

**COMPARATIVE ECONOMIC ANALYSIS OF FARO-54 AND NERICA-1 RICE
PRODUCTION IN SELECTED LOCAL GOVERNMENT AREAS, NIGER
STATE, NIGERIA**

BY

**Aminu Rekiyet ABDULLAHI
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FACULTY OF AGRICULTURE
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ZARIA, KADUNA STATE
NIGERIA**

JANUARY, 2016

DECLARATION

I hereby declare that this dissertation titled “**Comparative Economic Analysis of Faro-54 and Nerica-1 Rice Production in Selected Local Government Areas, Niger State, Nigeria**” has been written by me and it is a record of my research work. No part of this dissertation has been presented in any previous application for another Degree or Diploma in this or any other institution. All borrowed information have been duly acknowledged in the text and a list of references provided.

Aminu Rekiyet ABDULLAHI
Student

Date

CERTIFICATION

This dissertation titled ‘**Comparative Economic Analysis of Faro-54 and Nerica-1 Rice Production in Selected Local Government Areas, Niger State, Nigeria**’, by Aminu Rekiyet ABDULLAH meets the regulations governing the award of the Degree of Master of Science in Agricultural Economics of the Ahmadu Bello University Zaria, and is approved for its contribution to knowledge and literary presentation.

Prof Z. Abdulsalam
Chairman, Supervisory Committee

Date

Prof M. G. Maianguwa
Member, Supervisory Committee

Date

Prof Z. Abdulsalam
Head of Department

Date

Prof K. Bala
Dean, School of Postgraduate Studies,
Ahmadu Bello University, Zaria.

Date

DEDICATION

I dedicated this dissertation to my lovely wife, Fati Abdullahi for her, moral support, encouragement and prayers. May Almighty ALLAH reward you with the best of HIS Favours (Amen)

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ABSTRACT

The study evaluates comparative economic analysis of FARO-54 and NERICA-1 rice production in Niger State, Nigeria. Primary data were collected using structured questionnaire, administered to 174 respondents for both FARO-54 and NERICA-1 farmers during the 2014 cropping season. Data collected were analyzed using descriptive statistics, farm budgeting analysis and stochastic frontier production function. Results of the study indicated that, the average age were 42 and 40 years for FARO-54 and NERICA-1 farmers respectively. The average household size for the two groups was 4 and 5 members per household for FARO-54 and NERICA-1 respectively. Majority 59% and 54% of FARO-54 and NERICA-1 farmers had between 11-20 years of farming experience respectively. The average farming experience for the two groups are 11 years. Majority 60% and 70% of FARO-54 and NERICA-1 rice farmers do not have formal education. The average farm size among FARO-54 and NERICA-1 farmers was 1.2 hectares and 0.8 hectares respectively. Majority of FARO-54 (87.4%) and NERICA-1 (92.5%) had no access to credit, majority of FARO-54 (82.2%) and NERICA-1 (86.8%) do not have access extension contact. However, majority of FARO-54 (88.5%) and NERICA-1 (76.4%) do not participate in any cooperative association in the study area. The total revenue (TR) for FARO-54 and NERICA-1 were ₦84,315.88/ha and ₦76,458.96/ha respectively while the total cost of production for FARO-54 and NERICA-1 was ₦78,447.12/ha and ₦61,483.04 respectively. The net farm income was therefore ₦84,315.88/ha and ₦76,458.96. The estimated mean technical efficiency for FARO-54 was 0.76 and NERICA-1 was 0.83. The mean allocative efficiency of FARO-54 farmers is 0.92 while the average allocative efficiency for NERICA-1 farmer is 0.86. The mean economic efficiency of FARO-54 farmers is 0.54 while the average economic efficiency for NERICA-1 farmer is 0.45. Finally, among the constraints identified in the study area, the majority of the rice farmers attested to the fact that pest and diseases, poor market price, inadequate capital and poor transportation. It could be concluded that the two production systems are profitable; however, NERICA-1 production was more profitable with higher rate of returns to investment. It is recommended that agro based industries and non-governmental organization should be encouraged by the local government to support research and production of rice for commercial purposes

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Nigeria is the largest rice producing country in the West African region (WARDA, 2002). Rice production in Nigeria rose gradually over the years to surpass major rice producing countries like Cote d'Ivoire, and Sierra Leone (WARDA, 2002). In 2002, Nigeria accounted for nearly 44% of the total rice output and 57% of the total rice producing area in West Africa. 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. The principal factors driving increased rice production in Nigeria was population growth and urbanization (WARDA, 2002).

In response to the prevailing rice supply deficit situation in the country, successive Nigerian governments have intervened in the rice sub-sector, by increasing tariff on rice importation so that local production could be encouraged. This was expected to widen the home market for the nation's local rice (Bamidele *et al.*, 2010). The Federal government of Nigeria also established research institutions and programmes geared toward increasing rice production. These included the National Cereals Research Institute (NCRI) at Badeggi in 1974, the National Seed Council (NASC) at Sheda, Abuja in 1975, and Operation Feed the Nation (OFN) programme in 1976, the River Basin Development Authorities (RBDAs) in 1977, the Agricultural Development Projects (ADP) in 1975, the Structural Adjustment Programme (SAP) in 1986 and the Presidential Initiative on increased rice production, processing and export in 2002 (Bamidele *et al.*, 2010). These agricultural programmes have common objectives of increasing production and productivity in the rice sub-sector, thereby achieving food

self-sufficiency. The Nigerian government has also embarked on an ambitious plan to make the country self-sufficient in rice production by 2015 under its current Agricultural Transformation Agenda (ATA) (Adesina 2012). This initiative is in response to the perceived threat of larger volume of milled rice imports into Nigeria since the 1990's. The potential for Nigeria to succeed in its quest to become self-sufficient in rice will depend a lot on how well the government can maintain its policies and invest over the long term certainly, there is a high level of political will and leadership to change attitudes towards transforming the rice sector and the rural economy more broadly. These factors are important in facing the many skeptics among the record of well-intentioned but failed efforts in the past. Another positive sign is the unprecedented attention being given to improving the post-harvest segment of the rice value chain in order to improve quality and compete more effectively with imports (Adesina 2012).The study compared two varieties of rice production in the study area namely: FARO-54 and NERICA-1 rice system in terms of their economic efficiency and their level of profitability.

1.2 Problem Statement

Rice is a staple food in many African countries. Over the years, the crop has witnessed a steady increase in demand and this accounted for its important place in the strategic food security planning of many countries (Akande, 2011). Since mid- 1970s, rice consumption in Nigeria has risen tremendously at about 10 percent per annum due to changing consumer preferences (Akande, 2011). However annual domestic production of (4 million metric tonnes) has never been able to meet the annual demand of (5 million metric tonnes leading to considerable imports which today stand at about 1 million metric tonnes yearly(Akande, 20011). The imports are procured in the world

market, with Nigeria spending annually over 360 billion Naira on rice imports alone Federal Ministry of Agriculture and Rural Development (FMARD, 2013).

In an attempt to address the nation's rice demand of (5 million metric tones) and supply gap of 1 million metric tones) the Nigerian government introduced some public policies and programmes to boost rice production. However, these public policies have neither been consistent nor appropriate and domestic production has continued to lag behind demand (Akande, 2011) For instance, from 1986 to mid-1990s, import of rice was illegal. In 1995, import of rice was allowed at 100 percent tariff, and in 1996, the tariff was reduced to 50 percent, but was later increased to 85 percent in 2001 (Akpokodjeet *al.*, 2001). Even during rice import ban period. Nigeria was still importing several thousand tonnes of rice annually through illegal trade. Notwithstanding, the various public policy measures, domestic rice production has not increased sufficiently to meet the increase in demand (Akpokodjeet *al.*, 2001). The inability of Nigeria's rice sub-sector to meet the domestic demand could be attributed to low productivity, inefficiency in the use of resources, disincentives from the macro-economic environment, and production by small -scale farmers, who use traditional technologies (FMARD., 2012).

Also maximum yield are not 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.

This study, therefore, seeks to answer the following research questions.

- i. What are the socio-economic characteristics of FARO-54 and NERICA-1 farmers in the study area?
- ii. What are the costs and return of FARO-54 and NERICA-1 production?
- iii. What is the technical, allocative and economic efficiencies of FARO-54 and NERICA-1 production?
- iv. What are the constraints associated with the production of FARO-54 and NERICA-1?

1.3 Objective of the Study

The broad objective of the study was to comparative economic analysis of FARO-54 and NERICA-1 production in Niger State of Nigeria. The specific objectives were to:

- i. describe the socio-economic characteristics of FARO-54 and NERICA-1 farmers;
- ii. determine the costs and return of FARO-54 with NERICA-1 production in the area;
- iii. estimate the technical, allocative and economic efficiencies in FARO-54 and NERICA-1;
- iv. describe the constraints associated with FARO-54 and NERICA-1 farmers in the study area.

1.4 Justification of the Study

In an economy where resources are scarce and opportunities are lacking the efficiency of resource are 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, costs and returns and technical relationship between inputs and outputs, in rice production, in the study area.

The information from this study will also contribute to knowledge relevant to policy formulation that will create enabling environment for sustainable rice production in Niger state. Nigeria. This will help farmers and other agencies by identifying problem areas for improvements. Similarly, the study will be useful to the government of Niger State, as a basis for rational and empirical policy formulation for rice production in the State. Finally, it is hoped that this work will be of assistance to researchers who will identify other areas for further studies on rice farming

1.5 Research Hypotheses

The *hypotheses* tested in this study were:

- i. There is no significant difference in technical efficiencies of FARO-54 and NERICA-1 production.
- ii. There is no significant difference in profitability between FARO-54 and NERICA-1 production

CHAPTER TWO

LITERATURE REVIEW

2.1 Brief Description of FARO-54 and NERICA-1 Rice

FARO-54 and NERICA-1, are improved varieties of rice which originated from West African Rice Development Association (WARDA). They were developed and released by the National Cereals Research Institute (NCRI), Badeggi, to farmers in 2003. Both of them are grown in upland areas. The traditional method for cultivating these varieties is by drilling the field and sowing the seed. Upland rice cultivation is well suited to countries and regions with low labour cost and rainfall.

FARO-54 has tillering capacity of 4-8 with full panicle exertion. Its days to maturity last between 100-105 days and the grain type is A, which means, it is a long grain type. FARO -55, popularly known as NERICA-1 has tillering capacity of 4-6 with full panicle exertion. Its days to maturity are also between 100-105 days and the grain type is B which means it is a medium grain type (National Centre for Genetic Resources and Biotechnology Ibadan.) (NACGRAB 2010).

2.2 Distinguishing Characteristics of FARO-54 and NERICA-1 Varieties

FARO-54 was discovered from the crosses of IRAT 104 and ITA 257 and originated from WARDA, it is an upland rice with plant height of 110 – 130 cm, its tillering capacity is between 4 – 8 plants. The stem base is green in colour with long leaves. The leaf sheath is also green with full panicle exertion. It has drooping flag leaf. The Husk colour of unripe seed is straw, and apiculus colour of unripe seed is also straw. It has a colourless stigma with awnless awns and medium ligule. It has maturity days of 100 – 105 with potential yields of 2.5 – 3.0 tonnes per hectares. The grain type is A

which means it has a long grain type. It was developed and release by National Cereals Research Institute (NCRI), Badeggi in 2003 (NCRI, 2010).

FARO-55(NERICA-1) was also discovered from the crosses of WAB 56 – 104 and C. G 14 and originated from WARDA. It is an upland rice with plant height of 110 – 120 cm. It has tillering capacity of 4 – 6/ plant. The stem base is light purple in colour with long leaves. The leaf sheath is purple in colour with full panicle exertion. It has an erect flag leaf. The husk colour unripe to purple stigma with awnless awns and short ligule. It has maturity days of 95 – 100 with potential yields of 2.0 – 3.0 tones per hectares. The grain type is B which means that, it has a medium grain types.It was developed and released by National Cereals Research Institute (NCRI) Badeggi in 2003 (NCRI, 2010).

