estimator when the contribution of the technical inefficiency effects to the total variance term is large. Given this result and the availability of automated ML routines, the ML estimator should be used in preference to the OLS estimator whenever possible.

The Cobb-Douglas functional form has been commonly used in the empirical estimation of frontier models. Its simplicity is a very attractive feature. A logarithmic transformation provides a model which is linear in the logarithms of the inputs and hence, the Cobb-Douglas form is easy to estimate.A number of alternative functional forms have also been used in the frontier literature. The two most popular alternative forms are the translog and the Zellner-Revankargeneralized production function (for example Forsund and Hjalmarsson, 1979, and Kumbhakar, Ghosh and McGuckin, 1991). TheZellner-Revankar form removes the returns-to-scale restriction, while the

translog form imposes no restrictions upon returns to scale or substitution possibilities, but has the drawback of being susceptible tomulticollinearity and degree of freedom problems.

2.5 Measurement of Profitability

2.5.1 Gross margin analysis

The gross margin analysis involves evaluating the efficiency of an individual enterprise (or farm plan) so that comparison can be made between enterprises or different farm plans. It is a very useful planning tool in situations where fixed capital is negligible portion of the farming enterprise as is the case in subsistence agriculture.

Gross Margin (GM) by definition is the difference between the gross farm income (GI) and total variable cost (TVC), that is GM=GI-TVC (Olukosi and Erhabor, 2005)

2.5.2 Net farm income

The net farm income which measures the returns to unpaid family labour, operator's land, labour, capital and management is notationally represented as:

Net farm income = gross receipts - total cost of production. Although, the income can be withdrawn from the business without affecting its scale of operation, it is generally advisable to plough it back into the farm business (Olukosi and Erhabor, 2005).

2.6 Empirical Studies

2.6.1 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.

According to UgbajahandUzuegbuna(2012) Causative Factors of Decline in Cocoyam Production in Ezeagu Local Government area of Enugu State: Implications for Sustainable Food Security, reported that gender roles in the planting of cocoyam production revealed that39.2% was done by only men in the household and 5% was done by only women. The result also showed that 20% of cocoyam planting was done by men and children together, while 27.5% of the planting was done by everybody in the family. About 6% of them indicated that men and women do the planting while 2.5% indicated that planting was done by children only.

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-LawaI*et al*. (2009) also reported that 82.73% of the youth in agriculture are male.Chikezie*et al*. (2012) revealed in his findings of factors constraining rural youth involvement in cassava production that majority of the youths in Onu-Imo local government area of Imo State were at the productive age where their energies could be harnessed and utilized for productive venture in agriculture especially cassava production. From his findings 9.17% of the respondents were less than 20 years, 43.33% and 33.33% were between 21–25 years and 26–30 years, respectively, while only 14.17% of the respondents were more than 30 years of age. He also revealed that 81.67% of the respondents were male, while 18.33% were female.

Abdullah*et al.* (2012), who reported that in Ikara Local Government Area of Kaduna State, majority of the farmers were middle aged. This result suggests that majority of sorghum farmers in the study area are young farmers who were within the age bracket in which people are innovative and active at work (Asiabaka, 1998). Similarly, this findings is in line with Okwoche*et al.* (2012), who 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 sorghum farming in the study areas has higher patronage among young people who are energetic enough to withstand the stress involved in the sorghum farm operations and more so that sorghum farming is dominated by men considering the data from these Northern State. The result also confirms that of Asogwa*et al.* (2012), who reported that the age range of 31 and less than 40 years is predominant with 42%. Also 32% of the farmers belong to 20 to less than 30 years age group.

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

2.6.2 Cost and returns analysis

Cost- return analysis 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 an 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, 2005). The returns on naira invested in cotton production by the farmers were ₦0.22 that is 22%.

Alam*et al.,* (2013) reported the average costs and returns of cotton production in Katsina State. The averagerevenue 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 had the highest percentage (21%)of the total cost of production. The total variable cost constituted 95% while fixed cost constituted 5% of the total cost. The enterprise had an average net farm income of ₦21, 172.12.The result of the study further revealed thatreturns on Naira invested by farmers in the studyarea was ₦0.56, meaning that a farmer gain 56Kobo in every one naira invested in cotton production. The result of the study clearly indicated that cotton production is a profitable venture hence farmers in the study area should be advisedto venture into it because it is a profitable enterprise.

2.6.3 Technical, allocative and economic efficiency

2.6.3.1 Technical efficiency

By applying their model of technical inefficiency effects using panel data on Indian paddy rice producers, Battese and Coelli (1995) found a positive relationship between the degree of inefficiency and the producer's age, and a negative relationship between the degree of inefficiency and the educational level of the producer. Coelli and Battese (1996) used the same approach to analysethe factors affecting the technical inefficiency of Indian farmers, and found the mean technical efficiency levels to be 0.74 and 0.71, respectively, for the villages of Aurelle, Kanzara and Shirapur. They also found a negative correlation between technical inefficiency and variables such as farm size and the level of education and age of the farmer.

By using the trans logarithmic stochastic frontier production function in which inefficiency effects are a function of socioeconomic variables, Ajibefun*et al*. (1996) obtained technical indicators whose average was 82%. They found positive correlations between the degree of technical inefficiency and the farmer's age, farm size and proportion of hired labour used, and a negative correlation between the degree of technical inefficiency and the producer's experience. Lyubov and Jensen (1998) used the same approach as Ajibefun*et al*. (1996) to analyse the technical efficiency of grain production in the Ukraine from 1989 to 1991. Out of the 80 farms considered, they found that variables such as the number of farm workers per hectare, the proportion of active household members engaged in non-agricultural activities, and the distance between the farm and the nearest city, have a negative impact on technical inefficiency

2.6.3.2 ***Allocative efficiency***

A firm is said to have realized allocative efficiency if it is operating with the optimal combination of inputs given input prices. The traditional approachesto measuring allocative efficiency require input prices (Atkinson andCornwell, 1994; Kumbhakar, 1991) which arehardly available in reality. This explains why empirical studies of allocative efficiency are highly concentrated on certain industries, particularly banking, because information on input price can be readily obtained for these industries.

In his seminar paper,Farrell (1957)used the concept of efficiency postulated byKoopmans (1951)and the radial type of efficiency measure considered by Debreu (1951)to introduce the foundation for efficiency analysis. Hedifferentiated between technical and allocative efficiencies. A firm is technically efficient if it uses the minimal possiblecombination of inputs for producing a certain output (input orientation). Allocative efficiency, or as Farrell called it price efficiency, refers to the ability of a firm to choose the optimal combination of inputs given input prices. If a firm has realized both technical and allocative efficiency, it is then cost efficient (overall efficient).

2.6.4 Production constraints faced by small holder farmer

Among all rice ecologies, weed control is considered one of the most important yield-reducing factors due to its high demand on labor inputs and soil nutrients, which contributes to lower levels of land and labor productivity (Defoer et al. 2004). The problem is exacerbated by reduced fallowing, which is leading to decreased soil fertility and land degradation problems over time. Second to the challenges of weed control and soil fertility, problems of drought, disease (such as blast), and pests are also common. 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 2003a). Common pests include birds and rodents. Many of these constraints have been brought under control in areas where the adoption and diffusion of improved varieties has been widespread.

