COMPARATIVE ANALYSIS OF RESOURCE USE EFFICIENCY IN RICE PRODUCTION AMONG FADAMA III AND NON-FADAMA III BENEFICIARY RICE FARMERS IN NIGER STATE, NIGERIA

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TITLE PAGE

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A RESEARCH DESSERTATION
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NOVEMBER, 2013

CERTIFICATION

Mamun Mallam, a postgraduate student in the department of Agricultural Economics, with registration number PG/M.Sc/07/42859 has satisfactorily completed the requirements for course and research work for the award of Master of Science (M.Sc) in Agricultural Economics. The work embodied in this dissertation, except where duly acknowledged, is the product of my original work and has not been previously published in part or full for any other diploma or degree of this or any university.

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DATE

DEDICATION

This research is dedicated to God, my family, my supervisor and my friends.

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I thank God for His Grace which has made the completion of this work a reality. I owe my supervisor, Professor Noble J. Nweze KSP, a debt of gratitude for his principles, patience and guidance. I have personally benefitted not only from his great erudition, but also from his combination of firmness and sensitivity, and have added him to my few role models in Nigeria.

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ABSTRACT

This study investigated resource use efficiency of Fadama III and non-Fadama III beneficiary rice farmers in Niger State, Nigeria. Primary data were collected using questionnaire/interview schedule administered to a sample of one hundred and twenty rice farmers, selected using multi-stage sampling technique. Data were analyzed using descriptive statistics, stochastic frontier production function, return to scale analysis, gross margin analysis, net farm income analysis and likert scale rating technique. Maximum likelihood estimates of the Cobb-Douglas frontier function showed that coefficient of seeds (0.479), labour (0.445) and herbicides (0.093) had significant effects on output of Fadama III beneficiary rice farmers while fertilizer (0.069) is the input with significant effect on output of the non-beneficiary farmers. The estimated coefficients of the inefficiency model revealed that age, household size, educational level, extension contact and Fadama advisory services positively affected Fadama III rice farmersô technical efficiency, but only age and educational level were significant. On the other hand, age, household size and extension contact positively affected non-Fadama III rice farmersô technical efficiency, but only extension contact was significant. An increasing return to scale of 1.432 and 1.168 were recorded for the Fadama III and non-Fadama III rice farmers, respectively. The technical efficiencies of the Fadama III rice farmers ranged from 0.411 ï 1 with a mean value of 0.79 while that of the non Fadama III beneficiary rice farmers ranged from 0.435 ï 0.989 with a mean value of 0.81 on the scale of 1.This showed that technical efficiency can be increased by 21 and 19 percents to attain optimal level in the Fadama III and non Fadama III beneficiary rice farmers, respectively. Allocative efficiency analysis showed that all resource inputs were underutilized. Fadama III rice farmers made a gross margin of N69, 288.37, a net farm income of N67, 599.91 and a return on Naira Invested of 1.81 per ha while the non-Fadama III rice farmers made a gross margin of N30, 250.36, a net farm income of N28, 550.26 and a return on Naira invested of 1.12 per ha. The student t-test showed that there was no significant difference between the technical efficiencies of Fadama III and non-Fadama III beneficiary rice farmers. However, the t-test showed a significant difference between the profit of the Fadama III and non-Fadama III rice farmers. The study recommended that project implementers should tackle the challenge of elite capture, inputs diversion and intensify advisory services/training, while policy makers facilitate the usage of high yielding seeds, labour saving technology and agro-chemicals for rice farmers.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

The food sub-sector of Nigerian agriculture has a large array of staple crops, but rice has risen to a position of pre-eminence. At independence in 1960, rice was merely a festival food consumed mostly in affluent homes during the Christmas and other religious festivals (UNEP,2002). However, as shown in the report of Akpokoye, Lancon and Erenstein (2001), since the mid-1970s, rice consumption in Nigeria has risen tremendously, (+10.3% per annum) as a result of accelerating population growth rate and changing consumer preferences. Urbanization appears to be the main cause of the shift in consumer preferences towards rice in Nigeria. Rice is easy to prepare compared to other traditional cereals, thereby reducing the chore of food preparation and fitting more easily the urban lifestyles of rich and poor alike. The poorest third of urban households obtain 33% of their cereal-based calories from rice, and rice purchases represent a major component of cash expenditures on cereals (World Bank 1991).

Ogundele and Okoruwa (2006) noted that in an apparent move to respond to the increased per capita consumption of rice in Nigeria, local production boomed, averaging 9.3% per annum. These increases have been traced to vast expansion of cropped rice area at an annual average of 7.9% and to a lesser extent to an increase in rice yield of 1.49% per annum. In spite of this, the production increase was not sufficient to match the consumption increase.

Rice production, according to Onoja (2007), can be found in each of the geopolitical zones of the country. These extend from the Northern to Southern zones with most rice grown in middle Belt (Niger, Benue, Kaduna, Kogi and Taraba States) and the Eastern states (Enugu, Cross River and Ebonyi States). Daramola (2005) observed that the middle belt of the country (where Niger state is located) has a comparative advantage in production over the other parts of the country.

According to Singh *et al* (1997) rice production systems in Nigeria include upland rainfed, lowland rainfed, irrigated lowland and deep water and mangrove rice. Daramola (2005) asserted that mangrove is the least important in terms of area, accounting for less than 1% of the total rice area with deep water accounting for 5% of the rice production area, although this figure is most likely overestimated given the physical unit to area expansion in this environment. Of the estimated three million metric tons of annual rice production, three major rice production systems, namely upland rainfed, lowland rainfed and irrigated productions account for 97%. West African Rice Development Association ï WARDA (2003) and Daramola (2005) agree that lowlands without water control i.e. Fadama areas are the main ecology followed by upland and irrigated rice.

In order to address the demand /supply gap, governments have at various times come up with policies and programmes. These include National Accelerated Food Production Programme established in 1972, Agricultural Development Project established in 1975, Operation Feed the Nation established in 1975, River Basin Development Authority established in 1978, the Green Revolution established in 1980, the Directorate of Food, Road and Rural Infrastructure established in 1985, National Land Development Authority established in 1988, National Fadama Development programme established in 1992 and FADAMA II established in 2004.

The first National Fadama Development Project was approved on March 26, 1992 and became effective February 23, 1993. Small scale irrigation in the fadama has been hampered by several constraints which include poor infrastructure in the Fadamas, low investment in technology development and extension for irrigated agriculture, weak financial intermediation, poorly organized Fadama Farms and limited access to foreign exchange for importation of irrigation equipment. The first

National Fadama Development Project ï FADAMA I was designed to tackle these constraints (NFDP, 2003). The programme came to a close on March 31, 1999 and FADAMA II and III later came on board.

The second and the third National Fadama Development Project which started in May, 2004, and March, 2009, respectively aims to sustainably increase the income of all users of Fadama resources that include crop farmers, gatherers of edible and non edible fruits, fisher folks, hunters, pastoralists and service providers. In Niger State the Fadama II was implemented in the eleven participating local government areas which are Agaie, Lavan, Katcha, Lapai, Shiroro, Suleja, Chanchaga, Kontagora, Mariga, Magama and Borgu, while Fadama III is being implemented in the entire twenty-five LGAs of Niger State. The project development approach is the Community Driven Development (CDD) which is a bottom up approach that empowers communities /associations to develop social and all inclusive local development plans whereby communities take responsibility for designing, implementing, operating and maintaining as well as monitoring and evaluating the sub projects as prioritized in their local development plans (NSFDO 2005).

Having expended much in the Fadama Project, a World Bank intervention that employs a Community Driven Development approach, it is very pertinent to determine the resource use efficiency of rice farmers, the major users of Fadama in Niger State, since World Bank (2009) observed that out of the three CDD objectives (service delivery, empowerment/governance and economic livelihood) evaluation data has been most lacking on outcomes in terms of improvements in the lives and incomes of the poorest people themselves.