2.3 World Production and International Rice Trade

According to FAO (2010), estimates the average annual world production of rice during 1999-2003 was 593 million tonnes of paddy (unhusked grain) from 153 million hectares. Asia accounts for 90% of the world production and area (FAO, 2010). During 1999-2003, tropical Africa produced on average 11.9 million tonnes of paddy (2% of world production) annually on 7.7 million hectares (5% of world area). These data include African rice (*OryzaglaberrimaSteud.*), which occupies less than 20% of the rice area in West Africa. The main producers are Nigeria (3.5 million tonnes from 2.9 million hectares), Madagascar (2.6 million tonnes from 1.2 million hectares) and Cote d'Ivoire (1.1 million tonnes from 0.5 million hectares).

The annual world paddy production increased steadily from 241 million tonnes/year in 1961-1965 to 593 million tonnes/year in 1999-2003, and the harvested area from 121 to 153 million hectares. (Brink and Belay, 2006) In the same period, the annual paddy production in tropical Africa increased from 3.6 to 11.9 million tonnes/year, and the harvested area from 2.8 to 7.7 million hectares (Brink and Belay 2006). Only 5% of the world's rice production enters into international trade. Thailand is the world's largest exporter of milled rice (26% of world trade during 1998-2002) followed by Vietnam, India, the United States, China and Pakistan(Brink and Belay, 2006). All countries in tropical Africa are net importers of milled rice and during 1998-2002 an average of 4.8 million tonnes of milled rice was imported annually. This means that more than one third of the rice consumption in tropical Africa is satisfied through imports. The main rice importers are Nigeria, Senegal and Cote d'Ivoire. The annual milled rice consumption in tropical Africa varies tremendously between 0.15 kilogram and 95 kilogram with an average of about 18 kilogram for the period 1998-2002 (Brink and Belay 2006)

2.4 Rice Production Trend in Nigeria

Rice production started in Nigeria with the low-yielding indigenous red grain specie *Oryzaglaberrima* that was widely grown in the Niger Delta area (Hard castle, 1959). The high-yielding white grain, *Oryzasativa*L. was introduced at about 1890 and by 1960, accounted for more than 60% of the rice grown in the country(Brink and Belay, 2006). Today, rice is cultivated in virtually all the agro-ecological zones in Nigeria, but on a relatively small scale. For example, in 2000, out of about 25 million hectares of land cultivated to various food crops, only about 6.7% was under rice (PCU, 2001). The trend in production shows that rice output increased between 1961-2010,

from 207,200 tonnes to 3,885,154 tons. However, average yield increased between 1961 and 1990 from 1.147 tons per hectare to 2.090 tons per hectare, but fell thereafter, between 1991 – 2010 from 1.783 tons per hectare to 1.66 tonnes per hectare (FAO, 2012) (Table 1).

Table 2.1: Rice Production Trends in Nigeria (1961-2010).

<u>Period</u>	<u>Average area cultivated ha</u>	<u>Average output</u>	<u>Average yield (tons/ha)</u>
1961-1965	179,200	207,200	1.147
1966-1970	234,000	321,000	1.360
1971-1975	288,800	470,200	1.670
1976-1980	332,000	596,200	1.710
1981-1985	630,000	1,300,200	2.063
1986-1990	1,06,200	2,216,064	2.090
1991-1995	1,678,000	2,979,600	1.783
1996-2000	1,742,582	3,011,028	1.733
2001-2005	2,271,200	3,139,400	1.38
2006-2010	2,365,502	3,885,154	1.66

Source: PCU, 2010, FAO STAT 2012, AND FMARD, Nigeria, 2013

2.5 Resource Productivity and Efficiency in Agriculture

2.5.1 Agricultural Productivity

Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs. Its measures are subdivided into partial, multifactor and total. Partial factor productivity is the amount of output per unit of a particular input. It only considers a single input in the ratio. For example, it uses yields of crops to determine the productivity of field crops. Literature indicates that it is easy to compute as it requires limited data, but it can be hard to identify factors that cause productivity of field crops to change (Liebenberg *et al*, 2010)..

Zepeda (2001) examined agricultural investment and productivity in the context of developing countries. The study used number of models of production growth (index numbers or growth accounting techniques, econometric estimation of production relationships and nonparametric approaches) to measure the change in output, to identify the relative contribution of different inputs to output growth and to identify the

Solow residual or output growth not due to increases in inputs. Results show a relatively weak relationship between physical capital and growth, as compared to investment in technology and human capital. Other factors found to be stimulants to growth included; the policy environment, political stability and natural resources degradation. Various authors support the findings of Zepeda (2001).

Fulginitiet *al* (1998) examined changes in agricultural productivity in eighteen developing countries over the period 1961–1985. The study used a nonparametric, output based malmquist index and a parametric variable coefficient Cobb-Douglas production function to examine, whether declining agricultural productivity in less developed countries was due to use of inputs. Econometric analysis indicated that most output growth was imputed to commercial inputs like machinery and fertilizers. Chavas (2001) analyzed international agricultural productivity using Non-parametric methods to estimate productivity indices. The analysis used FAO annual data on agricultural inputs and outputs for twelve developing countries between 1960 and 1994.

Technical efficiency indices for time series analysis results suggested that in general the technology of the early 1990s was similar to the one in the early 1960s. This showed that the improvement in agricultural production was not because of technology but because of other inputs such as fertilizer and pesticides. The general empirical results indicated only weak evidence of agricultural technical change and productivity growth both over time and across countries. There was much evidence of strong productivity growth in agriculture over the last few decades corresponding to changes in inputs

2.5.2 Concept of Efficiency

The decrease output of food production over the years may not only be connected with deviations of farmer's practices from technical recommendations, but also with the use of resources at sub-optimal levels which ultimately leads to technical and allocative inefficiency (Coelli and Battese, 1996). An underlying premise behind much of research in efficiency is that farmers are not making efficient use of existing technology, then efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Belbase and Grabowski, 1985; Huynh, 2008; Adeleke, 2008). Production efficiency has two components: technical and allocative efficiency. Technical efficiency is the extent to which the maximum possible output is achieved from a given combination of inputs or the ability of a firm to obtain maximum output from a given set of input. Allocative efficiency is the ability of a firm to use inputs in optimal proportions given their respective prices and production technology (Coelliet *al.*, 1998). Technical inefficiency occurs when the level of production for the firm is less than the frontier output and it increases when timing and methods of application of production inputs are mismanaged. Allocative inefficiency increases when the ratio of marginal products of input is not the same to the ratio of market prices (Bashkh, 2007).

2.6 The Stochastic Frontier Production Function

The stochastic production frontier is motivated by the idea that deviations from the production 'frontier' may not be entirely under the control of the production unit under study (Aigner *et al.*, 1977; Battese and Corra, 1977 and Meeusen and Van Den Broeck, 1977). These models allow for technical inefficiency and also acknowledge the fact that random shocks outside the control of producers can affect output. They account

for measurement error and other factors such as weather, luck and disease on the value of the output variable, together with the combined effects of unspecified input variables in the production function. The main virtue of the stochastic frontier model is that, at least in principle, these effects can be separated from the contribution in variation of technical efficiency. This approach is closer to the theoretical production function which gives the maximum output from a given input mix, than the average production function and is more realistic than the deterministic frontiers of Farrell (1957) and Aigner and Chu (1968) (Huynh, 2008; Adeleke. 2008).

The stochastic frontier production approach attempts to distinguish the effects of stochastic noise from the effects of inefficiency. Addressing the stochastic noise problem associated with the deterministic frontier, and statistical hypothesis testing are the main strengths of the stochastic frontier approach. Assumptions regarding the parametric functional form for the frontier technology and the distributional assumptions for the technical inefficiency term are its major drawbacks. Coelli (1995) provided a review and critique of the recent developments and applications of frontier techniques of efficiency measurement. Comprehensive reviews of the various stochastic frontier functions and econometric estimation of frontiers are provided also by Forsundet *al.* (1980), Schridt(1986), Baver(1990) Battese (1991), Battese (1992) and Brevo-Ureta and Pinheiro (1993).

Most empirical applications of stochastic frontiers in agriculture have investigated the sources of farmer technical inefficiency using a two-stage approach (Tadesse and Krishnamoorthy, 1997). The first stage of this method estimates a stochastic frontier by maximum likelihood techniques and calculates the technical efficiency for each farm

under the assumption that these inefficiency effects are identically distributed. It ignores the fact that the technical inefficiency is a function of farm-specific variables. Once technical inefficiency is estimated, it is further regressed in the second stage on a set of farm-specific factors that may explain differences in technical inefficiency among farms using Ordinary Least Squares (OLS) method. The OLS results in the second step contradict the assumption of identically distributed inefficiency effects in the stochastic frontier model, since the technical inefficiency, that is, the dependent variable is one sided (Kumbhakar *et al.*, 1991). Thus, in the second stage, the estimated technical inefficiency effects are modelled as a function of some farm-specific characteristics which implies that inefficiency effects are not identically distributed, unless the coefficients of the farm-specific factors are simultaneously equal to zero (Coelli *et al.*, 1998). The two-stage approach, using a stochastic frontier, has been applied by Kalirajan (1981), Pitt and Lee (1981), Coelli (1995), Sharma *et al.* (1999), Nchare (2007), Lahu and Kuri (2011) for cross sectional data.

The problems of this two-stage method can be addressed using a one-stage formulation. This specifies the technical inefficiency effects (Kumbhakar *et al.*, 1991) and estimates the stochastic frontier and the inefficiency effects simultaneously, given appropriate distributional assumptions (Battese and Coelli, 1995). The simultaneous estimation of the stochastic production frontiers and models of technical inefficiency using maximum likelihood techniques has been proposed by Kumbhakar *et al.* (1991), Reifschneider and Stevenson (1991), Huang and Lui (1994) and Battese and Coelli (1995). This one-stage approach is statistically consistent and leads to more efficient inference with respect to the parameters (Coelli and Battese, 1996). The approach has been applied empirically by among others, Kumbhakar *et al.* (1991), Coelli and Battese (1996), Coelli (1996),

Ajibefunet *al.* (1996), Battese and Broca (1997), Seyoumet *al.* (1998) and Amaza and Maurice (2005).

2.7 Empirical Application of Stochastic Frontier Production Function

The stochastic frontier production function has been applied in a considerable number of empirical studies in the field of Agriculture: Bagi(1982) used stochastic frontier Cobb-Douglas production function model to determine whether there is significance difference in the technical efficiencies of small, large and mixed enterprise farms in West Tennessee. His finding indicated that variability of farm effect was highly significant and the mean technical efficiency of mixed enterprise (0.76) was smaller than that of crop farms (0.85). Rola and Quintana-Adejandrino (1993) used a Cobb-Douglas stochastic frontier production function to estimate the technical efficiencies in selected regions of the Philippines. The estimated mean technical efficiencies were found to be 0.72, 0.65 and 0.57 for irrigated, rain fed and upland environments respectively, Seyoumet *al.* (1998) investigated the technical efficiency of two samples of maize producers in Eastern Ethiopia, one involving farmers within Sasakawa Global 2000 project and other involving farmers outside the project. The Cobb-Douglas stochastic frontier production function indicated that those in the Sasakawa Global 2000 project were more technically efficient than those outside the project, relative to their respective technologies (0.94 and 0.79 respectively).

2.8 Measurement of Profitability.

2.8.1 Gross Margin Analysis.

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

the farming enterprise as is the case with subsistence agriculture. Gross Margin (GM) by definition is the difference between the gross farm income (GFI) and the total variable cost (TVC), expressed as:

$$GM = GFI - TVC \text{ (Olukosi and Erhabor, 2005).}$$

Gross farm income (GFI)

The gross farm income also called total value of production is the total physical product multiplied by the unit price of the product. Gross farm income is the sum of the total value of products from each hectare of land farmed in a given season or year. If a farmer owns both crop and livestock, the gross farm income is the sum of the total value of products from both the crop and livestock enterprises (Olukosi and Erhabor, 2005).