In the lowland rice ecology, water control has also been shown to be a critical constraint to intensification and maximizing yield potential. Land preparation methods become critical in this regard, including the use of herbicides and mechanized tillers. Given the ecology's importance in supplying the bulk of rice in Nigeria, there is great potential to improve its performance through improved water control methods and use of modern inputs and technologies. Additionally, the lowland systems often integrate well with aquaculture production, given sufficient water levels during the early stages of production.

Despite the low levels of rice intensification, the use of improved rice varieties has a long history in Nigeria. In fact, among West African countries, Nigeria has consistently led in the development and diffusion of improved seed for all three major rice ecologies. The National Cereals Research Institute has conducted varietal improvement research in Nigeria for more than half a century. According to Dalton and Guei (2003a), the first official release of an improved rice variety in Nigeria occurred in 1954 for the rainfed lowland system, and since then more than 50 improved varieties have been released. The most popular seeds adopted by farmers have typically exhibited traits of early maturing and high yields (Longtau 2003a). Diffusion rates of modern improved varieties are highest in irrigated lowland areas and moderate in upland areas, but still low in rainfed lowland ecologies (Dalton and Guei 2003b).

Unfortunately, maximum yields are rarely realized due to limited access to and inefficient use of complementary technologies such as fertilizer, land cultivation techniques, weeding, and water control. Part of the problem has been the high cost of inputs such as fertilizer, chemicals (herbicides and insecticides), and mechanized implements (tractors and tillers). The use of tractors has been limited to large-scale irrigated areas and, mostly on a fee-for-service basis, areas where the land has been parceled out among many small-scale farmers. For the majority of farmers, owning a tractor is next to impossible given its high up-front capital cost and high operating and maintenance costs.

Ugbajah andUzuegbuna (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 2003a). Common pests include birds and rodents. High cost of labour 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. Abdullahi (1980) also reported 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 Study Area

The study was conducted in some selected Local Government Areas of Niger State, Nigeria. The State is divided into 25 Local Government Areas. It is located between latitude 80^0 to 11^0 30^1North and Longitude $03^0$to 7^0 40^1 East (NBS, 2011). It occupies a land area of approximately 76, 469.903square kilometers or about 10% of Nigeria's land mass (NBS, 2011). The state has an estimated population of 3,950249 (National Population Commission, 2006). This gives the state a population density of about 33per square kilometer, the lowest in the country. The estimated projected population of the state at 3% growth rate per annum in 2014 is 4,898,309. The State has a tropical climate marked by dry and wet seasons. The rainy season commences in April and ends in October. The dry season begins from November and ends in March. It has a mean annual rainfall of 1000mm and mean temperature of 33.5^0C. The State is characterized by Guinea Savanna vegetation with trees like sheabutter and locust bean (NAMDA, 2003). The State is endowed with fertile agricultural land and has the capacity to produce most Nigerian staple food (such as rice, maize, sorghum, soybean, groundnut, yam, pepper, tomatoes and livestock such as goat, poultry, cattle and sheep).

Niger state is popular for its brass work, particularly in Bida. It is also known for pottery, weaving and several cottage industries which can be found throughout the state. However, there are 3-prominent ethnic group, Nupe, Gbagi (Gwari) and Hausa. Other ethnic group includes, Kamberi, Kamuku, Gade, pangu and Ingwai (NAMDA, 2003).

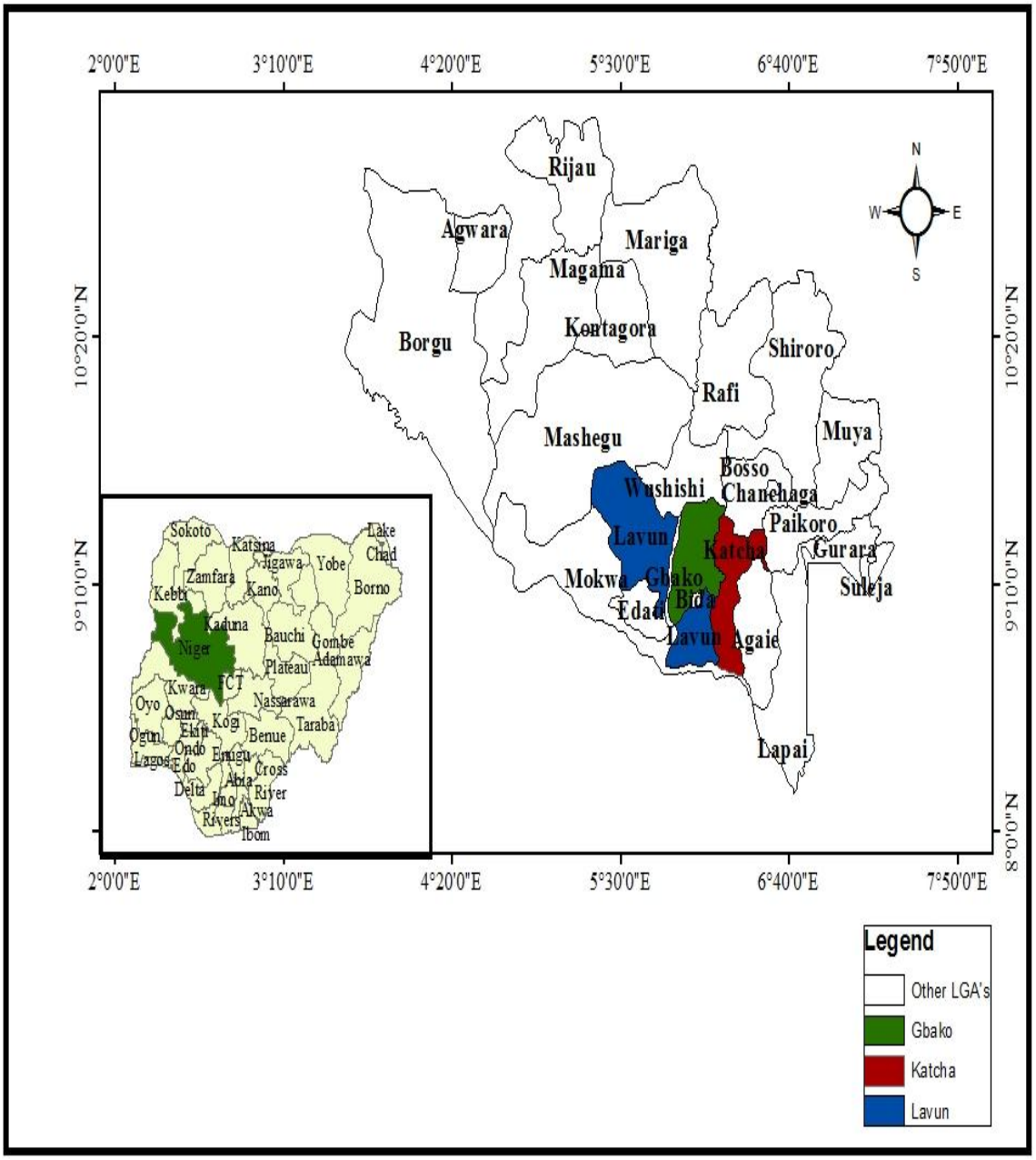


Figure 1: Map of Niger State Showing the Study Areas

3.2 Sampling Procedure and Sample Size

A multistage sampling technique was used for the study. The first stage involved the purposive selection of the three Local Government Areas based on concentrationofrain-fed lowland rice production among the farmers. Second stage involved the selection ofnine villages which were randomly selected, threevillages were selected from each Local Government Area. The final stage involved a proportional sampling of farmers from each of the villages. Ten percent (10%) of the sample frame (1532) was used as the sample size. A total of 153 farmers were proportionally selected.