1.2 The Problem Statement

The demand for rice has been increasing at a much faster rate in Nigeria than in any other African country since the mid 1970s (FAO, 2001). According to Coalition for Africa Rice Development (2009), Nigeriaôs estimated annual rice demand is about

5 million tons, while it produces on the average about 2.21 million tons milled product. The national rice supply demand gap of 2.79 million tons is abridged by importation. Agriculture Digest (2008), reported that the shortfall that is imported annually is projected to cost $267 million. In the light of foreign exchange constraints, this scenario will jeopardize the food security policy of the federal government if left unchecked.

Generally, expected increases in agricultural demand associated with population growth and rising per capita incomes will require continuing increases in agricultural productivity. Agricultural productivity of a production unit, defined as the ratio of its output to its input, varies due to differences in production technology, differences in the setting in which production occurs and differences in efficiency of the production process (Kebede, 2001).

Central to the challenge of Nigeriaôs rice supply and demand gap is the issue of efficiency of the rice farmers in the use of resources. Average yield of upland and lowland rainfed rice in Nigeria is 1.8 tons per hectare, while that of the irrigation is 3.0 ton /ha. This is very low when compared with 3.0 ton/ha from upland, and lowland systems and 7.0 ton/ha from irrigation systems in places like Cote dôIvoire and Senegal (WARDA and NISER, 2001). It, therefore, appears that rice farmers in Nigeria are not getting maximum return from the resources committed to the enterprise. The question posed by Mbah (2006) was whether this scenario was a result of farmersô inability to accept changes or inability to utilize resources efficiently.

With the advent of the National Fadama Development project, fadama rice farmers in Niger State have been facing rapid changes in circumstances that shape their households and even community lives. The intervention of the project in the form of Capacity Building, Advisory Services, Community Driven Capital Asset Acquisition, Economic and Rural Infrastructure should affect farmersô behaviour in their decision making process. Under these circumstances and in light of the aforementioned factors which Kebede (2001) said occasion variation in productivity, it is important to raise the questions: Are Fadama rice farmers now making efficient use of resources? Do rice farmers in the benefiting communities of Fadama project record higher profit than those in the non-benefiting communities? Given the changes brought about by the Fadama project this study seeks to find out if Fadama rice farmers in Niger State have overcome challenges pertaining to productivity, profitability and if they now make efficient use of resources.

1.3 Objectives of the Study

The broad objective of this study is to conduct a comparative analysis of resource use efficiency in rice production among Fadama III and non-Fadama III beneficiary rice farmers in Niger State.

The specific objectives of the study are to:

i. examine and compare the socio-economic characteristics of Fadama III and non-Fadama III beneficiary rice farmers in Niger State;
ii. determine and compare the technical efficiencies of Fadama III and non-Fadama III beneficiary rice farmers in Niger State;
iii. estimate the return to scale of Fadama III and non-Fadama III beneficiary rice farmers in Niger State.
iv. determine and compare allocative efficiencies of Fadama III and non-Fadama III beneficiary rice farmers in Niger State;
v. determine and compare profitability of Fadama III and non-Fadama III beneficiary rice farmers in Niger State;
vi. identify the major constraints of rice farming in Niger State and
vii. make recommendations based on the findings of the study.

1.4 Hypotheses of the Study

The following null hypotheses guided the study:

H_{01}: There is no significant difference in technical efficiency between Fadama III and non-Fadama III beneficiary rice farmers in Niger State.

H_{02} : There is no significant difference in profitability between Fadama III and non-Fadama III beneficiary rice farmers in Niger Sate.

1.5 Justification for the Study

Developing economies can benefit from efficiency studies. Measurements of the extent of efficiency indicate which aspects of farm characteristics can be addressed by public investment to improve efficiency (Kebede, 2001).

The food problem in Nigeria has been exacerbated by the low level of productivity of resources used in recent time. Existing low level of productivity in food grain production reflect low level of technical, allocative and economic efficiencies. According to CBN (2003) increase farm productivity and efficiency is no longer debatable but a necessity in view of imminent food deficit experienced in the country as judged by the over reliance on food importation.

At the moment there is no comprehensive and up to date information as regards the level of resource use efficiencies of the farmers. The few available ones were either based on other systems or on other locations. Anvebuwaôs (2006) and Mbaôs (2006) focused on profitability of rice marketing in Ebonyi State. Aye and Oboh (2005) studied resources use efficiency in rice production in Benue State. Onoja (2007) studied the efficiency of rice production under small scale FMIS and lowland rain-fed system in Kogi State. Nweze and Abdurrahman (2008) studied Fadama farming system in Bauchi and Gombe State.

In recent years, despite all the human and material resources put into the sector, the rate of its productivity increase is said to be declining (Falusi, 1995). According to FACU (1992) and FDA (1995) the productive efficiency for most crops still falls short of 60 percent. The shortfalls are attributable to inefficiency in production. This implies that there is scope for additional increases in output from existing hectarages of food crops if resources are properly harnessed and efficiently used. This study becomes crucial since increased output and productivity are directly related to production efficiency /inefficiency given the state of technology.

Given the huge financial investment in the Fadama Project, the unimpressive performance of some similar earlier efforts, the potentialities of the project to empower farming households in communities with Fadama resources as well as the manifest gap between demand for and supply of rice in Nigeria, the need for a study to ascertain the resource use efficiency of Fadama rice farmers is justified.

The findings of this research would serve to guide policy makers, extension workers, Fadama Project implementers, governments and donor agencies in some areas of their projects or programmes with needs for adjustments. The results of this study will also provide baseline information for further research and policy formulation in agriculture ï specifically, policies for improving technical efficiency and profitability of rice farm households.

CHAPTER TWO

LITERATURE REVIEW

Related literature will be reviewed in this chapter under the following sections.

- Definition and Development of Fadama Farming in Nigeria.
- Economic Importance of Fadama Farming
- Rice Production Systems
- Inputs used in Rice Production in Nigeria
- Rice Production Trends in Nigeria
- Efforts to Boost Rice Production in Nigeria
- Developments in the Nigeria Rice Sector Policy
- Profitability of Rice Production in Nigeria
- Efficiency of Rice Production in Nigeria
- Community Driven Development Approach and Fadama Project
- Theoretical Framework
- Analytical Framework

2.1 Definition and Development of Fadama Farming in Nigeria

Fadama, a Hausa word adopted by World Bank, refers to the low lying swampy areas consisting of alluvial deposits and containing extensive exploitable aquifers. Fadama lands are among the worldôs most productive ecosystem, rich in biodiversity of forest wildlife, fisheries, crops, livestock and water resources that are being competed for by fadama communities (Kutigi, 2005). Qureshi (1989) defined it as alluvial lowlands formed by erosional and depositional actions of rivers and streams possessing fine texture and less acid which makes it a rich agricultural soil. In Nigeria, they are visible along the flood plains of Niger, Sokoto-Rima, Benue-Jemaari and Yobe rivers. They vary in width from a few hundred meters to as much as twenty hectares stretch and encompasses land and water resources that could be developed for irrigated agriculture (world drop, 1993).

Fadama lands were known to provide the basis for human settlement and civilization. Sanders (1998) reported that an 18th century local Hausa ruler engaged the service of about one thousand workers to build a small barrage or simple dam and a canal of about three kilometers long to carry water from a natural pond to a nearby depression which flooded during rains but lack water for the rest of the year. According to Nazim (1993), dry season farming in the fadama lands had been practiced by means of hand operated water lifting device known as shado of until the improved technology of pump irrigation was introduced. He posited that the traditional shadoof was limited to the development of small plots of land mostly for growing vegetables, but with the advert of pump irrigation the need to properly identify and develop the fadama land arose.

In a paper on the prospects of irrigation farming in Nigeira, Dawakintofa (1989) explained that the Federal Government recognized the potential of fadama and established eleven River Basin Development Authorities via decree No 36 of 25th June and No 37 of 3rd August. The Federal Government later created a whole Ministry of Water Resources to oversee programmes and activities of River Basin Development Authorities.

Fadama development in Niger State got popularized from the defunct Bida Agricultural Development project which ran from 1980 to 1987 and took advantage of the perennial nature of river/stream flow that allows for dry season farming.