Total Variable Cost

Total variable cost of production: is the sum of operating costs. This excludes fixed cost, family and operators labour and management. These elements are excluded here because the farm and family are closely associated in a traditional setting.

CHAPTER THREE

METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Niger State of Nigeria. The State is in the northern part of Nigeria and is located between latitudes 8°22'N and 11°30'E and longitudes 3°30'N and 7°20'E (NGADP 2003). It covers a land area of 74,244 square kilometres which is about 8% of the country's land mass. The state had an estimated population in 2006 of 3,950,249 (NPC, 2006), and based on projections of population growth rate of 3% per annum, the population as at 2014 was 4,898,309.

The State is bounded in the North by Zamfara State, in the north-west by Kebbi State in the South by Kogi State, in the South-West by Kwara State, in the North-East by Kaduna State and in the south-east by the Federal Capital Territory. 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 1000 mm and mean temperature of 33.5°C (NGADP, 2003).

The State is characterized by Guinea Savanna vegetation with the tree like sheabuter and locust beans (NGADP, 2003). More than 80% of the population is engaged in agricultural production activities (NGADP, 2003). The crops grown include rice, maize, ground-nut, cassava, sorghum, cotton, cowpea, pigeonpea, soyabean and yam. Livestock kept include cows, goat, sheep poultry and fish. Niger State is also popular for its brass work, particularly in Bida, and for pottery, fishery, weaving and several cottage industries which can be found throughout the State. There are 3 prominent ethnic group in the state, namely, Nupe, Gbagi (Gwari) and Hausa. Other ethnic groups include Kamberi, Kamuku, Kakanda, Gade, Pangu and Ingwai (NGADP, 2003).

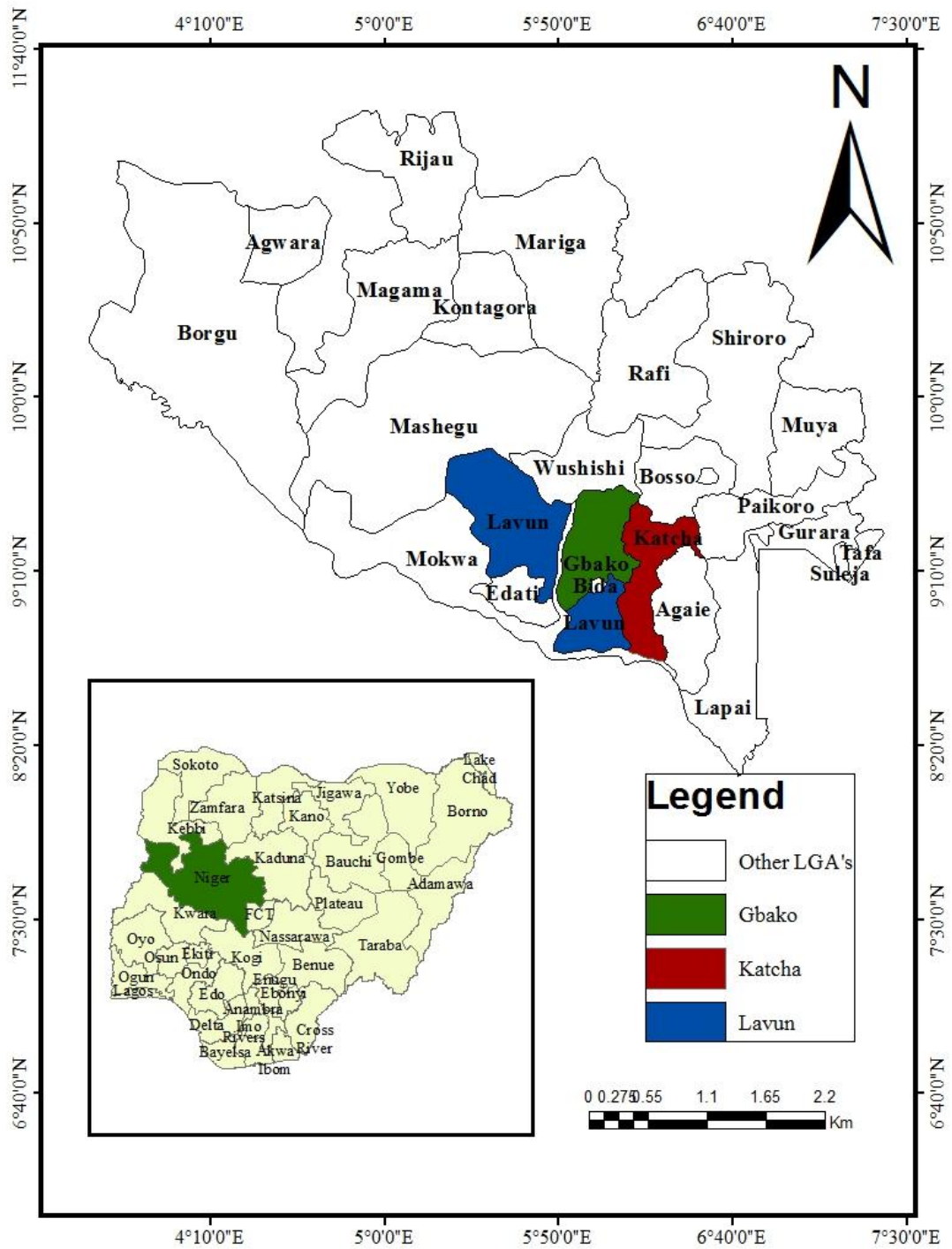


Figure 1: Map of Niger State showing the Study Area

3.2 Sample Size and Sampling Techniques

Multi-stage sampling technique was employed in the selection of farmers. A reconnaissance survey was conducted in Lavun, Katcha and Gbako. The first stage is the purposive selection of three local government areas in Niger State which are Lavun, Katcha and Gbako Local Government Areas. The purposive selection of these LGAs was due to their involvement in FARO-54 and NERICA-I production in the state. The second stage random selection of 20% of the farm sample size of FARO-54 and NERICA-1 farmers in each village. In all, a total of one hundred and seventy four farmers were randomly selected for both FARO-54 and NERICA-1 farmers in the study area (Table 2)

Table 3: Sampling size of the farmers selected in the study area.

LGA	Villages	FARO-54		NERICA-I	
		Sample frame	Sample Size 20%	Sample frame	Sample Size 20%
Lavun	EmitsuNdadan	132	26	156	31
	KudiWoro	115	23	102	20
	PatiNda	103	21	98	20
Katcha	Dibo	103	21	77	15
	Edo Itsu	97	19	79	16
	Kashe	71	14	115	23
Gbako	Ndagbachi	96	19	86	17
	Ajakpe	79	16	61	12
	Rogota	77	15	100	20
Total		873	174	830	174

3.3 Method of Data Collection

Primary data were used for this study. The primary data were collected using structured questionnaire. The data collected include:

- i. Socio-economic characteristics of the farmers such as age, farming experience, household size, educational level, farm size, extension contacts, amount of credit received, non-farm income and membership of cooperatives.
- ii. Production information on FARO-54 and NERICA-1, such as (i.) the quantity of the inputs used and their prices. (ii.) quantity of output produced and their prices.

These inputs are farm size, labour, fertilizers and agro-chemicals. And

- iii. The constraints associated with FARO-54 and NERICA-1 production..

3.4 Analytical Techniques

The analytical tools that were used to achieve the objectives of this study were descriptive statistics, gross margin analysis, t - Test and stochastic frontier production function.

3.4.1 Descriptive statistics

Percentages, means, frequency distributions, were used to achieve objectives (i) and (iv) of the study.

3.4.2 Gross margin analysis

Gross margin (GM) analysis were used to achieve objective(ii) of the study. The tool was used to estimate the costs and return in FARO-54 and NERICA-1 production. The total variable cost and total revenue was estimated. The difference between the two is the gross margin (GM). The gross margin analysis was used based on the assumption that fixed costs in small scale farming are negligible (Olukosi and Erhabor, 2006).

Gross margin wascalculated as:

$$GM = TR - TVC \dots\dots\dots (1)$$

Where:

GM = Gross margin (₦/ha)

TR = Total revenue (₦/ha)

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

3.4.3 t – Test Statistics

The t-test was used to achieve hypotheses i and ii and is expressed as follows:-

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\frac{\sqrt{S_1^2 + S_2^2}}{n_1 + n_2}}$$

t = Where the calculated t-test value

\bar{X}_1 = Mean profit of Faro-54 farmers

\bar{X}_2 = Mean profit Nerica-1

S_1^2 = Standard deviation of the profit of Faro-54

S_2^2 = Standard deviation of the profit Nerica-1

n_1 = Number of farmers after the adoption of Faro-54 and Nerica-1

n_2 = Number of farmers before the adoption of Faro-54 and Nerica-1

3.4.4 The stochastic frontier production function

The Cobb-Douglas functional form of the stochastic frontier production function was used to achieve objective (iii) of the study.

The stochastic frontier production function has the advantage of allowing simultaneous estimation of individual technical efficiency of the farmer as well as identifying determinants of technical efficiency (Battese and Coelli, 1977). The Cobb-douglas is commonly used in the estimation of the stochastic frontier production function because a logarithmic transformation provides a model which is linear in the logarithms of the inputs, hence the Cobb-Douglas form is very easy to estimate.. The Cob-Douglas stochastic frontier production function is expressed as:

$$\ln Y_1 = a_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + v_1 - u_1$$

Where:

\ln = The natural logarithm

Y = yield(kg/ha) of FARO-54 and NERICA-1

a_0 = Intercept (constant term)

$a_1 - a_6$ = Regression coefficients to be estimated.

X_1 = Farm size (ha)

X_2 = Seed (kg)

X_3 = Labour (man-hour)

X_4 = Fertilizer (kg)

X_5 = Herbicides (litres)

X_6 = Other capital such as money used for plough(₦)

V_i = Error term not under the control of farmers

U_i = Error term under the control of farmers (technical inefficiency)

The determinants of technical efficiency were modeled in terms of the socio-economic factors that were assumed to affect the technical efficiency of production of farmers.

The model to identify determinants of efficiency is expressed as:

$$U_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + e_i$$

Where:

U_1 = Technical efficiency

β_0 = Constant

$\beta_1 - \beta_8$ = Regression coefficients

X_1	=	Age (years)
X_2	=	Householdsize (Number of persons }
X_3	=	Farming experience (years)
X_4	=	Educational level (years)
X_5	=	Farm size (ha)
X_6	=	Extension visits (number of times each farmer had extension contact in a year)
X_7	=	Membership of cooperatives (years)
X_8	=	Membership of association
e_i	=	Error term

Finally, Economic Efficiency (EE) was estimated as the product of technical efficiency (TE) and allocative efficiency (AE).

Economic Efficiency = Technical Efficiency × Allocative Efficiency

The estimates for all the parameters of the stochastic frontier function and the inefficiency model were simultaneously obtained by the maximum likelihood estimate method using the program FRONTIER version 4.1 (Coelli, 1996).

The technical efficiency of an individual farm is defined in terms of the ratio of the observed output (Y_i) to the corresponding frontier output (Y_i^*), given the available technology, conditional on the level of input used by the farm. Hence the technical efficiency of farm i is expressed as follows:

Technical efficiency = $Y_i/Y_i^* = f(X_i, \beta) \exp(V_i - U_i) / f(X_i, \beta) \exp(V_i) = \exp(-U_i)$. This is obtained from the result of the FRONTIER 4.1 (Coelli, 2000). Based on the individual

farm's technical efficiency, the mean technical efficiency for the sample is obtained (Yao and Liu, 2000).

3.5 Definition and Measurement of Variables.

3.5.1. Age: This refers to the number of years from birth of the respondent to the time of data collection. It is measured in years. This variable is expected to be negatively related with technical efficiency, the reason is that, the older a farmer is, the fewer the number of farm practices he adopts, hence, lead to reduction in the level of technical efficiency.