Table3.1: Sample frame and sample size of rice farmers in the study area.

LGA's	**No of villages**	**Villages**	***Sampleframe**	**Sample size (10%)**
Katcha	25	Baddegi	360	36
		Sidisaba	211	21
		Magwayi	209	21
Lavun	13	Sheshibikun	180	18
		Manbe	140	14
		Sachi	130	13
Gbako	15	Edozhigi	105	11
		Sheshimandiko	97	10
		Man sani	100	10

Total	**1532**	**153**

* Source:Niger State Agricultural and Mechanization Development Authority (NAMDA), 2015

3.3 Data Collection

Primary data were used for this study. These werecollected with the aid of structured questionnaire, using interview method. The information was collected on farmers' socio-economic characteristics such as age,household size, educational level, farming experience, amount of credit received, numbers of extension contact,cooperative membership, farm size andoff-farm income. Information was also collected on Production: input (seed (kg), fertilizer (kg), labour (man-days) agrochemical (litres)) and output (rice (kg/ha)) data. Other information collected was theConstraintsassociated with rain-fed lowland rice production.

3.4 Analytical Techniques

The tools of analysis used are:Descriptive statistics, Net farm income, Stochastic Frontier Production Function (SFPF)

3.4.1 Descriptive statistics.

Descriptive statistics was used to achieve objective (i) and (iv) of the study. It involved the use of measures of central tendency such as mean, frequency distribution and percentages.

3.4.2 Net Farm Income

The Net Farm Income (NFI) was employed to achieve objective (ii). It was used to estimate the profitability of rice production. The formula for net farm income is stated as follows:

NFI= TR-TC……………………………………………………………….3

Where:

NFI= net farm income (₦)

TR= total revenue (₦)

TC= total cost of production (₦)

TVC= (cost of seed, cost of fertilizer, cost of labour and cost of agrochemical)

TC= TVC+TFC

The straight line method of evaluating depreciation was used to obtain fixed cost for durable farm tools such as sprayer, hoes and cutlasses.

The straight line method depreciation is specified as:

$$D = \frac{(P - S)}{N} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (4)$$

Where:

D= depreciation

P= purchase price of the assets

S= salvage value of the assets

N= number of years of life of the asset

3.4.2 Stochastic Frontier production and Cost Functions.

The stochastic frontier production and cost functions were employed to achieve objective (iii). The production function of the model is specified as:

$$\ln Y = \beta_o + \beta_1 \ln X_1 i + \beta_2 \ln X_2 i + \beta_3 \ln X_3 i + \beta_4 \ln X_4 i + \beta_5 \ln X_5 i + (Vi - Ui) \ldots\ldots\ldots 5$$

Where:

ln = the natural logarithm

Y = output of rice (kg)

βo = constant term

β_1- β_3 = regression coefficients

X_1 = farm size (hectares)

X_2 = quantity of seed (kg)

X_3 =quantity of fertilizer (kg)

X_4 = total labour used (man-days)

X_5 = quantity of agrochemical (litres)

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

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

The inefficiency of production, $U_{i,}$ was modelled in terms of the factors that are assumed to affect the efficiency of production of farmers. These factors are the socio-economic and management variables of the farmers. The determinants of technical inefficiency are defined by:

$U_i = \delta_0 + \delta_1 1nZ_1 + \delta_2 lnZ_2 + \delta_3 lnZ_3 + \delta_4 lnZ_4 + \delta_5 lnZ_5 + \delta_6 lnZ_6$ 6

Where:

U_i = inefficiency effect

δ_0 = constant

δ_1-δ_6 = Parameters to be estimated.

Z_1 = age of farmer (years)

Z_2 = household size (number of person in the household)

Z_3 = formal education (years)

Z_4 = amount of credit (Naira)

Z_5 = access to extension services (number of contact)

Z_6 = membership of cooperative (years)

The stochastic frontier cost function model is specified as:

$lnC = \beta o + \beta_1 lnX_1 i + \beta_2 lnX_2 i + \beta_3 lnX_3 i + \beta_4 lnX_4 i + (Vi + Ui)$……7

Where:

ln = the natural logarithm

ln C = cost of production of rice (kg/ha)

βo = constant term

β_1- β_3 = regression coefficients

X_1 = cost of seed (₦)

X_2 = cost of fertilizer (₦)

X_3 = cost oflabour used (₦)

X_4 = cost of agrochemicals (₦)

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

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

3.5 Explanation of Dependent and Independent variables

Ten explanatory variables measured as continuous and discrete variables werehypothesized for determinants of rice production and its profitability.

(i)Age: This refers to the number of years an individual attained from birth. It is a continuous variable and was measured in years. The *apriori* expectation for age was expected to be negative; this implies that the age of the farmer reduced inefficiency or increases technical efficiency.

(ii) Household size: This means the total number of people in the house which includes the wives, children and dependants that reside within the same house. Since food requirements increases with the number of person in the household and also because land and finance to purchase agricultural inputs are limited. Increasing family size, according to Brown (2004), tends to exert more pressure on consumption than the labour it contributes to production. This was measured in numbers. The *apriori*expectation for household size was expected to be negative; this implies that the household size of the farmer reduced inefficiency or increasing technical efficiency.

(iii)Education Status: This refers to the acquisition of knowledge through formal schooling. This was measured by the number of years spent in school. The *apriori* expectation for educational status of the farmer was expected to be negative; this implies that the educational status of the farmer reduced inefficiency or increases technical efficiency.

(iv) Amount of money received: This refers to amount of money received from both formal and informal sources. It was measured as the actual money/credit borrowed. The

apriori expectation for amount of money received was expected to be negative; this implies that the amount of money received by the farmer reduced inefficiency or increases technical efficiency.

(v) Numbers of extension contact/period: This refers to the access to government extension services by the respondents in the production cycle. It was measured in numbers. The *apriori* expectation for extension contact was expected to be negative, this implies that the extension contact of the farmer reduced inefficiency or increases technical efficiency.