2.2 Economic Importance of Fadama Farming

Ater (2002) gave the positive contributions of fadama farming to include employment of idle family labour, higher productivity associated with better fertility of soils, improved solar radiation, low incidence of pests and disease, prevalent higher commodity prices and security of providing agricultural commodities at all seasons.

Gura (1996) noted that increased vegetable production in the fadama not only contribute to better health and quality of life, it also enhance the social and economic status of women and children who are the main producers.

2.3 Rice Production Systems

Akpokodge, Lancon and Erenstein (2001), citing Singh *et al* (1997), reported that rice can be grown over a wide range of edaphic and ecological conditions, and that in order to formulate a national strategy and action plan for increasing rice production, due cognizance must be made of these widely varying conditions. They gave the prevalent types of rice production systems in Nigeria as rainfed upland, rainfed lowland and irrigated lowland. Other less common rice production systems include deepwater and mangrove swamp rice.

Rainfed upland rice production system account for 30% of the total area under rice. Under this system, rice is directly seeded in non-flooded, well drained soil on level to steeply sloping fields. Rain fall is the only source of water-generally limiting this system to areas with more than 1,300mm of annual rainfall. Because of higher rainfall, yields are slightly higher in the south than in the north. The average yield of the rainfed upland rice is 1.7 tons/ha (Akpokodge, Lancon and Erenstein, 2001).

According to FAO (2001), Rainfed lowland rice is the most important system and accounts for approximately half of total rice area in Nigeria. Increasing use of rain fed lowland appears to have been a major source of the rapid increase in paddy production in recent years. Rice under this system is transplanted or seeded directly in the soil on level to slightly sloping fields with variable depth and duration of flooding depending on rainfall. This system is found mainly along the flooded river valleys such as the Niger Basin, Kaduna Basin, Benue Basin etc of the Northern States. But such system is also common in Abakaliki and Ogoja areas of Ebonyi and Cross River states respectively. In most of these areas, the river banks or fadamas are usually flooded during the rainy season which lasts for 4-5 mouths. Only one crop is planted in a year under sole cropping practice and the average yield is about 2.2 ton/ha (UNEP 2002).

FAO (2001) reported that irrigated rice systems account for 16% of total rice area in Nigeria. Irrigated rice encompasses lowlands with good control, enabling two crops per year. The yield obtained (3.5 ton/ha) is generally higher than in other systems. Irrigated rice systems include both large scale irrigation schemes in the north and small-scale developed inland valley bottoms in the south. Rice is the main irrigated crop in Nigeria-particularly in the main season (Fagade, 1997; Shaib *et al*, 1997). Deep water rice system can generally be defined as those where flooding achieves a depth of 60-100cm, and floating rice systems as those where flooding exceeds 100cm. Deep water and floating rice represent an increasingly marginalized production system for which area and production figures are generally limited and unreliable. In Nigeria, this production system can be found in the Sokoto-Riwa valleys and in some other flooded plains or fadamas where water depth is very high; and the water level may rise quickly (Akpokodge, Lancon and Erenstein, 2001; UNEP, 2002).

The mangrove swamp rice production system is found where the oceanôs tidal action causes inundation at high tide and drainage at low tide. Most mangrove swamps experience a salt-free growing period during the rainy season when freshwater floods wash the land and displace tidal flows. As a result, the rice growing period is directly related to distance from the ocean, varying between less than four months in the nearest estuaries to more than six months in those more distant (Akpokodge, Lancon and Erenstein 2001; UNEP 2002).

Table 2.1: Major Features of Nigerian Rice Production Systems

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

Source: WARDA, 2001.

2.4 Inputs used in Rice Production in Nigeria

Many research reports on rice production in Nigeria (Daramola, 2005; Urama and Hodge 2005; and Ogundele and Okoruwa, 2006; Onoja 2007) identified the following major inputs used in rice production. Labour (family, group or hired), land (upland, irrigated or swamp) rice seedlings, fertilizers, herbicides, hired machines and insecticides and herbicides. These are the major cost components of rice production in Nigeria.

Ogundele and Okoruwa (2006) reported that family labour constitutes the major proportion of the aggregate labour use in Nigerian agriculture, and that the amount of person days of family labour that can be engaged by rice farmers will depend on the household size, the age structure of the household and the primary occupation of the household members.

International Rice Research Institute (IRRI 1995) recommended a seed rate of 100kg/ha of upland and lowland rice production system. But a study by Okundele and Okoruwa (2006) found that traditional technology rice farmers planted about 50kg/ha, while their improved technology counterparts planted about half of that amount (27kg/ha). This has a lot of implications for output and eventually yield. Ogundele and Okoruwa (2006) found that the quantity and type of seed planted by rice farmers depend on the production system, size of the farm, availability of the seed varieties, price per kg, the technology available to the farmer, ability of the farmer to take risks and the sustainability of the variety to a particular environment.

Onoja (2007) reporting Ogundele and Okoruwa (2006) noted that during the 2003 rice production season, an average of 90kg/ha of fertilizer was applied by the traditional technology rice farmers, while the improved technology rice farmers applied about 170kg/ha. Both cases fell well below the recommended rate of 250-350kg per hectare for upland and lowland swamp production system and this has serious effect on yield.

Farm sizes in Nigeria have been described as small, medium or large scale, if they fall into categories of less than 5ha, between 5ha and 10ha, or more than 10ha, respectively (Upton, 1972). Most of the rice farmers in Nigeria are of small to medium scale categories. The average farm size among the traditional rice farmers was 2.59ha while that of improved technology farmers was 6.52ha. The average farm size that could be cultivated by a rice farmer irrespective of the technology depends on the availability of land, the ownership structure, availability of labour input and the production ecology (Ogundele and Okoruwa, 2006). Olaf et al (2002) reported an average of 3.30ha in a study carried out on rice production in Nigeria.

2.5 Trends in Rice Production in Nigeria

Rice production started in Nigeria in 1500 BC with low-yielding indigenous red grain species *Oryza gleberrima* that was widely grown in the Niger Delta area (Herdeastle, 1959; Ogundele and Okoruwa, 2006). The high-yielding white grain, O. Sativa was introduced about 1890 and by 1960 accounted for more than 60% of the rice grown in the country. Presently, rice is grown in virtually all the agro-ecological zones in Nigeria, but on a relatively small scale. In 2000, out of about 25 million hectares of land cultivated to various food crops, only about 6.7% was under rice (PCU, 2001) Ogundele and Okoruwa (2006) reported that the trend in production shows that paddy rice first experienced a boom in the 1965-1970 period, when average output stood at 321,000 tons. During this period, average area cultivated to rice stood at 234,000 hectares while average national yield was 1.36 tons/ha. Another significant improvement was recorded in 1986-1990, when output increased to over 2 million tons while average area cultivated and yield rose to 1,069, hectares and 2,096 tons/ha respectively. Throughout the 1980s rice output and yield increased. But in the 1991 ï 1995 period, while rice output increased, yield of rice declined, which implies that the increased output was a result of extensive land cultivation.

Table 2.2: Trends in Rice production in Nigeria (1961 – 2000)

Period	Average area cultivated	Average output	Average yield (tons/ha)
1961 ï 1965	179,200	207,200	1.147
1966 ï 1970	234,000	321,000	1.360
1971 ï 1975	288,800	470,200	1.670
1976 ï 1980	332,000	596,200	1.710
1981 ï 1985	630,000	1,300,200	2.063
1986 ï 1990	1,06,200	2,216,064	2.090
1991 ï 1995	1,678,000	2,979,600	1.783
1996 ï 2000	1,742, 582	3,011,028	1.733

Source: PCU, FMARD, Nigeria, 2002.

As shown in tables 2.3 the cultivated area by small-holder rice farmers in 1999 was 1,780.85 hectares and the total production was 300,181.8 metric tons. The cultivated area declined to 1, 206.37 in 2002 and the total production also declined to 200,236.3 metric tons. However, as the cultivated area rose to 1,982.49 hectares in 2009, the total production also increased to 400,320.078 metric tons indicating that increased production in Nigeria is still being achieved mainly through area expansion.