3.5.2. Farming experience: This was defined as the number of years the farmer has been actively engaged in rice production. It is measured in years. Farming experience is expected to be positively related with technical efficiency, the reason is that, the more a farmer acquired experiences in farming practices, the more the increase in the level of technical efficiency

3.5.3. Householdsize: This was defined as the number of people in the Household which includes the household heads, wives, children, relatives and dependents. It is measured in numbers of persons in the household. Household is expected to be negatively related with technical efficiency, the reason is that, the larger the family size, the fewer it adopts or accepts innovations or new farm practices. Also in larger family, financial resources may not go far enough to purchase modern inputs after the other commitments of the family have been taken care of, therefore, bringing about reduction in the level of technical efficiency.

3.5.4. Educational level: This was defined by the number of years spent in a formal school. It is measured in years of schooling. Education is expected to be positively

related with technical efficiency, the reason is that, the higher the level of education of a farmer the more receptive to new technologies and innovations which will consequently lead to higher level in technical efficiency

3.5.5. Amount of Credit: It was defined as the amount of credit obtained from both formal and informal sources. It is measure in Naira. Amount of credit is expected to be positively related with technical efficiency, this is because, the more a farmer has an access to credit, the more is expected to enhance their timely acquisition of production inputs that would increase productive or technical efficiency.

3.5.6. Non-farm income: This is an annual non-farm income that a household heads or his family members earn from off-farm activities. It is measured in Naira. A non-farm income is expected to be positively related with technical efficiency, because it provides cash to buy food grains, non-food items and modern implements for household members that required for the expansion of farming activities thereby increasing technical efficiency. This was measured in Naira.

3.5.7. Extension contacts: It was defined as the number of times the respondents have had contacts with extension agents. It is measured in number of contact. Extension contact is expected to be positively related with technical efficiency, the reason is that, the greater the contact with the respondents, the broader mental horizons and the higher the level of aspiration and this enhance knowledge about techniques of production which increase technical efficiency.

3.5.8. Membership of Cooperative: Access to loans with these group depends on membership and is expected that access to credit should increase household ability to diversify more and have higher income and increased production .This variable is

expected to be positively related with technical efficiency because having access to credit through membership of cooperative to increase household ability and diversify production activities which contribute immensely to technical efficiency.

3.5.9 Farm size.It is included in the model to determine the extent to which variability in farm size affect output. It was measured in hectares. This is expected to be positively related with output. Therefore, a unit increase in farm size increases the output by a unit

3.5.10.Quantity of Seeds: This is included in the model to determine how variability in the quantity of seed will affect output. It was measured in kilogrammes.This is expected to be positively related with output. Therefore, a unit increase in seed increases the output by a unit

3.5.11. Labour:(man days):This consists of family and hired labour. It is included to determine how variability in labour affects output.. Labour was measured in man-days. This is expected to be positively related with output. Therefore, a unit increase in labour increases the output by a unit

3.5.12. Quantity of FertilizerIt is included in the model to determine the extent to which variability in quantity offertilizer affects output. It was measured in kilogrammes. This is expected to be positively related with output. Therefore, a unit increase in fertilizer increases the output by a unit

3.5.13. Quantity of Agro-chemicals It is included to determine the extent to which variability in agro-chemicals will affect output. It was measured in litres. This is expected to be positively related with output. Therefore, a unit increase in agrochemical increases the output by a unit

3.5.14. Output (Kg). This is the product harvested from farmers' field. It was measured in kilogrammes.

3.5.15 Farm Income: Is the total annual income earned from crop, fishing and livestock sale. Income is very crucial for purchase of agricultural inputs.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of FARO-54 and NERICA-1 farmers in Niger State

4.1.1 Age distribution of FARO-54 and NERICA-1 rice farmers

The results presented in Table 4.1 show the age distribution of FARO-54 and NERICA-1 rice farmers in Niger State. The results showed that about 45% and 49% of FARO-54 and NERICA-1 rice farmers respectively were within 30-39 years. The average ages were 42 and 40 years for FARO-54 and NERICA-1 rice farmers respectively. Implication of these findings is that large proportions of the respondents were adults and can adequately be regarded as active, agile, and physically disposed to farming activities. Age is very important in agricultural production activities because age has a significant influence on the decision making process of farmers with respect to adoption of improved farming technologies and other production-related decisions. This finding supports Olayeet *al.* (2009) and Yaaisheet *al.* (2009), that majority of the sampled farmers in their study were within the productive age of between 21 and 50 years. According to Asongwa, Ihemeje and Ezihe (2011) argued that age of farmers have a positive effect on technical inefficiency effects.

Table 4.1. Distribution of the respondents based on their age

Age (Years)	FARO-54	NERICA-1
21-29	39(22.4)	47(27.0)
30-39	79(45.4)	86(49.4)
40-49	39(22.4)	24(13.8)
50-59	11(6.3)	5(2.9)
60-69	6(3.4)	2(1.1)
Total	174(100)	174(100)
Mean	42	40
Minimum	24	22
Maximum	68	62

Figures in parentheses are percentages

4.1.2. Household size of the farmers

The results presented in Table 4.2 show that majority (60.9%) of FARO-54 rice farmers had household size between 1-5 members. Those that had household size of 1-5 members are among NERICA-1 farmers constitute 64.4%. The average household size for the two groups was 4 members for FARO-54 rice farmers while NERICA-1 rice farmers had average of 5 members per household. These results imply that household sizes among rice farmers is subsistence in nature. Size of the household may enhance labour availability that can be used for different agricultural activities (Oyewole, 2012). The significance of household size in agriculture hinges on the fact that the availability of labour for farm production, the total area cultivated to different crop enterprises, the amount of farm produce retained for domestic consumption, and the marketable surplus are all determined by the size of the farm household (Amaza, Joseph and Yakubu 2009).

However, Ahmed (2011) argued that large household size is associated with increased household consumption expenditure which reduces the money that could be used for production purposes. According to Okoruwa and Ogundele (2006) large family size does not necessarily translate to higher use of family labour because some of the young able bodied family member may prefer other jobs than farming. This finding is also in line with Mahabub and Jaim (2011) who reported that an average household size of male farmers' household was found to be 5 persons while 4 persons for the female farmers.

Table 4.2 Distribution of the respondents based on household size

Household Size	FARO-54	NERICA-1
1-5	106(60.9)	112(64.4)
6-10	53(30.5)	38(21.8)
11-15	10(5.7)	20(11.5)
16-20	5(2.9)	4(2.3)
Total	174(100)	174(100)
Mean	4	5
Minimum	2	3
Maximum	18	20

Figures in parentheses are percentages

4.1.3 Farming experience among FARO-54 and NERICA-1 rice farmers

The result presented in Table 4.3 show that the majority of 59.2% of FARO-54 rice farmers had farming experience between 11-20 years while the majority (53.6%) of NERICA-1 rice farmers had farming experience between 11-20 years. The average farming experience for FARO-54 and NERICA-1 farmers were 11 years for the two

groups. These results implied that farmers in the study area have sufficient experience in rice production. Farming experience of a farmer determines his ability to make effective farm management decisions, not only adhering to agronomic practices but also with respect to input combination or resource allocation. Farming experience is expected to influence farm production efficiencies because of accumulation of skills. This findings is in line with Ajani (2000) on productivity in food farming in northern area of Oyo State revealed that year of farming experience increased agricultural productivity among farming households in Nigeria. Sabo (2009) and Mohammed (2011) who reported that farmers had many years of practical experience on farming ranging from 11 to 20 years.

Table 4.3 Distribution of the respondents based on their farming experience

Farming Experience (years)	FARO-54	NERICA-1
1-10	56(32.2)	62(35.6)
11-20	103(59.2)	98(56.3)
21-30	13(7.5)	4(2.3)
31-40	2(1.1)	10(5.7)
Total	174(100)	174(100.0)
Mean	11	11
Minimum	1	1
Maximum	40	33

Figures in parentheses are percentages

4.1.4 Educational level of the respondents

The result presented in Table 4.4 shows the distribution of FARO-54 and NERICA-1 rice farmers by their educational level indicates that about 60% of FARO-54 rice

farmers do not have access to formal education, 17.3% had primary education, and 12.9% had secondary education. Those that had tertiary education constitute 6.3%. Among the NERICA-1 rice farmers 70.1% had no formal education, 12.1% had primary education, and 11.5% had secondary education. Only 6.3% had tertiary education. This implies that the educational level of the farmer in the study area is low. The level of farmers' education is believed to influence the use of improved technology in agriculture and hence, farm productivity. The level of education determines the level of opportunities available to improve livelihood strategies, enhance food security, and reduce the level of poverty. It affects the level of exposure to new ideas and managerial capacity in production and the perception of the household members on how to adopt and integrate innovations into the household's survival strategies. Oluwatayo, Sekumade and Adesoji (2008) observed that the more educated a farmer is, the more the chances that the farmer will adopt innovations than the uneducated ones. Mohammed, Omotosho and Falola (2009) noted that level of education is expected to influence farmers' adoption of agricultural innovations and decision on various aspects of farming. They also maintained that education is highly important for sustainable agricultural growth and development.

Table 4.4. Distribution of the respondents based on their level of education

Education	FARO-54	NERICA-1
No formal education	104(59.8)	122(70.1)
Primary education	30(17.2)	21(12.1)
Secondary education	19(10.9)	20(11.5)
Tertiary education	11(6.3)	11(6.3)
Total	174(100)	174(100.0)

Figures in parentheses are percentages

4.1.5 Distribution of respondents based on farm sizes

The result presented in Table 4.5 revealed that the majority (60.9%) of FARO-54 rice farmers had farm size of between 0.1-1.0 hectares while the majority (64.4%) of NERICA-1 rice farmers had farm size ranging from 0.1-1.0 hectares. The average farm size among FARO-54 and NERICA-1 rice farmers was 1.2 hectares and 0.8 hectares respectively. 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 impedent to agricultural mechanization through farm machineries like tractor will be difficult. Small farm sizes might be as a result of the fact that most of the farmers got their land through inheritance.

The implication of this finding is that rice farmers are predominantly small-scale farmers. These results also agreed with Ojuekaiye's (2001) classification of farms between 0.1 hectares and 5.9 hectares as small-scale. Small farm size is an impediment to agricultural mechanization because using farm machineries like tractors for farm operation will be underutilized.

Table 4.5 Distribution of the respondents based on their farm size

Farm Size	FARO-54	NERICA-1
0.1-1.0	106(60.9)	112(64.4)
1.1-2.0	50(28.7)	36(21.8)
2.1-3.0	10(5.7)	20(11.5)
3.1-4.0	5(2.9)	4(2.3)
4.1-5.0	3(1.7)	Nil
Total	174(100)	174(100)
Mean	1.2	0.8
Minimum	0.1	0.2
Maximum	5.0	3.8

Figures in parentheses are percentages

4.1.6 Distribution of respondents based on extension contact

The result presented in Table 4.6 revealed that the majority of FARO-54 rice farmers (82.2%) and NERICA-1 rice farmers (86.8%) farmers do not have access to extension contact in the study area. About 18% and 13% had contact ranging from 1-9 years for FARO-54 and NERICA-1 rice farmers respectively. The study revealed that the extension contact was very low in the area, as most of the respondent had never received an extension agent on their farms. Consequently, extension training and information on rice farming were received by only few farmers. The provision of agricultural extension can lead to significant yield increases. This findings is at variance with Oladele (2004) who reported that Nigeria has elaborate agricultural research and extension system, far reaching innovations that are capable of boosting farmer's agricultural production and Nigeria's economic development. Umar, Ndanitsa and Olaleye(2009) argued that higher extension contacts would increase adoption of improved farm production technologies. They further argued that the frequency of

extension contact is very essential as it guides the farmers on awareness to the adoption stage.