(vi) Number of years of membership in Cooperative Society: This refers to coming together of individuals into group of farmers for interaction and sharing of ideas for a common goal attainment. Thus, it influences the attitude of members towards community developmental projects. This variable was used to characterize farmers based on particular involvement in production and/or marketing organization at the time of data collection. It was measured in years. The *apriori* expectation for cooperative society was expected to be negative; this implies that the cooperative society of thefarmer reduced inefficiency or increases technical efficiency.

(vii) Quantity of seed: This was measured in kilograms (kg). It was included in the model to examine the actual kilograms of the rice seed. The *apriori* expectation for quantity of seed was expected to be positive; this implies that, a unit increase in quantity of seed brought about increase in output.

(viii) Labour: This consist of family and hired labour, it was included in the model to examine how variability inlabour used affect output. Following Norman (1972), children age 7-14years are accorded 0.5 of adult male equivalent, female adult of 15-46years are accorded 0.75 and male adults of 15-64years are accorded 1.00. Labour was

measured in man-days. The *apriori* expectation for quantity of labourwas expected to be positive; this implies that, a unit increase in quantity of labourbrought about increase in output.

(ix) Quantity of fertilizer: This was measured in kilograms (kg). It was included in the model to examine the actual kilograms of the fertilizer used in the production cycle. The *apriori* expectation for quantity of fertilizer was expected to be positive; this implies that, a unit increase in quantity of fertilizer to a certain extent brought about increase in output.

(vii) Quantity of agrochemical: This was measured in litres. It was included in the model to examine the actual litres of agrochemical used in rice production. The *apriori* expectation for quantity of agrochemical was expected to be positive; this implies that, a unit increase in quantity of agrochemical brought about increase in output.

(vii) Land: This was measured in hectares (ha). It was included in the model to examine the actual hectares ofland used in rice production. The *apriori* expectation for land was expected to be positive; this implies that, a unit increase in land area brought about increase in output.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Rain-FedLowland Rice Farmers

4.1.1 Age of lowland rice farmers

The result presented in Table 4.1 shows that about 46% of lowland rice farmers were within the age range of 40-49 years, with a mean age of 40 years. The average age of rice farmers was found to be approximately 40 years with minimum of 23 years and maximum of 60 years. The standard deviation of the age was 8.58 and coefficient of variation of 21.45. This implies that farmers in the study area are within the productive stage. Age is an important determinant of socio-economic status of a population since people reduce in energy as they advance in age. Therefore, the age of lowland rice farmers could have negative implications on the future of lowland rice production in the

study area. This is because these older people may not be willing to adopt innovations in agriculture; usually, they argued that their forefathers practiced farming successfully without modern innovations. However, it is important to note that the older a farmer becomes, the better his understanding of the social, climatic and economic factors that affect farming and thus more experienced. The coefficient of variation of about 21% implies low inconsistency in age level among farmers' age in the study area.This agrees with the findings of Institute for Agricultural Research (2001), who reported that the most active farmers' age group engaged in agricultural production is within 31-50 years.

Table 4.1: Age distribution of rain-fedlowland rice farmers

Age (years)	**Frequency**	**Percentage**
20-29	9	5.9
30-39	58	37.9
40-49	70	45.8
50-59	9	5.9
>60	10	4.6
Total	**153**	**100**
Mean	**40**	

Minimum	23
Maximum	60

Standard deviation =8.58 and coefficient of variation = 21.45

4.1.2 Household size of lowland rice farmers

The result presented in Table 4.2 shows the distribution of lowland rice farmers by household size. Majority (73.9) of the farmers had household size that ranged from 1-10 persons. The maximum family size observed was 28 persons with a minimum of 1 person and average of 9 persons. The standard deviation of the household size was 5.42 and coefficient of variation of 60.6. This implies that the farmers in the study area might have an 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 the 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 withBanmeke (2003), who reported that large household size assist more on farm and other household activities.

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

Household size (number)	**Frequency**	**Percentage**
1-10	113	73.9
11-20	35	22.9

21-30	5	3.2
Total	**153**	**100**

Mean	**9**
Minimum	1
Maximum	28

Standard deviation =5.42 and coefficient of variation = 60.6

4.1.3 Educational level of lowland rice farmers

The result in Table 4.3 revealed that 19% of farmers had no formal education; about 8% of the respondent had only primary education. About 33% had secondary education and 26% had tertiary education while about 14% had Quranic education. However, 81% of the farmers were literate.Literacy is believed to have a positive implication on efficient use of productive resources and adoption of farm innovation.

This indicates that the farmers' educational level is high. This finding is in line with Amaza (2000), who reported 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	29	19.0

Primary education	12	7.8
Secondary education	50	32.7
Tertiary education	40	26.1
Quranic education	22	14.4
Total	**153**	**100**

4.1.4 Membership of cooperative society

The result presented in Table 4.4 revealed that about 51% of lowland rice farmers are not members of any cooperative association. The average years of membership of cooperative society was 4 years. The coefficient of variation of about 132% implies high inconsistency in membership of cooperative among lowland rice farmer in the study area. The effect of this result is that most of the lowland 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 profit maximization.This finding is in line with Odebiyi (2000) that cooperative groups ensure that members derive benefits from the groups which they could not derive individually.According to Idiong*et al*. (2007), membership of cooperative affords the farmers opportunities of sharing information on modern rice production practices.

Table 4.4: Distribution of rice farmers according to years spent in the cooperative association

Cooperative association	Frequency	Percentage
Non members	77	50.3
1-10 years	62	40.5
11-20 years	11	7.2
21-30 years	3	2.0
Total	**153**	**100**
Mean	**4**	
Minimum	**0**	
Maximum	**30**	

Standard deviation =5.69 and coefficient of variation = 131.7

4.1.5 Number of extension visit

The result presented in Table 4.5 revealed that about 46% of rice farmers in the study area had no contact to extension service while about 54% of the respondents had extension contact .The maximum extension contact observed was 13 with a minimum of one contact and an average of 3 contacts per year. 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. The coefficient of variation of about 146% implies high inconsistency in extension contact among lowland rice farmers in the study area.

Table 4.5: Distribution of lowland rice farmers according to extension visit

Extension Contact (Numbers)	**Frequency**	**Percentage**
No contact	71	46.4
1-10	70	45.8
11-20	11	7.2
21-30	1	0.6
Total	**153**	**100**
Mean	**3**	
Minimum	1	
Maximum	13	

Standard deviation =4.62 and coefficient of variation = 146.2;

4.1.6 Farm size of lowland rice farmers

The result presented in Table 4.6 revealed that about 48% of the lowland rice farmers have farm size ranging from 0.1-1.0 hectares with an average of 2 hectares. This show that farmers in the study area will not be able to enjoy economy of scale in production, because small farm sizes is an impediment to agricultural mechanization through farm machineries like tractor. Small farm sizes might be as a result of the fact that most of the farmers got their land through inheritance.The coefficient of variation of about 47%

implies high inconsistency in membership of cooperative among lowland rice farmers in the study area.