Table 2.3: Annual Trend in Rice Production in Nigeria (1999-2009)

Year	Average Area cultivated in hectare	Production in '000 metric tons	Average Yield (Kg/Ha)
1999	1,780.85	3,181.8	1,789
2000	1,563.73	2,913.6	1,864
2001	1,286.30	2,386.4	1,855
2002	1,206.37	2,236.3	1,854
2003	1,264.55	2,367.1	1,872
2004	1,286.66	2,415.8	1,879
2005	1,365.04	2,659.6	1,948
2006	1,399.99	2,715.3	1,975
2007	1,707.62	3,371.8	1,975
2008	1,800.27	3,670.1	2,039
2009	1,982.49	4,320.09	2,179

Source:NPAFS, FMA&WR, Abuja, 2010

2.6 Efforts to Boost Rice Production in Nigeria

Active and systematic rice research started in the country in 1953 with the establishment of the Federal Rice Station at Badeggi in Niger State. The focus on rice research at the station was the development of varieties with improved grain quality, uniform shape and sizes appropriate for minimal breakage during milling. The aims were achieved mainly through introduction and adaptation (Imolehin, 1991). Between 1954 and 1970, 13 improved rice varieties, comprising two upland, eight shallow swamp and three deep-flooded rices were released to Nigerian farmers. From 1971 onwards, research activities on rice focused on developing high-yielding and disease resistant varieties, efficient use of nutrients, and good soil management. These aims were achieved through introduction, adaptation and hybridization (Imolehin, 1991).

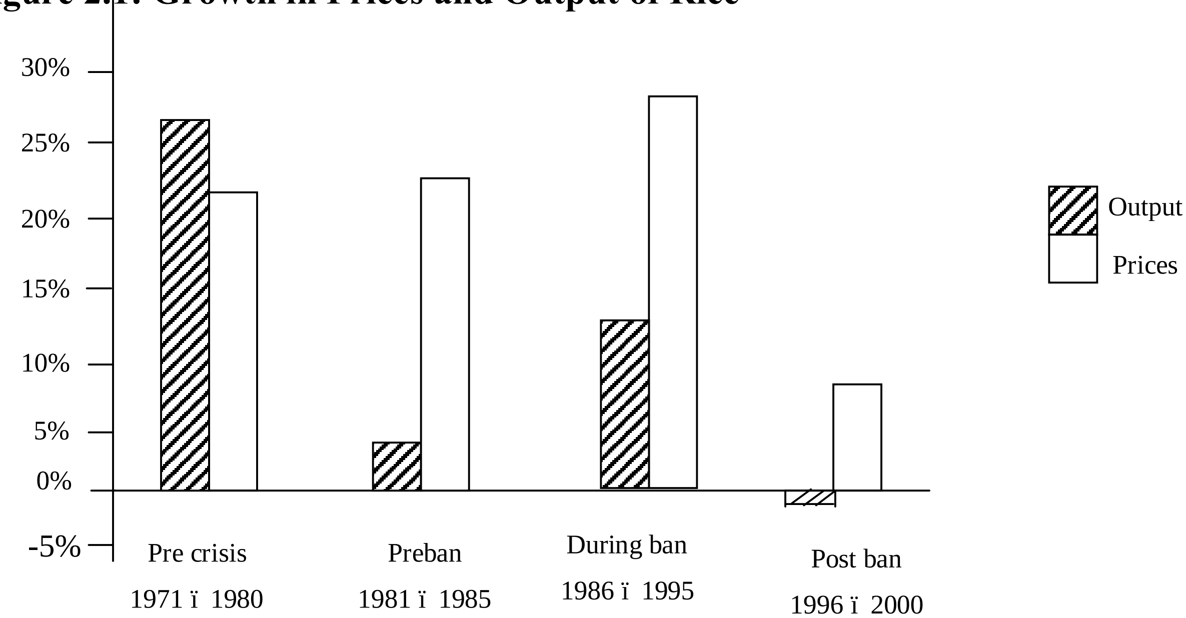
A remarkable effort to develop suitable rice varieties for Nigerian farmers was made in 1997 with the release of FARO 51, a variety that is resistant to the African rice gall midge (ARGM) *Orseolia oryziviva* (World Bank, 1997). When grown in an ARGM endemic area of Abakaliki, the variety exceeded the yields from farmersô varieties by 26% (FAO, 2000). Ogundele and Okoruwa (2006) reported that WARDA developed an improved variety mainly for upland farmers. According to them, this variety, known as NERICA (New Rice for African Countries), was observed to have given a yield of 3.0 tons per hectare. Increased rice production is expected to be achieved effectively when Nigerian farmers in all the ecological zones of the country utilize improved rice varieties along with appropriate cultural and management practices.

2.7 Developments in the Nigerian Rice Sector Policy

Nigeriaøs rice policy can be discussed in reference to three important periods. According to Akpokodge, Lancon and Ereinstien (2001), these are the pre-ban, ban and post-ban periods. They reported that these periods are critical as a result of the fact that the kind of policies put in place during these periods had profound impact on the rice economy. The pre-ban period, the era prior to the introduction of absolute quantitative restriction on rice imports (1971 ï 1985), can be classified into two: the pre crisis period (1971 ï 1980) and the crisis (1981 ï 1985) periods. The pre-crisis period was largely characterized by liberal policies on rice imports with some ad hoc policies put in place during times of interim shortages. While more stringent policies were put in place during the crisis period, outright ban was not a major feature. That changed in the ban period (1986 -1995), when it was illegal to import rice into the country, although illegal importation was going on across the countryøs borders. In the post-ban period (1995-date) quantitative restrictions on rice importation were lifted and the country generally adopted a more liberal trade policy towards rice. From 2000 to date, the Federal Government has resorted to constant and upward adjustment of the import tariff on rice, from 50% in 2000 through 75% in 2001 to 100% in 2002. From the beginning of 2003, the tariff was adjusted to 150% (Ogundele and Okoruwa, 2006).

The effect of trade policy on rice production in Nigeria can be determined by examining the growth in output before, during and after ban on rice imports. Prior to the crisis period (1971 ï 1980), the average annual growth in rice output was 27%. However, this plunged to 4% during the 1981 ï 85 period, when Nigeria relied considerably on rice importation. Nigeria imposed a ban on rice imports during the 1986 ï 95 period and the annual growth in rice production rocketed to 13%. But after the removal of the ban in 1995, the average annual growth dived to ï 1% (Akpokodge, Lancon and Erenstein, 2001). See figure 2.1.

Figure 2.1: Growth in Prices and Output of Rice



Source: Computed Employing FBSTAT and Central Bank of Nigeria Data

2.8 Profitability of Rice Production in Nigeria

Several studies have estimated the costs and returns from cultivation of rice in Nigeria (Olagoke, 1990; Okorji and Onwuka, 1994; Nwoye, 1997; UNEP 2002). Olagoke (1990) compared the average production costs, input usage and returns for the major rice production systems in the Uzo-Uwani area of Enugu State and found the highest rice yield per hectare was obtained from irrigated fields which averaged 2.19 tons paddy per ha. This was followed by the swamp fields with mean paddy yield of 1.96 tons/ha while the upland field gave 1.71 tons/ha. Irrigated rice fields also averaged the highest total production costs, mainly because of higher labour and irrigation costs. Owing to higher production costs of irrigated rice, swamp rice with slightly lower yields, gave the highest net returns of the three production systems. Swamp rice also gave the lowest production costs per kg of output ï ₦0.92kg which compare with a unit paddy price of ₦1.21 per kg. Total production costs and yields were the lowest for upland rice, resulting in the lowest average returns per hectare.