Table 4.6 Distribution of the respondents based on the number of extension visits

Number of extension visit	FARO-54	NERICA-1
No contact	143(82.2)	151(86.8)
1-3	28(16.1)	21(12.1)
4-6	2(1.1)	2(1.1)
7-9	1(0.6)	Nil
Total	174(100)	174(100)
Mean	1	1
Minimum	2	1
Maximum	9	6

Figures in parentheses are percentages

4.1.7 Years of membership of cooperatives

The results presented in Table 4.7 showed the distribution of the respondents by their numbers of years spent as a membership in cooperatives association. It was found that majority of FARO-54 (88.5%) and NERICA-1 rice farmers (76.4%) do not belong to any farmers' association. About 11% and 23% who belong to cooperative association ranges between 1-10 years for FARO-54 and 1-15 years for NERICA-1 rice farmers respectively. Average years of membership were 2 and 3 years for FARO-54 and NERICA-1 rice farmers respectively. Membership of a cooperative enables farmers to interact with other farmers, share their experiences and assist themselves. Interaction of farmers with other farmers is an avenue through which innovation diffusion can occur. The implication of these results is that most of the farmers in the study area do not enjoy the assumed benefits accrued to cooperative societies through pooling of

resources together for a better expansion and effective management of resources. This finding is at variance with Odebiyi (2010) that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually.

Table 4.7. Distribution of the respondents based on years of membership of cooperative

Years of membership	FARO-54	NERICA-1
No membership	154(88.5)	133(76.4)
1-5	18(10.3)	31(17.8)
6-10	2(1.1)	6(3.4)
11-15	Nil	4(2.3)
Total	174(100)	174(100)
Mean	2	3
Minimum	1	1
Maximum	10	14

Figures in parentheses are percentages

4.2 Costs and Return of FARO-54 with NERICA-1 production

The viability of an enterprise is indicated by the amount of profit realized per period of time. Profit is the difference between the monetary value of goods produced and the cost of the resources used in their production. The amount of revenue realized and operating cost of a business venture determines how much gain or loss the enterprise can achieve within a certain period. The profitability analysis which was used to achieve objective ii is shown in Table 4.8.

Cost of seed

The quantity of seed used were 282.22 kg/ha and 264.24 kg/ha for FARO-54 farmers and NERICA-1 with an average market price of ₦46 per kg was used and this

constitutes 16.5% and 19.8% of the total cost of production for FARO-54 and NERICA-1 rice respectively. The average cost of seed for FARO-54 farmers was ₦12, 982.12 while for NERICA-1 rice farmers was ₦12, 155.04. The cost of seed was not much different among the FARO-54 and NERICA-1 rice farmers. This is because they operate on small scale with no significant difference in farm size among the rice farmers. They also purchase their seeds from virtually the same source and price.

Cost of labour

Labour was sourced from both family and hired. This costs consisted of cost of land preparation, planting, fertilizer application, weeding, replacement 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. Consequently, the imputed cost of labour used for family labour equals the prevailing wage rate of hired labour. Hence, labour cost accounts for 50.1% for FARO-54 and 48.6% for NERICA-1 of the total cost of production. The average cost of labour (₦39, 292) for FARO-54 farmers was higher compared to the cost of labour (₦29, 856) by NERICA-1 farmers. However, it was not much different, which implies that both group of farmers incurred similar cost in terms of labour.

Cost of fertilizer

The quantity of fertilizer used were 230.21 kg/ha and 171.60 kg/ha for FARO-54 farmers and NERICA-1 with an average market price of ₦100 per kg was used and this constitutes 29.3% and 27.9% of the total cost of production for FARO-54 and NERICA-1 rice respectively. The average cost of fertilizer for FARO-54 farmers was ₦23, 021 while for NERICA-1 rice farmers was ₦17, 160. The cost of fertilizer was not much different among the FARO-54 and NERICA-1 rice farmers. This result implied that

FARO-54 farmers incurred more cost on fertilizer. This could be attributed to the difference in the types and quantity of fertilizer use.

Cost of agro-chemicals

The quantity of agrochemical used were 3.94 litres/ha and 2.89 litres/ha for FARO-54 and NERICA-1 with an average market price of ₦800 per litre was used and this constitutes 4.1% and 3.8% of the total cost of production for FARO-54 and NERICA-1 rice respectively. The average cost of agrochemical for FARO-54 farmers was ₦ 3, 152 while for NERICA-1 rice farmers was ₦ 2, 312. The cost of agrochemical was not much different among the FARO-54 and NERICA-1 rice production. This is because they operate on small scale with no significant difference in farm size among the rice farmers.

The results presented in Table 4.8 indicated that the total revenue (TR) for FARO-54 and NERICA-1 were ₦162,763.0/ha and ₦137,942.00/ha respectively while the total variable cost of production for FARO-54 and NERICA-1 was ₦78,447.12/ha and ₦61,483.04 respectively. The gross income was therefore ₦84,315.88/ha and ₦76,458.96. The average rate of returns on investment (return per naira invested) was 2.07 for FARO-54, indicating that for every ₦1 invested in FARO-54 production in the study area, a profit of ₦1, 07 kobo was made. Similarly, the average rate of returns on investment (return per naira invested) was 2.24 for NERICA-1, indicating that for every ₦1 invested in NERICA-1 production in the study area, a profit of ₦1. 24 kobo was made. Thus, it could be concluded that NERICA-1 production in the study area was more profitable than FARO-54 rice production.

4.8 Summary of the cost of inputs and returns of FARO-54 and NERICA-1 rice farmers

Cost/Return Items	Unit price (₦)	Average Quantity		Value (₦/ha)	
		FARO-54	NERICA-1	FARO-54	NERICA-1
(A) Variable Costs					
Seed (kg/ha)	46	282.2(16.5)	264.2(19.8)	12982.12	12155.04
Labour (man-day/ha)	400	98.23(50.1)	74.64(48.6)	39292.0	29856.00
Fertilizer(kg/ha)	100	230.2(29.3)	171.6(27.9)	23021.0	17160.00
Agro-chemical(litre/ha)	800	3.94(4.1)	2.89(3.8)	3152.00	2312.00
Total Variable Costs				78,447.12	61,483.04
(B) Total Yield returns	50	3255.26	2758.84	162,763.0	137,942.00
(C) Gross Margin /ha				84,315.88	76,458.96
(D) return per naira invested				2.07	2.24

Figures in parentheses are percentages contribution

Test of Hypothesis

The null hypothesis (H_0) which stated there is no significant difference in profitability between FARO-54 and NERICA-1 production in the study area was tested using the result of a t-test presented in Table 4.16. The null hypothesis which states that rice production is not profitable under FARO-54 and NERICA-1 system is rejected because the t-values for both systems are significant at 5% level of probability (Table 4.9). This further confirmed that both type of rice production are profitable.

Table 4.9 Test of difference in profit between FARO-54 and NERICA-1 production systems

Estimates	FARO-54		NERICA-1	
	Revenue	Total cost	Revenue	Total cost
Mean	162763	82047.12	162763.0	137942.0
St. Deviation	193140.50	39412.67	84795.82	33949.07
Coefficient of Variation	118.7	48.0	52.1	246.75
Profit	80715.88		24821.0	
St. error	2572.59		401.84	
t-value	96.09***		159.31***	

*** Significant at 1% level of probability

4.3 Efficiency of FARO – 54 and NERICA – 1 Rice Production Introduction

4.3.1 Technical efficiency of FARO-54 and NERICA-1 rice production

The result of Maximum Likelihood Estimates (MLE) for the production frontier is presented in Table 4.10. The estimated parameters of sigma-squared were 0.548 and 0.023 for FARO-54 and NERICA-1 rice production systems respectively. These values were significantly different from zero at $p < 0.01$ and $p < 0.05$ probability levels, indicating a good fit and the correctness of the specified distributional assumption of the composite error term. The generalized likelihood ratio statistics were 69.421 and 93.641 for FARO-54 and NERICA-1 respectively. This ratio exceeds the critical chi-square values at $p < 0.01$ level of significance. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The values of the gamma statistics 0.643 and 0.568 for FARO-54 and NERICA-1 respectively are attributable to farmers' inefficiency factors. The result revealed that

technical inefficiency effects were present in rice production under the two production systems in the study area.

However, the estimated coefficients of all the parameters of production function for FARO-54 and NERICA-1 (farm size, seed, labour, fertilizer and agrochemical) were statistically significant at $P < 0.01$ level of probability and hence play a major role in rice production in the study area. The average technical efficiency for FARO-54 farmers was 0.76 implying that, on the average, the respondents are able to obtain 76% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (23%) of increasing the efficiency, by adopting the technology and techniques used by the best FARO-54 farmer. Similarly, the average technical efficiency for NERICA-1 farmers was 0.83 implying that, on the average, the rice farmers are able to obtain 83% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (17%) of increasing the efficiency, by adopting the technology and techniques used by the best NERICA-1 farmer. Thus, it could be concluded that NERICA-1 farmers are more technically efficient than FARO-54 farmers.

The estimated coefficient for farm size for FARO-54 (0.851) and NERICA-1 (0.413) were positive and statistically significant ($p < 0.01$). This implies that as more land is being put to rice production the output level will increase. The results also implied that a unit increase in land size would increase FARO-54 and NERICA-1 output by 0.851 and 0.413 units respectively. This further implied that there is the possibility of increasing rice yield when more farm size is put into its production.

The estimated coefficient of labour for FARO-54 (0.202) was positive and significant ($p < 0.05$) while under NERICA-1 production the coefficient for labour (0.553) was

positive and significant at ($p < 0.01$). These show that labour exerts positive and significant influence on rice output under FARO-54 and NERICA-1 rice production. The implication of this is that rice output would increase if rice farmers in the study area increase the use of labour. The results also implied that a unit increase in the amount of labour would increase FARO-54 and NERICA-1 rice output by 0.202 and 0.553 units respectively.

The estimated coefficient of Seed (1.384) for FARO-54 and 0.8855 for NERICA-1 were positive and significant ($p < 0.01$). This implies that increase in the use of seed will lead to an increase in yield. The coefficient of fertilizer (-0.6384) was significant at ($p < 0.01$) under FARO-54 system; this can be attributed to wrong time, type and method of application of fertilizer. However, for NERICA-1 rice production, the coefficient (0.395) was positive and significant ($p < 0.01$). It showed that fertilizer has significant influence on rice production under NERICA-1 rice production. These results implied that if fertilizer increase by ($p < 0.01$) the level of FARO-54 will decrease the output by magnitude of 0.638 while increase in fertilizer by ($p < 0.01$) the level of NERICA-1 rice output would increase by 0.395. It implied that FARO-54 and NERICA-1 rice farmers complied with fertilizer type, time and method of application.

The results further showed that agrochemical was positively related to rice yield under FARO-54 at 0.1% level of significant, while under NERICA-1 it was negative at 0.1% level. The reason for the ineffectiveness of agrochemical on FARO-54 could be non-adherence to specification on mixing formula and wrong time of application.

Table 4.10: Estimates of Technical Efficiency model for the rice farmers

Variable	FARO-54	NERICA-1
Constant	3.426 (12.57***)	-0.413(-0.510)
Farm size	0.241 (4.76***)	0.044 (0.493)
Seed	1.384(14.41***)	0.859 (13.022***)
Labour	0.202 (2.13**)	0.553 (14.487***)
Fertilizer	0.638 (4.96***)	0.395 (3.586***)
Agrochemical	0.189 (1.81*)	-0.495 (-7.762***)
Sigma squared	0.548 (4.508***)	0.023 (1.756*)
Gamma	0.643 (58.39***)	0.568 (1.936*)
Mean efficiency	0.76	0.83

Figures in parentheses are t-ratio

*** P<0.01

** P<0.05

* P<0.1

Test of Hypotheses

As shown in Table 4.11, the generalized likelihood-ratio test at 1% level of significance rejects the first null hypothesis that there is no significant difference between inputs and output of rice production under FARO-54 and NERICA-1 production systems. This suggests that the variables in the Cobb-Douglas stochastic production model are not zero, hence has significant relationship. This implied that there is significant relationship between input and output in rice production under the two systems.