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

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

Farm size (hectares)	**Frequency**	**Percentage**
0.1-1.0	74	48.4
1.1-2.0	52	34.0
2.1-3.0	24	15.7
3.1-4.0	3	2.0
Total	**153**	**100**
Mean	**2**	
Minimum	0.5	
Maximum	4	

Standard deviation =0.39 and coefficient of variation = 47.3

4.1.7 Amount of credit obtained by lowland rice farmers

Adequate funding is required by farmers to finance all rice production and marketing activities. The results presented in Table 4.7 indicate that the majority (88.9%) of farmers had no access to credit to finance their rice production activities while those who had access to credit was 11.1%.

The farmers that had access to credit ranges between ₦10,000-₦90,000 in the study area. The majority (41.2%) of the farmers had access to credit ranges between30,001-60,000 with mean of ₦35,000. However, a large number of farmers had no access to funds to finance their rice production activities, which in turn reduce their level of profit. 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 farmers 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. Lack of credit facility will therefore have a negative effect on profit efficiency. The study by Wozniak (1993) supported this fact by reporting that creditincreases 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 4.7: Distribution of lowland rice farmers according to credit obtained.

Variable	**Frequency**	**Percentage**
Access to credit (N=153)		
No access	136	88.9
Access	17	11.1
Amount of credit accessed (n=17)		

10,000- 30,000	6	35.3
30,001- 60,000	7	41.2
60,001-90,000	4	23.5
Total	**153**	**100**
Mean	**35,000**	
Min	**10,000**	
Max	**90,000**	

4.2 Costs and Returns of Lowland Rice Production in the Study Area

4.2.1 Cost of rice production in the study area

Rice seed used by the farmers in the study area were mainly local seeds preserved from the last harvest. The quantity of rice seed was 1068.2kg/ha with an average market price of ₦271 per kg which constituted and this constitutes 62.2% of the total cost of production. The quantity of fertilizer was 490.47kg/ha with an average market price of ₦100 per kg constituting 28.5% of the total cost of production.

Labour costs consisted of cost of land preparation, planting, fertilizer application, weeding, supplying and harvesting. The family labour was computed on the basis of opportunity cost in man-days. The wage rate varied according to farm operation performed. An average wage rate of ₦400 per man-day was used, giving the average labour cost per hectare to be ₦9,780 while the total cost of fixed inputs (cost of renting

land and depreciation of tools) incurred on rice production was ₦6113 and this constitute 3.6% of the total fixed cost.

4.2.2 Returns to investment in rice production

Results presented in Table 4.9 indicated that the total revenue (TR) was ₦110,769/ha while the total cost (TVC + TFC) was ₦48,426/ha. The net farm income was therefore ₦62,343/ha. The average rate of returns on investment (return per naira invested) was 2.29, indicating that for every ₦1 invested in rice production in the study area, a profit of ₦1.29 kobo was made. Thus, it could be concluded that rice production in the study area though on a small scale, was economically viable. This finding is similar to that of Okoye*et al.*, (2009) in his study of Determinants of labour productivity on small-holder rice farms in Anambra State, Nigeria who observed that rice production is profitable by returning ₦1.80 to every ₦1.00 invested.

Table 4.9: Average costs and returns per hectare of lowland rice production.

Variables	**Unit price (₦)**	**Quantity (kg/ha)**	**Values/ha (₦)**	**% Total cost**
A. ariable cost				
seed (kg)	271	28.68	7,772	16.0
fertilizer (kg)	100	226.61	22,661	46.8
agrochemical (litre)	1200	1.00	1200.00	2.5
labour (man-days)				
Land preparation	800	4.10	3280	6.8
Planting	400	2.00	800.00	1.7

Fertilizer application	300	2.00	600.00	1.2
Agrochemical application	600	1.00	600.00	1.2
Weeding	400	9.50	1800.00	3.7
Harvesting	800	4.50	3600.00	7.4
Total variable cost			42,313	87.4
B. ixed costs				
Cost of renting land			4813	9.9
Depreciation of tools (hoe and cutlass)			1300	2.7
Total fixed cost			6,113	12.6
C. otal cost			48,426	100
D. otal Revenue	50	2215.38	110,769	
E. et Farm Income (NFI)			62,343	
F. Return per Naira Invested			2.29	

4.3 Efficiency of Rice Production

4.3.1 Estimated technical efficiency of rice farmers

The model specified was estimated by the maximum likelihood (ML) method using FRONTIER 4.1 software developed by Coelli (1995). The ML estimates and inefficiency determinants of the specified frontier are presented in Table 4.11. The study revealed that the generalized log likelihood function was -130.759. 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 of Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 30.1% and it was highly significant at ($p<0.01$) 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 yield 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 technical efficiency of the farmers and improve their yield. The value of sigma squared ($\boldsymbol{\sigma^2}$) was statistically significant at ($p<0.01$) 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 technical inefficiencies of rice farmers.

However, the estimated coefficients of farm size, fertilizer and labour were positive and significant at 1% and 10% level of probability and hence play a major role in rice production in the study area while the estimated coefficients of seed and agrochemical was statistically not significant. The average technical efficiency for the farmers was

0.63 implying that, on the average, the respondents are able to obtain 63% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (37%) of increasing the efficiency, by adopting the technology and techniques used by the most economically efficient farmer.

The estimated coefficient of farm size was 0.296 which is positive and statistically significant at 1% level. The implication of the positive coefficient of farm size is that it contributes positively to technical efficiency in rice farming in the study area and a unit increase in farm size will increase rice output. This is in line with findings of Bayacag (2001), who revealed that there is a positive and significant relationship between farm size and farmers' efficiency in production.

The estimated coefficient for seed was -0.336 which is negative and statistically not different from zero. The estimated -0.336 elasticity of seed implies that increasing seed by 1% will decrease rice output by less than 1% which means, all things being equal the output is elastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality seeds are not used, output will be low even if other inputs are in abundance. This is at variance with the findings of Shehu*et al* (2010) who observed that the estimated coefficient of seed and labour inputs were positive as expected and significant at 1% level which implies that the more seed is applied and the more labour employed the better the output of rice.

The estimated coefficient for quantity of fertilizer was 0.156 which is positive and statistically significant at 10% level. This implies that a 1% increase in fertilizer will

increase rice output by 15.6%. Fertilizer is a major land augmenting input because it improves the quality of land by raising yields per hectare. This study is in agreement with the findings of Maurice (2004)

The coefficient of labour was 0.233 which is positive and statistically significant at 1% level. This shows that labour is an important variable in rice farming in the study area. This is in line with several studies by Umoh (2006) and Okike (2000) which show the importance of labour in farming, particularly in developing countries where mechanization is rare on small scale farms. In the study area, human labour plays a crucial role in virtually all farming activities. This situation has variously been attributed to the practice of split-plot cropping on small scattered land holdings and lack of affordable equipment (Umoh, 2006).

The estimated coefficient of agrochemical was 0.197 which is positive and statistically not different from zero. This implies that unit increase in the quantity of agrochemical will increase technical inefficiency by 19.7%. This study is in agreement with the findings of Maurice (2004).