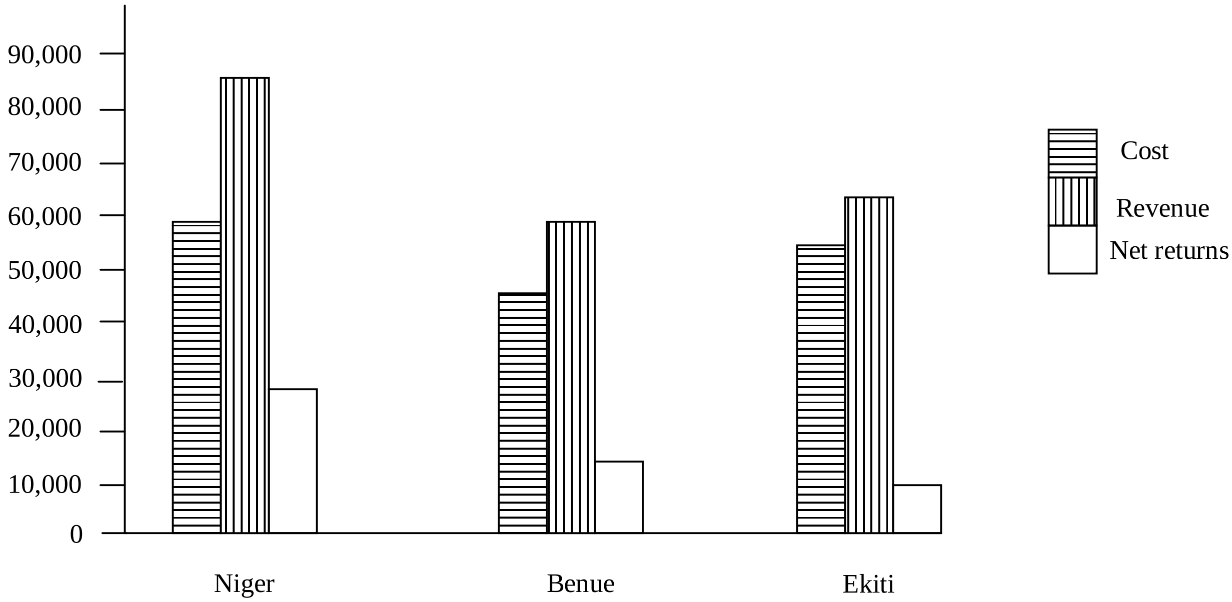
Okorji and Onwuka (1994) compared the profitability of rice production between irrigated and non-irrigated systems at Uzo-Uwani area of Enugu State, Nigeria. Their study found that the total variable cost per hectare was ₦4,385 for non-irrigated and ₦4,688 for irrigated rice, while the total fixed cost per hectare was ₦465 for non-irrigated rice and ₦1,554 for irrigated rice. The wide variation in costs between the two systems is attributable to water and machine costs under irrigation system.

An average of 2,842kg of paddy rice per hectare was harvested from non-irrigated system while 3,435kg of paddy rice per hectare was harvested from the irrigated system and the net return per hectare for non-irrigated and irrigated rice farmers were ₦4,615 and ₦5,197 respectively.

Nwoye (1997) studied the economics of rice production by small-holder farmers in Anambra State, Nigeria. Rice production was found to be more revenue yielding than other relative crops. Swamp rice, the focus of the study, yielded 2.0 ton paddy per ha, resulting in gross margin of ₦3,737 per ha and a total production cost of ₦2.67 per kg. The farmer made ₦1.59 in revenue for every ₦1 spent.

UNEP (2002) studied the profitability of rice production across three agro-ecological zones in Nigeria with Niger, Benue and Ekiti as case studies. It was found that cost of production was highest in Niger, followed by Ekiti and Benue. Labour cost component accounts for the highest share of production costs in the three zones. Yield is highest in Niger (2.82 tons/ha), followed by Benue (1.64 tons/ha) and Ekiti (1.5 tons/ha). The high production of Niger is accounted for by the use of fertilizer, insecticides and herbicides just as in Benue which cultivates similar system of rice (swamp). The low production of Ekiti is attributable to the upland rice that predominates in the area and the fact that the zone does not employ fertilizer on the farms. Net returns and profitability are highest in Niger, followed by Benue and Ekiti. These findings indicate that rice cultivation is still profitable under different ecologies see figure 2.2.

Figure 2.2: Costs and Returns in Rice Production by Agroecologies



Source: UNEP survey data, 2002

2.9 Efficiency of Rice Production in Nigeria

Amaza and Maurice (2005) attempted to identify factors that influence technical efficiency in rice-based fadama farmers in Adamawa State, Nigeria. The study showed that land, seeds and other costs were significant at 1% level; while fertilizer and water were significant at 5% level. The estimated coefficients for land, fertilizer, family labour, seeds, water and other costs were significant and positive, confirming to a priori expectation. This imply that increase in quantities of these inputs would result in increase output. The sources of inefficiency were examined by using the estimated δ-coefficients in association with the inefficiency variables in equation presented. The inefficiency factors are specified as those relating to farmersô specific socio-economic characteristics, viz; years of farming experience, educational levels, extension contact and household size.

Okoruwa and Ogundele (2006), in examining technical efficiency differentials between farmers planting traditional rice varieties and those planting improved varieties found that farm size, hired labour, herbicide and seed contributed significantly to the technical efficiency of the farmers and that increased output of rice in Nigeria had been accomplished mainly through area expansion. The coefficients of farm size were 1.07 and 0.88, respectively, for traditional and improved rice variety farmers. This, however, poses some challenges of environmental sustainability of the cultivation method. Although the use of hired labour and herbicides was found to contribute significantly to technical efficiency among the traditional rice variety farmers, their corresponding elasticities did not suggest that increased used of these inputs will yield more than proportionate increase in output. It was also observed that fertilizer, which is the most critical input in rice cultivation, was not significant. This underscores the low use of the input as a result of the erratic supply.

2.10 Community Driven Development Approach and Fadama Project

CDD ï broadly defined- is an approach that gives control over planning decision and investment resources to community groups and local governments**.** CDD programmes operate on the principles of local government, participatory governance, demand responsiveness, administrative autonomy, greater downward accountability and enhanced local capacity (World Bank, 2010). Mansuri and Rao (2004)viewed CDD as a mechanism which among other things enhance sustainability, improve efficiency and effectiveness, and complement market and public sector activities. According to IFAD (2010), CDD may be a way to correct failures by government, markets and civil society or a self-help approach to accelerate access for communities in rural areas to public goods and services. In an effort to promote greater livelihood security by strengthening activities that stabilize income streams, many CDD operations have promoted local producer organizations and microfinance systems and have actively engage in building occupational skills for income generation activities and jobs (World Bank, 2009)

In Niger State, the level of poverty which had defied solution using the Top-Down (Supply-Driven) approach necessitated a paradigm shift for Demand-Driven approach to development. Thus the state embraced the Community Driven Development in collaboration with the World Bank and the Federal Government in tackling poverty (Yahaya, 2009). The National Fadama Development approach is through Community Driven Development (CDD),which is a bottom-up approach that empowers communities/associations to develop all inclusive Local Development Plans whereby communities take responsibility for designing, implementing, operating and maintaining as well monitoring and evaluating the sub-projects prioritized in their Local Development Plans (Kutigi, 2005).

According to World Bank (2009), out of the three broad types of CDD objectives (service delivery, empowerment/governance and economic livelihood) evaluation data has been most lacking on outcomes in terms of improvement to the lives and incomes of the poorest people themselves. This is now beginning to change with a growing body of robust evidence from impact evaluations that have focused specially on this issue.