Table 4.11: Log-likelihood ratio test (LR)

Null hypotheses		$\ln(H_0)$	λ	*Critical value	Decision
$H_0: \beta_{ij} = 0$	FARO-54	-71.98	0.76	216.29	Reject H_0
	NERICA-1	-30.61	0.83	389.00	Reject H_0

* Critical value is significant at 1% level of probability

4.3.2. Maximum likelihood estimation of stochastic frontier cost function

The results of the cost function presented in Table 4.12 show that the estimated parameter of sigma (δ^2) were 0.43 for FARO-54 and 0.31 for FARO-54 and NERICA-1 rice production and these values were statistically significant at ($p < 0.01$) for both of them, which indicate a good fit and correctness of the specified composite error term distribution. The gamma estimates were 0.68 for FARO-54 and 0.43 for NERICA-1 and statistically significant ($p < 0.01$) meaning that 68% and 43% variation in total cost of FARO-54 and NERICA-1 production in the study area were due to inefficiency in the model.

However, the estimated coefficients of all the cost parameters of production function for FARO-54 and NERICA-1 (cost of farm size, cost of seed, and cost of labour, cost of fertilizer and cost of agrochemical) were statistically significant ($p < 0.01$) except cost of agrochemical which is not significant and hence play a major role in rice production in the study area. The average cost efficiency for FARO-54 farmers was 0.92 implying that, on the average, the farmers are able to obtain 92% of potential cost from a given mixture of production inputs. Similarly, the average cost efficiency for NERICA-1 farmers was 0.86 implying that, on the average, the respondents are able to obtain 86% of potential cost saving from a given mixture of production inputs. Thus, it could be

concluded that FARO-54 farmers are more allocatively efficient than NERICA-1 farmers in the study area.

The estimated coefficient (0.176) of farm size for FARO-54 and NERICA-1 (0.142) were positive and significant at ($p < 0.01$) and ($p < 0.1$) level respectively. The positive relationship of cost of farm size and cost allocation under FARO-54 and NERICA-1 rice production system indicated that an increase in cost of farm size would result to an increase in total cost of production for rice in the area. Also the estimated coefficients of farm size implied that if there is a unit increase in the cost of farm size the total cost of production would increase by 0.176 and 0.142 units for FARO-54 and NERICA-1 production systems respectively.

The cost of labour shows a positive and significant influence on the total cost of production. The coefficients for FARO-54 and NERICA-1 were significant at ($p < 0.01$). The implication of these results is that farmers' total cost of producing is increased as more labour is put into use. These show the importance of these variables in the allocation of costs in production.

The estimated coefficient of seed for FARO-54 (0.26) and NERICA-1 (0.23) were positive and significant at ($p < 0.01$). These implied that a rise in the cost of seed would result to 0.26 and 0.23 increase in the total cost of production under FARO-54 and NERICA-1 production system respectively. The result further revealed that an increase in the cost of seed by 1%, total cost of production would increase by 26% and 23% for FARO-54 and NERICA-1 production respectively.

The estimated coefficients of fertilizer cost under FARO-54 (0.24) and NERICA-1 (0.28) were positive and significant at ($p < 0.01$). The positive effect of cost of fertilizer implies that an increase in the cost of fertilizer would increase the total cost of production by 0.24 and 0.28 used for the production of FARO-54 and NERICA-1 respectively. With this, if the price of fertilizer increases, total cost of production would increase. It was further revealed that agro-chemicals were significant at ($p < 0.01$). Hence, the estimated coefficient for FARO-54 and NERICA-1 production were not statistically significant.

Table 4.12: Maximum Likelihood Estimation Results of Stochastic Frontier Cost Function

Variable	FARO-54	NERICA-1
Constant	0.415(0.45)	0.229(0.25)
Cost of farm size	0.176(3.21***)	0.142(1.815*)
Cost of labour	0.126(2.47***)	0.159(7.718***)
Cost of Seed	0.26(2.785***)	0.23(3.28***)
Cost of fertilizer	0.24(17.827***)	0.28(2.71***)
Cost of agrochemicals	0.014(1.597)	0.016(2.233)
Sigma squared	0.432 (6.864***)	0.314(2.880***)
Gamma	0.681 (196.7***)	0.432(152.99***)
Mean	0.92	0.86

Figures in parentheses are t-ratio

*** $P < 0.01$

** $P < 0.05$

* $P < 0.1$

4.3.3 Technical, Allocative and Economic Efficiency Indices

4.3.3.1 Frequency distribution of the technical efficiency in rice production

The results in Table 4.13 showed the frequency distribution of technical efficiency. The results reveal that technical efficiency index varied from one farmer to another and ranged from a minimum of 0.24 to a maximum of 0.99, with a mean of 0.76 and 0.83 for FARO-54 and NERICA-1 rice farmers respectively. The maximum efficiency for NERICA-1 farmers was 0.98 with minimum efficiency of 0.24. As shown in Table 4.12 majority of FARO-54 rice farmers (66.04%) and NERICA-1 farmers (60.36) had efficiency score between 0.9-1.0. Only 2.83% of the FARO-54 rice farmers and 6.40% of NERICA-1 rice farmers had efficiency scores less than 0.60. The implication of the results is that the average FARO-54 rice farmer requires 24%, that is, $\{1-(0.76/0.99) \times 100\}$ cost savings to attain the status of the most efficient FARO-54 rice farmer and 15%, that is, $\{1-(0.83/0.98) \times 100\}$ to attain the status of the most efficient NERICA-1 rice farmer. The least performing FARO-54 rice farmers would need 61% cost savings which is $\{1-(0.38/0.99) \times 100\}$ and NERICA-1 rice farmer would need 74% that is $\{1-(0.24/0.98) \times 100\}$ to become the most efficient farmer.

The fact that the technical efficiencies of all sampled rice farmers are less than 1, implies that no farmer reached the frontier of production. The mean efficiency of FARO-54 rice farmers implies that the shortfall in the output of rice is 24% while for NERICA-1 rice farmers is 14%. Thus, opportunity still exists for increasing farmers' productivity through increasing efficiency in the use of existing resources.

Table 4.13: Frequency Distribution of Technical Efficiency Estimates

Technical efficiency range	FARO-54	NERICA-1
0.21-0.30	Nil	1(1.90)
0.31-0.40	1(0.94)	Nil
0.41-0.50	Nil	1(0.90)
0.51-0.60	2(1.89)	4(3.60)
0.61-0.70	6(5.66)	5(4.50)
0.71-0.80	8(7.55)	13(11.71)
0.81-0.90	29(17.92)	20(18.02)
0.91-1.0	128(66.04)	67(60.36)
Total	174(100)	174(100)
Mean	0.76	0.83
Minimum	0.38	0.24
Maximum	0.99	0.98

Figures in parentheses are percentages

4.3.3.2 Allocative efficiency of rice farmers in the study area

As shown in Table 4.14, the mean allocative efficiency of FARO-54 is 0.92 while the maximum value is 0.96 and minimum is 0.54. On the other hand the average allocative efficiency for NERICA-1 rice is 0.86. The maximum and minimum were 0.94 and 0.21 respectively. These implied that if the average FARO-54 rice farmers in the study area were to achieve allocative efficiency of their most efficient counterpart, then the average farmer could realize 4.1% cost savings i.e. $\{1 - (0.92/0.96) \times 100\}$ and 14.6% cost saving i.e. $\{1 - (0.56/0.94) \times 100\}$ for FARO-54 and NERICA-1 rice farmers respectively.

For the most allocative inefficient farmer reveals cost savings of 47.9% $\{1 - (0.54/0.96) \times 100\}$ and 50.8% $\{1 - (0.52/0.94) \times 100\}$ for FARO-54 and NERICA-1 rice farmers respectively. Thus, in the short run, there is a scope of increasing rice allocative

efficiency by 8% for FARO-54 rice farmers and 14% for NERICA-1 rice farmers if farmers could adopt or practice the techniques and technologies used by the best allocative efficient farmer in the study area.

Table 4.14: Frequency Distribution of Allocative Efficiency Estimates

Allocative efficiency range	FARO-54	NERICA-1
0.21-0.30	12(11.32)	16(14.41)
0.31-0.40	3(2.82)	3(2.70)
0.41-0.50	8(7.55)	9(8.11)
0.51-0.60	9(8.49)	15(13.51)
0.61-0.70	31(29.25)	25(22.53)
0.71-0.80	34(32.08)	20(18.02)
0.81-0.90	7(6.60)	14(12.61)
0.91-1.0	2(1.89)	9(8.11)
Total	174(100)	174(100)
Mean	0.92	0.86
Minimum	0.22	0.21
Maximum	0.96	0.94

Figures in parentheses are percentages

4.3.3.3 Economic efficiency of rice farmers in the study area

The frequency distribution of the economic efficiency of rice farmers are presented in Table 4.15. The results showed that there was presence of economic inefficiency in rice production among the two categories of farmers in the study area. About 33% of FARO-54 rice farmers and 50% of NERICA-1 rice farmers had economic efficiency less than half. This implies that large number of FARO-54 rice farmers had economic inefficiency greater than half. The mean economic efficiency of FARO-54 farmer is 0.54 and NERICA-1 rice farmers had average economic efficiency of 0.45. These

results implied that FARO-54 farmers are more economically efficient than NERICA-1 rice farmers. This could be attributed to efficient utilization of resources by FARO-54 rice farmers.

The maximum economic efficiency of FARO-54 rice farmer was 0.89 and NERICA-1 rice farmer was 0.92. This means that if the average FARO-54 farmers in the study area were to reach the economic efficiency level of his most efficient counterpart. Then the average FARO-54 farmer could experience a cost savings of 39.3% $\{1 - (0.54/0.89) \times 100\}$ and for NERICA-1 rice farmers 47.8% $\{1 - (0.48/0.92) \times 100\}$. The most economically inefficient FARO-54 farmer suggests a gain in economic efficiency of 73% $\{1 - (0.24/0.89) \times 100\}$ and for NERICA-1 rice 77% $\{1 - (0.21/0.92) \times 100\}$. It is evident from these results that economic inefficiency constitutes a more serious problem than technical and allocative inefficiencies in the study area.

Table 4.15: Frequency Distribution of Economic Efficiency Estimates

Economic efficiency range	FARO-54	NERICA-1
0.11-0.2	11(10.38)	19(17.12)
0.21-0.30	2(1.89)	5(4.50)
0.31-0.40	5(4.72)	14(12.61)
0.41-0.50	17(16.04)	18(16.22)
0.51-0.60	20(18.87)	18(16.22)
0.61-0.70	30(28.30)	12(10.81)
0.71-0.80	20(18.87)	14(12.61)
0.81-0.90	1(0.93)	6(5.41)
0.91-1.0	Nil	5(4.50)
Total	174(100)	174(100)
Mean	0.54	0.45
Minimum	0.24	0.21
Maximum	0.89	0.92

Figures in parentheses are percentages

4.3.3.4 Constraints associated with FARO-54 and NERICA-1 farmers

Nigeria's agricultural sector in general as well as the rice subsector in particular has experienced some impediments which slowed the performance of the sector. This has caused the output growth not to keep pace with its demand, thereby, resulting in declining exports and domestic supplies and a growing reliance on imports of the products. Both groups of farmers highlighted some constraints they are facing in rice production in the study area and these are presented in Table 4.16 and are discussed accordingly.

Both FARO-54 and NERICA-1 ricefarmers ranked problem of pest and diseases as their 1st constraint. About 77% of the FARO-54 farmers identified this as a problem while 85% of the NERICA-1rice farmer had this challenge. The results show that pests and diseases were serious problems faced by the respondents in the study area. This problem could be poor management/cultural practice which could also be the reason why farmers faced this problem in the study area. The preponderance of this constraint is more to NERICA-1 rice farmers hence, the effect is greater on NERICA-1 rice farmers.