Table 4.11: Maximum Likelihood Estimates of Stochastic Frontier Production Function of Rice production

Variables	**Parameters**	**Coefficients**	**Std. error**	**T-Value**
Production Function				
Constant	β_0	6.565	0.269	24.339***
Farm size	β_1	0.296	0.051	5.760***
Seed	β_2	-0.336	0.033	-1.000
Fertilizer	β_3	0.156	0.095	1.651*
Labour	β_4	0.233	0.074	3.128***
Agrochemical	β_5	0.197	0.137	1.438
Inefficiency model				
Constant	Z_0	-30.073	11.197	2.686***
Age	Z_1	0.175	0.110	1.585
Household size	Z_2	0.556	0.159	3.487***
Educational status	Z_3	-1.283	0.339	-3.775***
Farming experience	Z_4	-0.534	0.143	-3.725***
Cooperative membership	Z_5	-0.813	0.221	-3.681***
Extension contact	Z_6	-0.336	0.223	-1.506
Diagnostic Statistic				
Sigma-square	$(\boldsymbol{\sigma^2})$	0.146	0.038	3.820***
Gamma	**(γ)**	0.301	0.097	3.105***
Log likelihood function	*L/f*	-130.759		
LR test		171.92		
Total number of observation		153		
Mean efficiency		0.63		

***P<0.01
** P<0.05
*P<0.10

The estimated result of the inefficiency model is contained in Table 4.11. Generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The results show that all the technical inefficiency variable except age and extension contact were statistically significant at 1% level of probability.

The coefficient of household size was positively signed with technical inefficiency and statistically significant at 1% level of probability. This implies that a unit increase in household size of rice farmers will leads to increase in technical inefficiency, thereby reducing the rice output. 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.

Years of education showed a negative relation with technical inefficiency and are significant at 1% level for rice farmers. The negative coefficient of education reveals that a high level of education results in a reduction in technical inefficiency of rice farmers. Kalirajan and Shard (1986) observed that education sharpens managerial input and leads to a better assessment of the importance and complexities of good decisions in farming. It also implied that education widens the scope of farmer'shorizon towards adoption of technological innovation, thereby moving him away from traditional practices to adopt technological concepts.

Experience in rice production was negative and significant at 1% for rice farmers. This shows that increase in experience in rice production would reduce technical inefficiency. Farmers' experience could be associated with skill accumulation which

could enhance productivity and resource allocationthereby reducing technical inefficiency.

Membership of cooperative was negative and significant at 1% level of probability for rice farmers. The negative coefficient for membership imply that membership of association reduces technical inefficiency in rice production. Membership of association could affords the farmers the opportunity of sharing information on modern farming practices by interacting with other farmers. Okike (2000) noted that the reduction of inefficiency effects through farmers belonging to cooperatives is linked to cooperatives being a source of good quality inputs, information and organized marketing of products. This implied that rice farmers can market their produce through cooperative societies for higher profit and income.

4.3.2 Estimated stochastic frontier cost functions

The Maximum Likelihood (ML) estimates of the stochastic frontier cost parameters for rice are presented in Table 4.12. For the cost function, the sigma (σ^2= 0.136) and the gamma (γ=0.002) are quite high and highly significant at 1.0% level of probability. The high and significant value of the sigma square (σ^2) indicate the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). The gamma (γ = 0.002) shows that 0.2% of the variability in the output of rice farmers that are unexplained by the function is due to allocativeinefficiency.

The results of stochastic frontier cost function for rice in Niger State are shown in Table 4.12. The estimated coefficients of the parameters of the cost function are positive except that of fertilizer which is negative. The cost of agrochemical, labour, farm size and output are significant at 5% and 1% level while fertilizer and seed are not significant.

The estimated coefficient of the variable output was positively signed and statistically significant at 5% level indicating that if there is an increase in rice output the total cost of production will increase. This shows that the cost of production is influenced by the quantity of output realized. The result of this research agrees with the findings of Ogundari*et al* (2006) where they reported direct effect of output on cost of production in their study on economies of scale and cost efficiency in small scale maize production in Nigeria.

Table 4.12: Maximum Likelihood Estimates of Stochastic Frontier Allocative (Cost) Function of Rice production

Variables	**Parameters**	**Coefficients**	**Std. error**	**T-Value**
Production Function				
Constant	β_0	8.987	0.364	24.647***
Cost of Output	β_1	0.065	0.038	2.108**
Cost of Seed	β_2	0.007	0.056	0.133
Cost of Fertilizer	β_3	-0.138	0.287	-0.480
Cost of Agrochemical	β_4	0.442	0.081	5.444***
Cost of Labour	β_5	0.256	0.064	3.957***
Cost of farm size	β_6	0.220	0.099	2.221**
Inefficiency model				
Constant	Z_0	0.746	0.266	2.805***
Age	Z_1	-0.085	0.004	-2.044**
Household size	Z_2	-0.062	0.083	-0.753

Educational status	Z_3	-0.013	0.025	-0.541
Farming experience	Z_4	0.002	0.006	0.390
Cooperative membership	Z_5	-0.007	0.008	-0.989
Extension contact	Z_6	-0.336	0.223	-1.506
Diagnostic Statistic				
Sigma-square	(σ^2)	0.136	0.014	9.488***
Gamma	(γ)	0.002	0.143	19.966***
Log likelihood function	*L/f*	-643.561		
LR test	6.680			
Total number of observation	153			
Mean efficiency	0.62			

***p<0.01
**p<0.05
*p<0.10

The estimated coefficient cost of seed (0.007) and fertilizer (-0.138) were positively and negatively signed and were statistically not significant.

The cost of labour (0.256) both hired and family shows a positive and significant influence on the total cost of rice production at 1% level. The implication of these results is that farmers' total cost of producing rice is increased as more labour is put into use. These show the importance of these variables in the allocation of costs in rice production.

The estimated coefficient 0.220 of farm size is positive and significant at 5% level. The positive relationship of cost of farm size and cost of allocation of rice production system indicated that an increase in cost of farm land would result to an increase in total cost of production for rice in the area. Also the estimated coefficients of land implied that if

there is a unit increase in the cost of land the total cost of production would increase by magnitude of 0.220.

The factors influencing allocative efficiency of rice farmers in Niger State were not statistically significant except age which is statistically significant at 5% level. The results in Table 4.12 show the estimates of the allocative inefficiency model ofrice farmers. It was revealed that farmers' age was negative and significant at 5% for rice farmers. This implies that increase in age would decrease allocative inefficiency. It means that older farmers are more allocatively efficient in the use of resources and cost reduction of the inputs. It could be attributed to the fact that older farmers tend to be more efficient in financial expenditure that could increase their allocative efficiency. This implied that prudent financial expenditure is important for effective and efficient allocation of scarce resources for higher productivity and income.

4.3.3 Distribution of respondents according to technical, allocative and economic efficiencies of rice farmers in the study area.