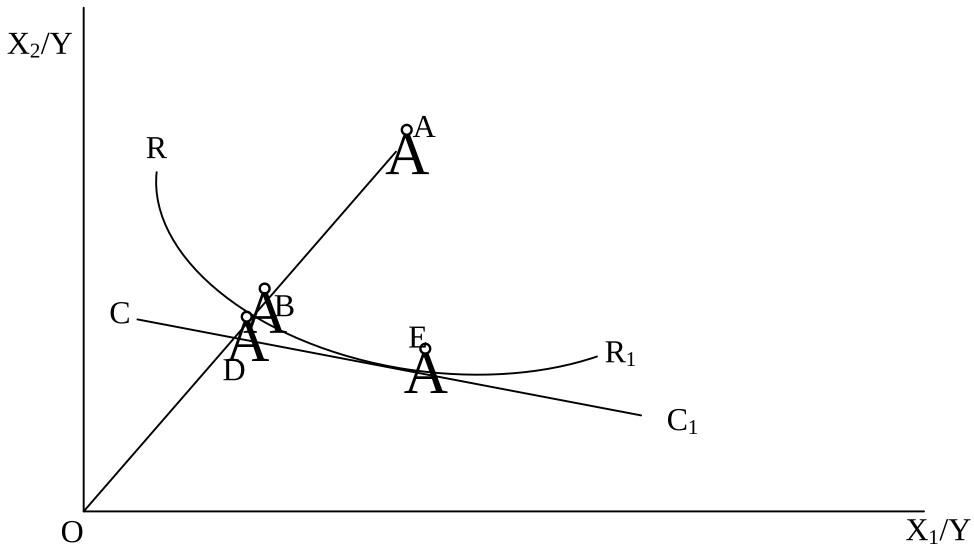
2.11 Theoretical Framework

The farm household unit is both a family and an enterprise that simultaneously engages itself in both consumption and production activities. This dual economic character of the farm household has implications for the economic analysis that can be made on it. The hypothesis that farm households are efficient is attributed to the farm household motivation of profit maximization.

The firm or farmersô ultimate goal in any production is profit maximization which the farmer hopes to achieve by allocation of his disposable resources. According to Arene (2003) production efficiency is concerned with relative performance of the process used in transforming inputs into output. A farmer is therefore assumed to allocate and utilize resources in an efficient way when these resources give an optimal level of production. Micro economic production function studies have usually been used as tools for examining the problems of efficiency of resource use and productivity at farm enterprise level. This study is based on the theory of resource use efficiency to maximize rice output per hectare of land area. Farrel (1957) first proposed an approach for estimating productive or Economic Efficiency (EE) of observed units, and decomposed productive efficiency into two elements: Technical Efficiency (TE) and Allocative Efficiency (AE). Technical Efficiency is the ability of a firm to produce a given level of output with minimum quantity of inputs under a given technology. Allocative efficiency is a measure of the degree of success in achieving the best combination of different inputs in producing a specific level of output considering the relative prices of these inputs. Economic Efficiency is a product of technical and allocative efficiencies (Olayide and Heady, 1982). In one sense, the efficiency of a firm is its success in producing as large an amount of output as possible from given sets of inputs. Maximum efficiency of firm is attained when it becomes impossible to reshuffle a given resource combination without decreasing total output (Umoh, 2006).

Based on Farrel (1957), measures of technical efficiency have been obtained by using input and output quantity without introducing prices of these inputs and outputs. To clarify this exposition, consider figure 2.3 below. Fadama rice farmer uses two input factors, x_1 and x_2, to produce a single output of paddy rice, Y.

Figure 2.3: Technical and Allocative Efficiencies



In the figure, curve RR_1, the efficiency unit isoquant, shows the technically efficient combinations of X_1 and X_2 used to produce one unit of output, Y. Point A, lying above the unit isoquant, represents a combination of X_1 and X_2 that can be used in producing Y. point B represents a technically efficient firm using two inputs in the same ratio as A. point B implies that the respective fadama rice farmer produces the same output s A, but with less inputs. Thus, the fraction OB/OA defines the technical efficiency of farm A. Therefore, the technical inefficiency of Fadama Rice farm A is 1 ï OB/OA which shows the proportion by which inputs could be reduced, keeping the input ratio (x_1 /x_2) constant without reduction in output. In other words, Fadama rice farmer A should have produced OA/OB times more output with the same input quantities.

If input prices are considered, then it is possible to examine the optimal combination of inputs that minimizes the cost of producing a given level of output. This optimal combination is where the slope of CC_1, the price line, is equal to that of the unit of isoquant RR_1. Thus E is the optimal or minimum cost point of production. Fadama Rice farm B is producing at a higher cost than E, although both points reflect

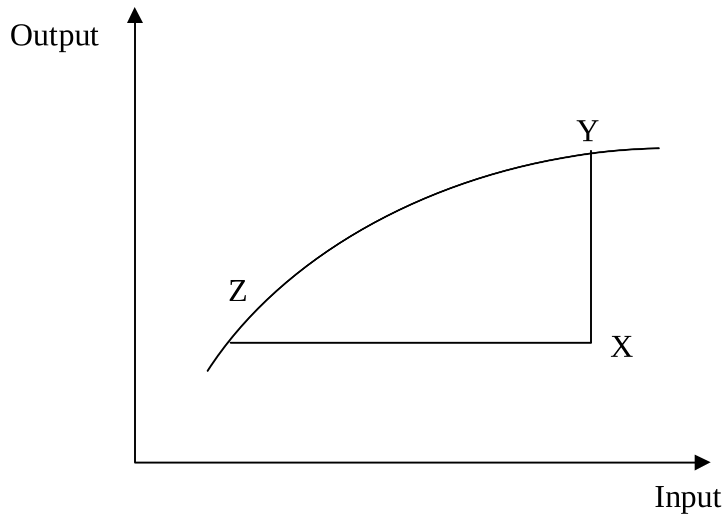
100 percent technical efficiency. The cost of production at E is only a fraction $\frac{OD}{OB}$ of the cost at B. Farell defines the ratio $\frac{OD}{OB}$ as the allocative efficiency of B. Consequently, the allocative inefficiency of B is 1 ï (OR/OB), which measures the potential reduction in cost from using optimal input proportions (Schmidt, 1986).

If both technical and allocative efficiencies of Fadama rice farm A are considered, then its production or economic efficiency is given by the ratio $\frac{OD}{OA}$. Accordingly, 1 - $\frac{OD}{OA}$ is economic inefficiency. Recall that economic efficiency is the product of technical efficiency ($\frac{OB}{OA}$) and allocative efficiency ($\frac{OD}{OB}$), i.e.

$$E\ E = (OB/OA)\ x\ (OD/OB) = OD/OA$$

This could be explained using another approach. A technically efficient farm operates on the production frontier. A technically inefficient farm operates below the frontier. An efficient farm could operate on the frontier either by increasing output with same input bundle or using less input to produce the same output. The closer a farm gets to the frontier the more technically efficient it becomes. Figure 2.4 below illustrates a production frontier put forward by Farrel (1957). A farm operating at x is an inefficient production unit, while a farm operating at Y and Z are both efficient since they are on the frontier. The farm at point x needs to move upward to point y or back ward to point z in order to be efficient. If its move towards y, more output is obtained with same amount of inputs, and if its move towards z, fewer amounts of inputs gives the same output. Both cases depicts more technical efficiency than the initial position x.

Figure 2.4: Production Frontier



There are many studies in Nigeria and elsewhere on efficiency of resource use by crop farmers. Adesina and Djato (1977) used a normalized profit function to determine the relative efficiency of male and female rice farmers in Cote dôIvoire. The result of the study showed that the relative degree of efficiency of women was similar to that of men. Oludimu (1987) used Cobb-Douglas production function to examine the efficiency of resource use in various farm enter prizes in Imo State. He found that the efficient use of resources took place only at the rational stage of production (at the decreasing but positive return to scale stage). Ajibefun and Abdukadir (1999) estimated technical efficiency for food crop farmers under the National Directorate of Employment in Ondo State, Nigeria. The result of the analysis indicated wide variation in the level of technical efficiency, between 0.22 and 0.88. Okon (2008) used multiple regression analysis to estimate the efficiency of resource use among urban vegetable (water leaf) farmers in Akwa Ibom State with a sample of 60 respondents, and found that educational level, household size and farming experience positively and significantly influenced output in the study area. He also found that although farmers made a profit (Gross margin) of ₦287,252 per hectare, they underutilized land

and manure, and over utilized labour resources, meaning they could have recorded higher profits.