The result revealed that about 51% of FARO-54 farmers and about 61% of NERICA-1 rice farmers rank poor marketing price as the second most serious constraint militating against rice production. This cannot be unconnected to the unorganised nature of our rural markets. Market information flow as regards good prices is a major challenge in this aspect. Markets are located in far areas which induce the farmers to sell at give-away prices. This makes farmers not to have steady pricing trend which they can predict at any time. The inconsistent trend of prices forces farmers to sell their produce as soon as they notice a rise in price.

About 43% and 32% of FARO-54 and NERICA-1 rice farmers respectively ranked inadequate capital as third most serious constraint affecting rice production in the study area. This affects rice production in the study area, because the meager savings the farmers might have made or the funds generated from relatives is not sufficient to satisfy various activities in rice production. Most of the farmers also complained of not having enough money to purchase chemicals to combat these diseases, although the economic advantage of spraying could lead to increase yield thereby justify the costs, they invested. The effect of this problem of capital was higher and more serious to FARO-54 rice farmer than NERICA-1 rice farmers in the study area.

Harvested farm produce are transported with great difficulties from the farms to market or points of processing. The farm products are mostly transported to the market for sale. Therefore, both categories of farmers ranked high cost of transportation as fourth constraint among the constraints encountered by them. About 13% of the FARO-54 rice farmer identified this as a problem while 7% of the NERICA-1 rice farmers had this challenge. This cannot be unconnected to the bad roads in the area which makes some roads inaccessible by vehicles rather they use motorcycle, hence, charges are high. Erratic fuel prices and its scarcity is also a factor in this case. The difficulty in getting transport to market their produce leads to these farmers being exploited by hawkers and people with their own private transport, thereby causing a decline in returns.

Table 4.16: Constraints associated with FARO-54 and NERICA-1 farmer

Constraints	*FARO-54		*NERICA-1	
	Frequency	Percentage	Frequency	Percentage
pest and disease	134	77.01 ¹	148	85.06 ¹
Poor market price	89	51.15 ²	106	60.92 ²
Inadequate capital	75	43.10 ³	56	32.18 ³
Transportation	23	13.22 ⁴	13	7.47 ⁴

* Multiple responses were allowed Ranks: ^{1, 2, 3 and 4}

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study evaluates comparative economic analysis of FARO-54 and NERICA-1 rice production in Niger State, Nigeria. The specific objectives were to describe the socio-economic characteristics of FARO-54 and NERICA-1 farmers, determine the costs and return of FARO-54 with NERICA-1 production, estimate the technical efficiencies in FARO-54 and NERICA-1; determine the resource use efficiency in FARO-54 and NERICA-1 and describe the constraints associated with FARO-54 and NERICA-1 farmers in the area. Multi-stage sampling technique was employed in selecting the respondents. Primary data for the study were collected using structured questionnaire, administered to 174 respondents for both FARO-54 and NERICA-1 farmers during the 2014 cropping season. Data collected were analyzed using descriptive statistics, farm budgeting analysis and stochastic frontier production function.

Results of the study indicated that the average age were 42 and 40 years for FARO-54 and NERICA-1 farmers respectively. The average household size for the two groups was 4 and 5 members per household for FARO-54 and NERICA-1 respectively. Majority 59% and 54% of FARO-54 and NERICA-1 farmers had between 11-20 years of farming experience respectively. The average farming experience for the two groups are 11 years. Majority 60% and 70% of FARO-54 and NERICA-1 had no formal education. The average farm size among FARO-54 and NERICA-1 farmers was 1.2 hectares and 0.8 hectares respectively. Majority of FARO-54 (87.4%) and NERICA-1 (92.5%) do not have access to credit, majority of FARO-54 (82.2%) and NERICA-1 (86.8%) do not have access extension contact. However, majority of FARO-54 (88.5%)

and NERICA-1 (76.4%) do not participate in any cooperative association in the study area.

The total revenue (TR) for FARO-54 and NERICA-1 were ₦82,047.12/ha and ₦67026.04/ha respectively while the total cost of production for FARO-54 and NERICA-1 was ₦162,763/ha and ₦137942 respectively. The net farm income was therefore ₦2268.76/ha and ₦70915.96.

The estimated mean technical efficiency for FARO-54 was 0.76 and NERICA-1 was 0.83. The mean allocative efficiency of FARO-54 farmers is 0.92 while the average allocative efficiency for NERICA-1 farmer is 0.86. An average FARO-54 rice farmer requires 24% cost savings to attain the status of the most efficient FARO-54 rice farmer and 15% to attain the status of the most efficient NERICA-1rice farmer. The least performing FARO-54 rice farmers would need 61% cost savings and NERICA-1rice farmer would need 74% become the most efficient farmer. An average farmer could realize 4.1% cost savings and 14.6% cost saving for FARO-54 and NERICA-1 rice farmers respectively to attain the status of the most allocatively efficient farmer. Finally, among the constraints identified in the study area, the majority of the respondent attested to the fact that pest and diseases, poor market price, inadequate capital and poor transportation were major constraints faced.

5.2 Conclusion

Based on the findings of this study, it could be concluded that the two production systems are profitable; however, NERICA-1 production was more profitable with higher rate of returns to investment. 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.

The implication of the study is that technical and allocative efficiency in farm production among the farmers under FARO-54 and NERICA-1 could be increased by 24 and 17%, 8 and 14% respectively through better use of available resources given the current state of technology.

5.3 Contributions to Knowledge

1. NERICA-1 production has net farm income of ₦76, 458.96/ha which is more profitable and with higher rate of return to investment of 2.24 than FARO-54 production with ₦84, 315.88/ha as net farm income and 2.06 rate of return to investment.
2. The study revealed that FARO-54 and NERICA-1 farmers in the study area achieved technical efficiency of 76 and 83 percent respectively.
3. The study revealed pest and diseases and inadequate capital as major constraints affecting FARO-54 and NERICA-1 production in the study area.

5.4 Recommendations

Based on the findings of this study the following recommendations are made:

- i. The most severe problems encountered in FARO-54 and NERICA-1 production were pest and disease. This constraint constitutes serious impediments to FARO-54 and NERICA-1 production and need to be addressed adequately before this 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 rice for commercial purposes.

- ii. Majority of the farmers financed their production through personal savings and relatives which are mostly not adequate for appreciable production. Agricultural loan facilities should be made accessible to FARO-54 and NERICA-1 producers to ensure timely and adequate utilization of agricultural inputs for improvement in farm production efficiency.
- iii. Fertilizer is one of the inputs that positively and significantly influence FARO-54 and NERICA-1 production in the study area. Therefore, government should ensure timely and adequate supply of fertilizer to farmers through its e-wallet programme at affordable prices in order to enhance the production of this crop.

REFERENCES

- Adeoti, J.O. (2002). *Technology and Environment in sub-Saharan Africa: Emerging trends in Nigerian Manufacturing Industry*. Aldershot, United Kingdom: Ashgate Publishing Limited.
- Adesina, A.A.(2012) Unlacking the potential of Agriculture in sub-sahara Africa, Nigeria's Transformation Agenda, for Agriculture Abuja, Nigeria. Federal Ministry of Agriculture and Rural Development.
- Aigner, D.I., Lovelli, C.A.K. and Schmidt, P. (1977).Formation and Estimation of Stochastic Frontier Production Function Model. *Journal of Econometrics* 6:21-37.
- Ajani, O.I.Y. (2000). Resource productivity in food farming in Northern area of Oyo State, Nigeria. Unpublished Ph.D Dissertation, Department of Agricultural Economics, University of Ibadan.
- Akande, T. (2001). An over view of the Nigerian rice economy. A project report. The Nigeria rice Economy in competitive world constraints, opportunities and strategic choices, WARDA.
- Akpokodje, G., Lancoun, F. and Erestein, O. (2001). Nigeria rice Economy State of the Arts, A Project Report. Nigeria Rice Economy in a competitive World: Constraints, Opportunities and Strategic Choices WARDA.
- Amaza, P.S. and Olayemi, J.K. (2000).The Influence of Education and Extension Contact on Food Crop Production in Gombe State, Nigeria. *Journal of Agriculture and Rural Development* (1):80-90.
- Amaza, P.S. and Maurice, D.C. (2005).Identification of factors that influence technical efficiency in rice-based production systems in Nigeria. Paper presented at workshop on Policies and Strategies for promoting rice production and food security in sub-saharan Africa. Held at Cotonou, Benin, 7-9 November.2005
- Bagi, F.S. (1982). Economic Efficiency of Share Cropping Reply and some further results: *Malaysia Economic Review*, (27):86-95.
- Meesun, W. and Van den.Broeck, J. (1977). Efficiency Estimation for Cobb-Douglas Production function with Composed Error, *international Economic Review*(18):435-444.
- MahammadLawal, A. Omotesho, O.A. and Falola, A. (2009). Technical Efficiency of youth participation in agriculture programme in Ondo State, Nigeria,. *Nigerian Journal of Agriculture, Food and Environment* 5(1):20-26.
- National Population commission (2006).Provisional Census Report for Nigeria, Draft Report, 2006.

- National Research Council (NRC) (1996). *Africa Rice Lost Crop of Africa* Vol. 1, National Academic Press, Abuja.
- NGADP (2003). Niger State Agricultural Development Project: 2003 Annual Report.
- Ogundari, Ojo, s.O. and Ajibefun, I.A. (2006). Economics of Scale and Cost Efficiency in small scale production: empirical Evidences from Nigeria. *Journal of social Sciences*: 13(2):131-136.
- Ogundele, O.O. and Okoruwa, V.O. (2006). Technical efficiency differentials in Rice production technologist in Nigeria. *African economic research Consortium, Research paper No. 54*.
- Olayide, S.O and Heady, E. O. (1982) Introduction to Agricultural Production Economics 1st Edition, University of Ibadan. Ibadan, Nigeria pp 71-76
- Olukosi, J.O. and Erhabor, P.O. (1988). *Introduction to Agricultural Production Economics*, University Press, University of Ibadan, Nigeria.
- Rola, A. and Quintana-Alejandriro, J.T. (1993). Technical Efficiency of Philippines Rice Farmers in Irrigated, Rainfed Lowland and Upland Environment: a Frontier production function analysis. *Philippine Journal of Crop Science* (18):56-69.
- Seyoun, e.T., Battese, G.E. and Fleming, E.M. (1998). Technical Efficiency and Productivity of Maize producers in Eastern Ethiopia: A study of farmers within and outside the Sasakawa global 2000 Project". *Agricultural Economics Journal* 19:340-348.
- West African rice Development Association (2007). *African rice trend*, 5th Edition, WARDA, Cotonou, Benin.
- Bamidele, I.S., Abayomi, O.O. and Adebisi, E.O. (2010). Economic Analysis of rice consumption pattern in Nigeria. *Journal of Agricultural Technology* 12:1-11.
- Battese, G.F. and Coelli, G.s. (1977). Estimation of a Production frontier Model with application to the pastoral zone of Eastern Australia, *Australia Journal of Agricultural Economics* 21(3):169-179.
- Coelli, T.J. (1995). Recent development in Frontier Estimation and Efficiency Measurement. *Australia Journal of Agricultural Economics* 39:219-245.
- Coelli, T.J. and Battese, G. (1996). Identification of Factors which influence the Technical Efficiency of India Farmers. *American Journal of Agricultural Economics* 40:103-128.
- Food and Agricultural Organization (FAO). (1999). North and south Gender Food security Assessment in parts of the Tekez River Watershed. *United Nation Development Programme, emergencies Unit for Ethiopia Mission*: May 26 – June 7, 1999, Addis Ababa, Ethiopia.