Distribution of rice farmers according to technical efficiency estimates

The frequency distribution of the technical efficiency estimates for rice farmers in the study area as obtained from the stochastic frontier model is presented in Table 4.13. It was observed from the study that about 64% of the farmers had technical efficiency (TE) of 0.61 and above while 36% of the farmers operated at less than 0.6 technical efficiency levels. The farmer with the best and least practice had technical efficiencies of 0.85 and 0.32 respectively. This implies that on the average, output fell by 38% from the maximum possible level attainable due to inefficiency.

Table 4.13: Frequency Distribution of Technical, Allocative and Economic Estimates from the Stochastic Frontier Model of Lowland Rice Farmers

	TechnicalEfficiency		**Allocative Efficiency**		**Economic Efficiency**	
Class	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
<0.2	14	9.15	0	0	21	13.73
0.21-0.40	13	8.50	6	3.92	52	33.99
0.41-0.60	28	18.30	49	32.03	69	45.10
0.61-0.80	55	35.95	86	56.21	11	7.18
0.81-1.00	43	28.10	12	7.84	0	0
Total	**153**	**100**	**153**	**100**	**153**	**100**
Mean	0.63		0.63		0.39	
Minimum	0.32		0.00034		0.19	
Maximum	0.85		0.63		0.78	

The study also suggest that for the average farmer in the study area to achieve technical efficiency of his most efficient counterpart, he could realize about 48% (1-0.62/0.85*100) cost savings while on the other hand, the least technically efficient farmers will have about 80 percent (1-0.24/0.84*100) cost savings to become the most efficient farmer. This finding is in line with Abdulrahman*et al*, (2015) who observed that average cocoyam farmer in Kaduna State would enjoy cost saving of about 20% if he or she attains the level of the most efficient farmer among the respondents in the study area.

4.3.4 Allocative efficiency estimates

The allocative efficiency estimates presented in Table4.13, indicate that it ranged from 0.20 to 1.00 with a mean allocative efficiency of 0.63. The result indicates that average rice farmer in the state would enjoy a cost saving of about 59% (1-0.63/0.63*100) if he or she attains the level of the most efficient farmer among the respondents. The most allocatively inefficient farmer will have an efficiency gain of 153% (1-0.03/0.63*100)

in rice production if he or she is to attain the efficiency level of most allocatively efficient farmer in the state. This finding is in line with Abdulrahman*et al* (2015).

4.3.5 Economic efficiency estimates of rice farmers.

The frequency distribution of the economic efficiency estimates for rice farmers in the study area as obtained from the stochastic frontier model is presented in Table 4.13. It was observed from the study that about 7% of the farmers had economic efficiency (EE) of 0.61 and above while 93% of the farmers operate at less than 0.6 efficiency levels. The mean economic efficiency of the 153 sampled farmers in the study area was 0.39. The farmer with the best and least practice had economic efficiencies of 0.78 and 0.19 respectively. This implies that on the average, output fall by 61% from the maximum possible level due to inefficiency.

The study also suggest that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he could realize about 78% cost savings while on the other hand, the least technically efficient farmers will have about cost savings to become the most efficient farmer. However, the average economic efficiency of the rice farmers was 39%. This indicates that rice farms were economically inefficient.

4.4 Production Constraints Associated with Lowland Rice Farmers

The problems faced by rice farmers in the study area were ranked according to their magnitude as stated by the farmers (Table 4.14). Pest and disease was the most severe constraint of rice producers with about 88% of rice farmers attesting to this fact. Rice as a crop is susceptible to attack by numerous insects and diseases throughout the life cycle and the effective control of these is inevitable if reasonable yield is expected.

About 80.7% of the rice farmers indicated flooding as most severe constraint affecting rice production in the study area and rank second.

About 56% of the rice farmers indicated inadequacy of capital and credit facilities which ranked third. 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.

About 46% 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 shortage in rice farming in the study area.

High cost of fertilizer was perceived to one of the constraint which ranked fifth with about 35% 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.

Unavailability of improved seed was ranked sixth (32%) 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 Abdulrahman*et al*, (2015), who opined that most farmers have little or no access to improved seeds and continue to recycle seeds that have become exhausted several years of cultivation.

Table 4.14: constraints associated with rice production

Variable	*Frequency	Percentage	Rank
Pest and disease	134	87.5	1st
Flooding	109	80.7	2nd
Lack/Inadequate capital	85	55.6	3rd
Inadequate Labour	71	46.4	4th
High cost of fertilizer	53	34.6	5th
Lack/inadequate improved seed	49	32.0	6th

***** Multiple response was allowed

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study focused on economic analysis of rain-fed lowland rice production among smallholder farmers in Niger State, Nigeria. Nine villages were randomly selected, three from each Local Government Areas and 153 farmers were selected in this area. The purpose of the study was to examine the economic analysis of rain-fed lowland rice production among smallholder farmers in Niger State, Nigeria, and to achieve this, the study came up with four specific objectives. These were to: describe the socio-economic characteristics of lowland rice farmers, determine the cost and return associated with lowland rice production, estimate the technical, allocative and economic efficiency in lowland rice production and to describe the constraint faced by smallholder lowland rice farmers in the study Area.Primary data were collected from 153 respondents through the use of structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, stochastic production frontier function model and net farm income.

The results of the socio-economic analysis shows that 43% of the respondents fall within the age range of 30-39years with an average age of 40 years. The household size was that of 1-10 persons. The majority (81%) of the farmers were literate having one form of formal education or the other. Majority (51%) of the farmers were not members of a cooperative society. About 46% of the respondents had no access to extension service while 90% of the respondents did not have access to credit.

The average costs incurred and revenue obtained per hectare for lowland rice production were estimated to determine the profitability of rice production. The total revenue was ₦110,769/ha while the total cost was ₦48,426/ha. The net farm income was therefore

₦62,343/ha. The average rate of returns on investment (return per naira invested) was 2.29, indicating that for every ₦1 invested in rice production in the study area, a profit of ₦1.29 kobo was made.

The stochastic frontier production function was estimated for technical, allocative and economic efficiency. It was observed from the study that 64% of the farmers had technical efficiency (TE) of 0.61 and above while 39% of the farmers operate at less than 0.6 efficiency level. The mean technical efficiency for the farmers in the study area was 0.61. The farmer with the best practice had a technical efficiency of 0.85 while 0.32 was the TE for the least efficient farmer. This implies that on the average, output fall by 39% from the maximum possible level due to inefficiency. The mean allocative efficiency was 0.63. The result indicates that average lowland rice farmer in the state would enjoy cost saving of about 59% whileallocatively inefficient farmer will have an efficiency gain of 153% to attain the level of most efficient farmer.The mean economic efficiency was 0.39. The farmer with the best practice has an economic efficiency of 0.78 while 0.19 was for the least efficient farmers. This implies that on the average, output fall by 61% from the maximum possible level due to economic inefficiency. The constraints faced by rain-fedlowland rice farmers in the study area were ranked in order of priority and these include pest and disease infestation, flooding, lack of capital, shortage of labour, high cost of fertilizer and adulterated seed.