The use of Stochastic Frontier Analysis in studies in Nigeria is a recent development (Umoh, 2006). Udo (2000) used the maximum likelihood estimation of the stochastic production function to examine the land management and resource use efficiency in South-eastern Nigeria. The study found a mean output oriented technical efficiency of 0.77 for the farmers, 0.98 for the most efficient farmers and 0.01 for the least efficient farmers. Okike (2000) investigated crop-lives tock interaction and economic efficiency of farmers in the Savannah zones of Nigeria. The study revealed that average economic efficiency of farmers was highest in the low-population-low market domain; Northern Guinea and Sudan savannas ecological zones; and cropped based mixed farmers farming system. Aye and Oboh (2004) used the maximum likelihood estimation of the stochastic production frontier model to investigate the resource use and factors that influence technical efficiency of rice farmers in Benue State, Nigeria. The study revealed an average technical efficiency of 22% showing that farmers actually operated with a substantial level of inefficiency. The inefficiency model in the study revealed that education, household size, access to credit, access to extension service, sex and crop variety signficiantly and positively affect farmers efficiency level. Omotesho, Muhammad-Lawal and Falola (2008) used the stochastic frontier model to analyse the technical efficiency of the youth-in-Agriculture programme in Ondo State and found that efficiency differentials exist among the youths in the programme. The study also revealed that land, labour herbicide and number of cassava cutting are the major factors affecting output of the youth in the programme.

2.12 Analytical Framework

The four major methods used in productivity and efficiency measurement are Least Square Econometric Production Models (LSEPM), Total Factor Productivity Indices (TFPI), Data Envelopment Analysis (DEA) and Stochastic Frontier Production Function (SFPF) analysis (Erhabo and Emokaro, 2008). The Center for Efficiency and Productivity Analysis (CEPA, 2003) recommended the use of either DEA or SFPF in measuring the efficiency of production due to the inadequacies associated with the use of LSEPM and TFPI. Consequently, Ogundari (2006) reported that Stochastic Frontier Analysis and DEA became the most commonly used methods. Both methods estimate the efficiency frontier, which shows the best performance observed among firms.

The Stochastic Frontier model was simultaneously proposed by Aigner et al (1977) and Meeuseen and Van den Broeck (1977) who drew their works from Farrel (1957) seminar paper on efficiency measurement. The SFPF requires that the researcher chooses a functional form and a distribution for the inefficiency index. DEA approaches uses linear programming to construct a piece-wise frontier that envelops the observation of all firms. An advantage of the DEA method is that multiple inputs and outputs can be considered simultaneously and inputs and outputs can be considered simultaneously. But a strong point for SFPF is that it takes into account measurement errors and other noise in the data. This is very important for studies of farm level data in developing economy like Nigeria where data almost always include measurement errors. Researchers that used the SFA include Battese and Coelli (19995), Udoh (2000), Okike (2000), Kebede (2001), Ajibefun and Davamola (2003), Ogundele and Okoruwa (2006) and David (2008).

In this study, the stochastic frontier production function will be used for the analysis of technical efficiency. Coelli (1996) specified the SFPF as:

$$Y_i = f\left(X_{ij}, \beta\right) + V_i - \mu_1 \quad (1)$$

Where

Y_i = output of the ith farm

Xij = vector of the actual jth input used by the ith farm

ȸ = vector of production coefficients to be estimated

V_i = the symmetric noise associated with random factors, assumed to be independent of εi, identical and normally distributed with zero mean and constant variance N (O, δ_V^2), intended to capture events beyond the control of farmers.

εi = the non-negative error term representing deviations from frontier production function, which is attributed to controllable factors (technical inefficiency), assumed to be half normal, independently and identicallyg distributed with zero mean and constant variance N (O, δ_V^2).

The stochastic frontier production function was established using the maximum likelihood estimation (MLE) procedure. The technical efficiency will be empirically measured by decomposing the deviation into a random component (v) and efficiency component (ε). The technical efficiency of individual farm will be determined as a ratio of observed output (Yi) to the corresponding frontier output (Yi*) given the available technology. That is

$$TE = Y_i / Y_i * \quad (2)$$

$$= f\ (X_i\beta) + \exp\ (V_i - \mu_i)\ /\ f(X_i\beta) + V_i \quad (3)$$

$$= \exp\ (-\ \mu_i)\ \textit{such that}\ 0 \le TE \le 1 \quad (4)$$

Technical Inefficiency Model

Technical efficiency of a farm is assumed to be determined by a number of factors that include socio-economic variables, farm specific variables and variables concerning the manager or decision maker of the farm. In this study, technical efficiency of rice farmers will be modeled to depend on input of production and on farm specific and management specific characteristics. The inefficiency model is represented as

Technical inefficiency,

$$\mu = \delta o = \sum_{j=i}^{n} \delta j m j i \qquad (5)$$

where δ j and Mj are unknown parameters to be estimated.

To determine profitability of fadama rice farming, Gross Margin, Net Farm Income and Return per Naira Invested was employed. GM, which is the difference between the Gross Income and Total Variable Cost was used because it is the preferred method of determining the profitability of subsistence farm enterprises in which fixed capital is negligible (Olukosi and Erhabor, 1998). The gross margin was obtained by subtracting the Total Variable Cost (TVC) per hectare from the Total Value Product (TVP) or gross returns (Erhabor and Kalu 1993).

CHAPTER THREE

METHODOLOGY OF STUDY

3.1 Study Area

The study area is Niger State, Nigeria. It is located in the middle belt region of the country, between latitudes 8^{o} 20^{1}N and $11^{0}30^{1}$N and longitudes $3^{0}3^{0}$E and $7^{0}20^{1}$E. The state is bordered to the North by Zamfara State, to the south by Kogi; while Kaduna State and the Federal Capital Territory (FCT) border the state to the northeast and southeast respectively. The state also shares a common international boundary with the Republic of Benin at Babanna in Borgu Local Government Area of the state.

With a total land area of 58, 500km^{2} and 8 Local Government Areas at inception in (1976) the state has expanded, due to merger with Borgu LGA formerly of Kwara State in 1991, resulting in increase in land area to about 75,000km^{2} and 25 LGAs. By the last census conducted in 2006, the stateøs population is put at about 3,950,249 (NPC, 2007). Niger State experiences distinct dry and wet seasons, the wet season decreasing in length and amount of rain from south to north. The mean annual rainfall varies from around 11,000mm in the north to more than 11,600mm in the south, and the duration of wet season varies from 187 to 220 days. The growing season for crops extends beyond the end of the rains because of residual soil moisture which takes sometimes to be consumed (Niger State Government, 2008). The average minimum temperature is about 26^{o}c while the maximum temperature is about 36^{o}c. The mean relative humidity ranges between 60 percent (January to February) and 80 percent (June to September). The state lies in the savannah vegetation zone, the northern part falls within Sudan savannah while the southern part falls into Guinea savannah zone. The predominant crops are rice, sorghum, millet, yam groundnut and cotton (NCRI, 1997).

3.2 Sampling Technique

Both purposive and multi-stage samplings were used for this study. This was done using the administratively delineated three agricultural zones of Bida, Kuta and Kontagora. Local Government Areas with highest rice production in each agricultural zone were purposively selected. From each of these local government areas, one Fadama III beneficiary rice producing community and one non-Fadama III beneficiary rice producing community were randomly selected. Twenty rice farmers were randomly selected from these communities, giving a sample size of one hundred and twenty (120) respondents, i.e.60 for Fadama III beneficiary rice farmers and 60 for non-Fadama III beneficiary rice farmers. The list of the local government areas with the highest rice production in the three zones was collected from Niger State Agricultural Development project. The Fadama III facilitators and key informants in the beneficiary communities of Fadama III project as well as agricultural extension agents and key informants in the non-beneficiary communities of Fadama III project helped in getting the list of rice farmers in each chosen community. The list formed the sampling frame from which a sample of rice farmers was selected using simple random sampling.

3.3 Methods of Data Collection

Data for this study were obtained from both primary and secondary sources. Primary data were collected by the researcher through field survey using structured questionnaire /interview schedule that elicited responses from rice farmers on input-output data such as output of rice in kg, farm size in hectares, labour (family /non family) used in man-days, fertilizer used in kg, agrochemicals used herbicides and pesticides) in liters and some farmer specific variables like family size, educational status, farming experience in years, extension agent contact and information on support from Fadama III like number of access to Fadama advisory services and Fadama inputs support as well as problems encountered in rice farming. Participatory methodologies like Focus Group Discussion (FGD) was also used to enhance the quality of the primary data collected.