- Food and Agricultural organization (FAO) (2010) FAOSTAT online Database available at <http://faostatfao.org> and <http://en.wikipedia.org/wiki/rice> Food and Agriculture Organization of United Nations Rome, Accessed in June 9th, 2010.
- Farrel, M.J. (1957). The Measurement of Production Efficiency. *Journal of Royal statistical Society Series, A*, 120:253-290.
- Jirgi, A.J., Abdulrahman, M. and Ibrahim, F.O. (2009). Adoption of Improved Rice Varieties among small scale farmers in Kacha Local Government Area of Niger State, Nigeria, *Journal of agricultural Extension* 13(1):95-98.
- Abdulrahman, M. (1989). Economic Importance of rice production in Niger State. An unpublished M.Sc Thesis, Department of Agricultural Economics and Rural Sociology, ABU, Zaria.
- Adeoye, G.O. (2003). Rice Revolution in practice, lesson from other countries. Paper presented at a seminar on Sustainable Rice Production in Nigeria held at Hamdala Hotel, Kaduna State, January 14th – 15th 2003, pp 2-11.
- Daramola, A.G. (2005). Government Policies and competitiveness of Nigerian rice Economy, Department of Agricultural Economics and Extension, Federal university of Technology, Akure, Nigeria.
- Fare, R.S., Grosskopf, C.A.K., Lovell and S. Yaisawarng, (1993). “Derivation of Shadow Prices for Undersirable Outputs: a Distance Function approach”. *Rev. Econ. Stat.* 75: 374-80.
- Farrell, M.J. (1957). The measurement of productive efficiency, *Journal of the Royal Statistical Society*, page, 253-290.
- Albouy, D. (2010). Program Evaluation and the difference in Difference Estimator Economics Section notes. Pdf Adobe Acrobat Document, at www.emlab.berkeley.edu. and www.docstoc.com. Retrieved on 7th June, 2010.
- National Centre for Genetic Resources and Biotechnology. Moor Plantation, Ibadan. Crop Varieties released and registered in Nigeria, 2010.
- Kumbhakar, S.C. Ghosh, S and Meduckiri, J. T (1995):“ A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in US Dairy Farms ”. *Journal of Business and Economic Statistics* 9:279-286.
- Muhammed-lawal, A.; Omotesho, O. A. and Falola, A. (2009). Technical Efficiency of Youth Participation in Agriculture. A Case Study of Youth-in-Agriculture Programme in Ondo State; South-West Nigeria. *Nigeria Journal of Agriculture, Food and Environment*: 5 (1), 20 – 26.

- Okoruwa, V.O and Ogundele, O.O (2006) “Technical Efficiency Differentials in Rice Production Technologies in Nigeria”. Nigerian Institute for Social and Economic Research(NISER).Ibadan Nigeria
- Bravo-Ureta, B.andPinheiro,A.(1991). Technical, Economic, and Allocative Efficiency in Peasant Farming: Evidence from the Dominican Republic.*The Developing*Okoruwa, V. O. and Ogundele, O. O. (2006). Technical efficiency differentials in rice production technologist in Nigeria. African Economic Research Consortium, Research paper No.154.
- Oladele, *Economies*,35 (1): 48-67.
- Ekong, E. E. (2003) *Rural Sociology: An Introduction and Analysis of Rural Nigeria*, Uyo: Dove Educational Publication.
- Asogwa, B.C., Ihemeje, J.C. and Ezihe, J.A.C. (2011). Technical and Allocative Efficiency Analysis of Nigerian Rural Farmers: Implication for Poverty Reduction, *Agricultural Journal*, 6(5): 243-251
- Mahabub, H. and Jaim, W. M. H. (2011). Empowering Women to Become Farmer
Entrepreneur Case study of a NGO Supported Program in Bangladesh. Paper presented at the IFAD onference on New Directions for Smallholder Agriculture 24-25 January, 2011 :1-30.
- Mohammed, B. T. (2011). Socio-economic analysis of melon production in Ifelodun Local Government Area, Kwara State, Nigeria. *Journal of Development and Agricultural Economics*. Vol. 3(8), :362-367
- Oladele, O.I 2004. Effect of World Bank loan withdrawal on the performance of agricultural extension in Nigeria. *Nordic Journal of African Studies*, 13(2):141-145
- Olaleye, R. S , Ibrahim, M. and Ojo, M. A. (2009). Probit Analysis of Women’s Access to Agricultural Inputs in Bosso Local Government Area, Niger State, Nigeria *Journal of Agricultural Extension* Vol. 13 (2):1-9.
- Ya’aisheModu, Alice J. Putai and A. M. Petu-Ibikunle (2009). An Economic Analysis of Cowpea Production among Women Farmers in Askira/Uba Local Government Area Borno State Nigeria. *African Journal of General Agriculture* 6 (1) :1-11
- Amaza, P., Tahirou, A., Patrick, .K., and Amare, T. (2009). Changes in household food security and poverty status in PROSAB area of Southern Borno State, Nigeria. Promoting Sustainable Agriculture in Borno State (PROSAB). International Institute of Tropical Agriculture, Ibadan, Nigeria. :1-40.

- Tijani, A.A., Alimi, T., Adesiyan, A.T (2006). Profit efficiency among poultry egg farmers: a case study of Aiyetodo farm settlement, Nigeria. *Res. J. Agric. Biol.i.*, 2(6): 256-261.
- Kalarijan and shand (1981). Application of the normalized profit functions in the estimation of the profit efficiency among smallholder farmers in Atiba Local Government Area of Oyo state, Nigeria. *Journal of Economic Theory* 2(3):71-76
- Forsund, F.R and L. Hjalmarsson{1980}Generalised Farrel measures efficiency. An Application to milk processing in Swedish Dairy plants . *Econ j.* 89 294-315
- Nchare, A (2007) Analysis of factor affecting the technical efficiency of Arabian coffee producers in Cameroon. African Economic Research Consortium, Nairobi- Kenya. Research paper-163.
- Sharma, P. V Staal, S, Delgado, C, Singh R.V (1999) Policy Technical and Environmental Determinants and implication of scaling-up of milk production in India. Annex 3 Research Report of International Food Policy Research Institutes (IFPRI)- Food and Agricultural Organisation, livestock, Industrialization project phase 2. Washington DC, IFPRI.
- Brink M. And Belly, G.(eds) (2006) plant resources of Tropical Africa I. Cereals and pulses, PROTA foundation, Wageningen Netherlands.
- USDA-ERS (united states Department of Agriculture Economic Research Services)(1991) International Base line Data. Accessed December 15. www.ers.usdagov/data-products/international-base-line-data.aspx.

**COMPARATIVE ECONOMIC IMPACT ANALYSIS OF
FARO-54 AND NERICA -1 PRODUCTION ON
PRODUCTIVITY AND INCOME OF FARMERS IN NIGER
STATE OF NIGERIA**

Dear Respondent,

This questionnaire will be used by a student of Agricultural Economic and Rural Sociology department ABU Zaria.

Please fill and tick where necessary. All information will be treated with utmost confidentiality and will be used for purpose of research.

SECTION A: SOCIO-ECONOMIC CHARACTERISTIC

1. Name..... Village..... LGA
2. Sex: Male () Female ()
3. Marital Status: Single () Married () Widow ()
4. Age (Years).....
5. Level of Education.....
 - i. (a) No formal Education () (b) Adult Education () (c) Qur'anic Education ()
(d) Primary Education () (e) Secondary Education () (f) Tertiary Education ()
 - ii. How many years did you spent in school.....
6. Family size (in number).....
7. Farming experience (years).....
8. Access to credit (whether formal or informal) Yes () No ()
If yes specify the amount..... and sources of formal and informal credit
9. Access to non-form income (other income apart from farm income) Yes () No ()
If yes specify the amount.....
10. Do you belong to any cooperative society? Yes () No ()
11. Do you have contact with extension agents Yes () No ()
If yes how long.....

B. Input Used

i. Farm Size (FARO -54)

Field no	Field size (ha)	Cost ₦

i. Farm Size (NERICA -1)

Field no	Field size (ha)	Cost ₦

ii. Quantity of seed (Kg) (FARO -54)

Field no	Quantity of seed	Cost ₦

Unit = Kg modu, tiya, bucket, bags etc

ii. Quantity of seed (Kg) (NERICA -1)

Field no	Quantity of seed	Cost ₱

Unit = Kg modu, tiya, bucket, bags etc

iii. Quantity of fertilizer (FARO-54)

Field no	Types of fertilizer	Cost ₱

Unit = Kg modu, tiya, bucket, bags etc

iii. Quantity of fertilizer (NERICA-1)

Field no	Types of fertilizer	Quantity	Cost ₱

Unit = kg modu, tiya, bucket, bags etc

iv. Quantity of Agrochemical (FARO-54)

Field no	Types of fertilizer	Quantity	Cost ₱

Quantity of Agrochemical (NERICA-1) (litre)

Field no	Types of Herbicide	Quantity	Cost ₱

v. Tractor (FARO - 54)

Field no	Cost of Plough	Cost of harrow	Total Cost ₱

Tractor (NERICA-1)

Field no	Cost of Plough	Cost of harrow	Total Cost ₦

iv Labour

(i) Manual ploughing (FARO - 54)

Field No	Family Labour					Hired Labour				
	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

iv Labour

(ii) Manual ploughing (NERICA - 1)

Field No	Family Labour					Hired Labour				
	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

vi. Planting (FARO - 54)

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Planting (NERICA- 1)

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Fertilizer Application (FARO - 54)

	Family Labour					Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

Fertilizer Application (NERICA- 1)

	Family Labour					Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

Herbicide Application (FARO- 54)

	Family Labour					Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

Herbicide Application (NERICA- 1)

		Family Labour				Hired Labour					
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC	

First weeding (FARO -54)

		Family Labour				Hired Labour					
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC	

First weeding (NERICA- 1)

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Second weeding FARO-54

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Second weeding NERICA -1

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Harvesting

(a) Rice cutting FARO-54

		Family Labour				Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC

Harvesting

(a) Rice cutting NERICA-1

		Family Labour				Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC

Rice packing FARO-54

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Rice Packing NERICA -1

	Family Labour					Hired Labour						
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C		

Threshing FARO -54

		Family Labour					Hired Labour					
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC		

Threshing NERICA -1

		Family Labour					Hired Labour					
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC		

Rice winnowing FARO-54

		Family Labour					Hired Labour					
Field No	No of men	Days	Hours/day	Cost/day	TC	No of men	Days spent	Hours/day	Cost/day	TC		

	n					n					

Rice winnowing NERICA -1

	Family Labour					Hired Labour				
Field No	No of men	Days	Hours/day	Cost/day	T C	No of men	Days spent	Hours/day	Cost/day	T C

Depreciation (FARO - 54)

S/N	Types of tools	Years of purchase	Purchase price	Years of utilization	Resale value

Depreciation (NERICA - 1)

S/N	Types of tools	Years of purchase	Purchase price	Yeas of utilization	Resale value

Marketing costs FARO

SN	No of bags	Price/bag	Total cost
Transportation			
Cost of warehouse			
Chemicals			
Packaging materials			
Others			

Marketing costs NERICA

SN	No of bags	Price/bag	Total cost
Transportation			
Cost of warehouse			
Chemicals			

Packaging materials			
Others			

Output FARO -54

Field no	Quantity harvested	Price per quantity	Value in ₱

Unit: kg, bags, mudu, tiya

Output NERICA -1

Field no	Quantity harvested	Price per quantity	Value in ₱

Unit: kg, bags, mudu, tiya

Farm income (FARO-54)

Field no	Farm income	Value in ₱

Farm income (NERICA-1)

Field no	Farm income	Value in ₦

Constraint associated with (FARO -54) farmers in the area

- 1.....
- 2.....
- 3.....
- 4.....
- 5.....
- 6.....
- 7.....

Constraint associated with (NERICA -1) farmers in the area

- 1.....
- 2.....
- 3.....
- 4.....
- 5.....
- 6.....
- 7.....

G- Suggest the possible solution to the problems identify by FARO-54 farmers in the area

Suggest the possible solution to the problems identify by NERICA -1 farmers in the area.

Thanks You