5.2 Conclusion

Based on the findings of this study, it can be concluded that rain-fed lowland rice production in the study area is profitable by returning ₦1.24 kobo to every ₦1.00 spent. Given that rice is an important staple food in Nigeria, any attempt to increase its

productivity would be a right step towards the resolution of food crisis and would also increase the country Gross Domestic Product (GDP).

Estimated mean technical efficiency was 0.63, allocative efficiency was 0.63 while economic efficiency was 0.37. It is evident here that, the rain-fed lowland rice production systems in the study area did not reach the frontier of production. Education, farming experience, extension contact and access to credit are major socio-economic determinant of technical, allocative and economic efficiency in lowland rice production. These factors tend to reduce inefficiencies as they are improved upon.The implication of the study is that technical and allocative efficiency in farm production among the farmers could be increased by 37 and 37%, respectively through better use of available resources given the current state of technology. This can be achieved through improved farmer-specificfactors.

5.3 Contribution of the Study to Knowledge

1. The study revealed that rain-fed lowland rice production in the study area is profitable with net farm income of ₦62,343/ha.

2. The study discovered pest and diseases (87.5%), flooding (80.7%), and inadequate capital (55.6%) as major constraints affecting rainfed lowland rice production which affect level of efficiency of the farmers in the study area.

3. It was discovered that rice farm were economically inefficient having a economic efficiency of (39%) in the study area.

5.4 Recommendations

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

i. Given the level of technical efficiency of rice production of 63% there is scope of increasing the efficiency. It is recommended that extension agent should teach the farmers the best practice to adopt and the right technology and techniques to use to achieve optimum efficiency.

ii. The most severe problems encountered in lowland rice production are pest and disease. This constraint constitutes serious impediments torice production and need to be addressed adequately before rice production can be improved in the study area. It is recommended that agro based industries and non-governmental organization should be encouraged by the local government to support research and production of improved rice seed variety that is resistance to diseases.

iii. Fertilizer is one of the inputs that positively and significantly influence rice production in the study area. Therefore, government should ensure timely and adequate supply of fertilizer to farmers through its e-wallet (GESS) programme at affordable prices in order to enhance the production of this crop.

iv. The study also indicated the crucial role of funds for rice production. It is therefore suggested that funds be made readily available to farmers as at when due. Farmers are generally poor and cannot possibly acquire even the common agro-chemicals like fertilizer and herbicides for their rice farms.

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ECONOMIC ANALYSIS OF RAIN-FED LOWLAND RICE PRODUCTION INSELECTED LOCAL GOVERNMENT AREAS, NIGER STATE.

Dear Respondent,

This questionnaire will be used by a student of Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University, Zaria. Please, respond or tick where necessary. All information will be treated with utmost confidentiality and will strictly be used for the purpose of research only. Thanks for your cooperation.

Instruction: Kindly tick (√) or fill in the blank spaces as appropriate

SECTION A: BACKGROUND INFORMATION OF THE FARMER

Questionnaire No……..….. Name of Respondent……

Village…… L.G.A……
Date……../……../2015.

SECTION B:SOCIO-ECONOMIC CHARACTERISTICS OF THE FARMER

1. Sex: Male ( ) Female ( )
2. Age of respondent (years): ……
3. Marital status: (a)Single ( ) (b) Married ( ) (c) Widow ( ) (d) Widower ( ) (e) Divorce ( )
4. Household size: ……
5. Family Size (All the number of the people depending on you for living)…….
6. (a) No of Adult Male ( ) (b) No of Adult female ( ) (c) Children >15yrs ( ) (d) Children <15yrs ( )
7. Highest level of Education:

(a) No Formal Education ( ) (b) Primary Education ( ) (c) Secondary Education ( ) (d) Tertiary Education ( ) (e) Quranic Education ( )

8. How long have you been in rice farming? (Years of experience)……..
9. Do you belong to any co-operative/Association? Yes ( ) No ( )
10. If yes, (Years of participation) ----------
11. What benefit did you derive as a member? ……..
12. What is your major source of capital for rice farming?

(a) Personal savings ( ) (b) credit (borrow) ( ) (c) Friends and family ( )
(d) Money Lenders (Borrow) ( ) (e) Association/Co-operative society ( )

13. If you borrow, what were the sources of the credit?

(a) Commercial bank ( ) (b) Bank of Agriculture ( ) (c) Cooperative Society ( ) (d) Money Lenders ( )
(e) Friends and Family ( ) (f) others (specify) …….

14. How much did you borrow to finance last production? (Fill for the source you indicated in the question above)

SOURCE OF LOAN	AMOUNT(₦)	INTEREST RATE (%)
Commercial Bank		
Bank of Agriculture		
Cooperative Societies		
Money Lenders		

Friends And Family		
Others (Specify)		

15. Have you been visited by an extension agent? Yes ( ) No ( )
16. If Yes, How many times in last one year? ……..
17. What activities did the agent teach you from the visit? .....
18. Of what benefit were the techniques learnt to you to the success of your farm? .....
19. Have you been trained on rice farming? Yes ( ) No ( )
20. If yes, which organization conducted the training? ……
21. Was the training beneficial to you?
    (a) Not beneficial ( ) (b) somehow beneficial ( ) (c) beneficial ( ) (d) very beneficial ( )
22. How many rice farm plots do you have? ..... Please indicate the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

23. How did you acquire your land? *(Please Tick below)*
(a) Inheritance……. (b) Lease …… (c) Borrowed……. (d)Purchased…….. (e) Gift…..

24. What does it cost to rent one Hectare of land per season in your village? ..... Naira

25. What is the quantity of seed you used?

Plot No	Quantity of Seed (Kg)	Cost (₦)
1		
2		
3		

26. What is the quantity and type of fertilizer you used?

Plot no.	Fertilizer type	Quantity (kg)	Cost (₦)
1			
2			
3			

27. What is the quantity and type of agrochemical used?

Plot No	Agrochemical type	Quantity(Litres)	Cost(₦)

1			
2			
3			

28. Please indicate the cost and type of labour for Land preparation

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

29. Please indicate the cost and type of labour for Planting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

30. Fertilizer Application

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

31. First Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost(₦)
1						
2						
3						

32. Second Weeding

Plot No	Hire Labour	Family Labour

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

33. Harvesting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

34. How much do you pay to transport rice output per bag? ……

35. rice output

Plot No	No. of output produced (Kg)	Total Qty sold (₦)	Price/Unit (₦)
1			
2			
3			

36. Information on other crops

Plot No	Types of crop grown	Number of output produced in (Kg)	Total Qty sold (₦)	Price/Unit	Total cost incurred (₦)	Profit (₦)
1						
2						
3						

37. Where do you sell your produce?

(a) At the Farm ( ) (b) Rural market ( ) (c) Urban market ( )

38. When do you sell your produce?

(a) Immediately after harvesting ( ) (b) Few months after harvest ( ) (c) Off season ( ) (g) what are the constraint faced and coping strategy used during the production of rice?

S/n	Constraints	Ranking according to severity 1=least severe, 2=moderately severe, 3= severe, 4= more	Coping Strategy

		severe, 5= most severe.	
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Thank you for your attention.