Secondary data were received from the Niger State Fadama Development Office, Niger State Agric Development project, and from journals, online publications as well as other published and unpublished materials relevant to the study.

3.4 Data Analysis

Data were analyzed using both descriptive and inferential statistics.

Objective 1 was realized using descriptive statistic like percentages, mean and standard deviation. A Cobb Douglas Stochastic Frontier Production Function was used through maximum likelihood estimate approach to determine the technical efficiencies of the rice farmers i.e. objective 2. Summation of input elasticities of production was done to estimate return to scale of rice farmers in the two groups, i.e. objective 3. Variables with positive coefficients from the OLS estimates of the function were used to estimate allocative efficiencies i.e. objective 4. Gross margin analysis, net farm income analysis and return on Naira invested were used to determine profitability of the rice farmers in the two groups, i.e. objective 5. Likert scale rating technique was used to identify constraints of rice farming in Niger State, objective 6.

3.5 Model Specification

3.5.1 The Stochastic Frontier Production Function for rice farmers is specified as:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 ij + \beta_2 \ln X_2 ij + \beta_3 \ln X_3 ij + \beta_4 \ln X_4 ij + \beta_5 \ln X_5 ij + Vij - Uij \quad \ldots\ldots \quad (6)$$

Where ln represent logarithm to base e, subscript ij refers to the jth observation of the ith farmer.

Y = total farm output of rice (kg /ha)

X_1= Farm size

X_2 = quantity of rice seed planted (kg/ha)

X_3 = quantity of fertilizer used (kg /ha)

X_4 = quantity of labour (family and non family used in man-days)

X_5 = quantity of herbicide in (liters /ha)

X_6 = quantity of pesticides in (liters /ha)

Vij = a symmetric error component that accounts for random effects and exogenous shock.

εij Ò0 = a one sided error component that measures technical inefficiency of production of farmers, as used to be truncated at zero (0).

$\beta_0 - \beta_n$ = parameters to be estimated.

The inefficiency model is represented by εij which is defined as:

$$\mu ij = \delta oj + \delta_1 InZ_1 ij + \delta_2 InZ_2 ij + \delta_3 InZ_3 ij + \delta_4 InZ_4 ij + \delta_5 InZ_5 ij + \delta_6 InZ_6 ij + \delta_7 InZ_7 ij + \delta_8 InZ_8 ij \quad \text{.........(7)}$$

Where

εij = Technical inefficiency

Z_1 = Age of the farmer

Z_2 = Household size

Z_3 = Educational level

Z_4 = Farming experience (in years)

Z_5 = Sex (1 for female, 0 for female)

Z_6 = No. of access to extension services

Z_7 = No. of access to FADAMA Project Advisory Services

Z_8 = Access to FADAMA input (1 for access, 0 otherwise)

The maximum ï likelihood estimates of the б and δ coefficients in two equation above were estimated simultaneously using program FRONTIER 4.1 (Coelli, 1994).

Objective 3 was realized through summation of input elasticities of production.

Objective 4 was realized through measuring allocative efficiency, which is interpreted as the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to output value is equal to the marginal factor cost. So objective 4 was determined by equating the marginal value product (MVP) of the ith input to its price or marginal factor cost (MFC). Variables with positive coefficients from OLS estimates of the Stochastic Frontier Function were considered. The method of examination is presented as follows:

The output elasticity of an input, X_i denoted by β_i is defined as the proportionate change of output, Q, with respect to X_i,

$$\beta_i = \frac{\partial(\ln q_i)}{\partial(\ln x_i)} = \frac{x_i}{q_i}\frac{\partial q_i}{\partial x_i} = MP_{xi}\, x_i \quad (i = 1, 2, \ldots n) \text{ (Henderson and Quandt, 1980)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

or $MP_{xi} = \beta_i \dfrac{q_i}{x_i}$

and $MVP_{xi} = MP_{xi}\, P$ $\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$ (9)

MP_{xi} is Marginal Product of X_i, which is the rate of change of its total production with respect to variation of X_i, quantity.

MVP_{xi} is the Marginal Value Product of X_i, and it is the product of marginal product of input (MP_{xi}) and output price (P).

Since MVP_{xi} represents the return generated by the additional unit increment of an input X_i, this should just cover the unit price of that input. Thus the MVP_{xi} is referred for determining the profitability of the last additional unit of any input by farmers. A farmer attains allocative efficiency if

$$MVP_{xi} = P_{xi} \text{ or } \frac{MVP_{xi}}{P_{xi}} = 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

3.5.2 Gross Margin, Net Farm Income, and Return on Naira Invested:

Objective (v) that seeks to determine and compare profitability of Fadama III and non-Fadama III beneficiary rice farmers was realized using Gross Margin Analysis, Net Farm Income Analysis and Return per Naira invested. The Gross Margin is given by

$$GM = GFI - TVC \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where

GM = Gross Margin (₦/ha)

GFI = Gross Farm Income (₦/ha)

TVC = Total Variable Cost (N/ha)

NFI =GFI-TVC-TFC é é é é é é é é é é é é é é é é (12)

Where

NFI =Net Farm Income/ha, GFI= Gross Farm Income/ha

TVC= Total Variable Cost/ha and TFC= Total Fixed Cost/ha

And Return per Naira invested, given by RNI = GM ÷ TVC é é (13)

Likert scale Rating Technique was used to identify and measure the constraints faced by Fadama III and non-Fadama III beneficiary rice farmers, and so was used to realized objective vi

3.5.3 Likert Scale Rating Technique:

Likert scale of a 4 point was adopted. The 4 point scale were graded as very serious = 4, serious = 3, not serious = 2 and Not very serious=1. Based on this grading, the problems faced by the farmers were ranked using weighted mean ($\bar{x}$). The mean score of respondents based on the point scale is 4+3+2+1= 10/4= 2.5

Using the interval scale of 0.05, the upper limit cut-off point was 2.50+0.05=2.55; the lower limit was 2.50-0.05=2.45. On the basis of the limit, any mean score below 2.45, (i.e.MS<2.45) was ranked as ñNot serious and Not very serious. Those between 2.45 and 2.55 were considered as óóseriousôô, while any mean score greater than or equal to 2.55 (i.e. MS Ó2.55) was considered as óóvery seriousôô

3.5.4 Hypotheses Testing:

t-test was be used to test hypotheses 1 and 2 at 5 percent level of significance.

Hypothesis I

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

Where t = t-test

$\bar{x}_1$ = The mean technical efficiencies of Fadama III beneficiary rice farmers.

$\bar{x}_2$ = The mean technical efficiencies of non-Fadama III beneficiary rice farmers.

S_1^2 = The variance of the technical efficiencies of Fadama III beneficiary rice farmers..

S_2^2 = The variance of the technical efficiencies non-Fadama III beneficiary rice farmers.

n_1 = The sample size of Fadama III beneficiary rice farmers.

n_2 = The sample size of non-Fadama III beneficiary rice farmers.

Hypothesis II

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

$\bar{x}_1$ = Mean profit of Fadama III beneficiary rice farmers.

$\bar{x}_2$ = Mean profit of non-Fadama III beneficiary rice farmers.

S_1^2 = The variance of the profit of Fadama III beneficiary rice farmers.

S_2^2 = The variance of the profit of non-Fadama III beneficiary rice farmers.

n_1 = The sample size of Fadama III beneficiary rice farmers.

n_2 = The sample size of non-Fadama III beneficiary rice farmers.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Socio-economic Characteristics of Respondents:

The major socio-economic characteristics of respondents considered in this study include age, gender, marital status, household size, farm size, farming experience, educational level and major occupation.

4.1.1 Age of Respondents:

Age of a farmer, to a large extent, affects outputs of farm operations, and can also affect the marginal physical productivity of labour. The age of the respondents studied varied as shown in Table 4.1 below.

Table 4.1: Age of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Age Range(yrs)	Frequency	Percentage	Frequency	Percentage
< 21	0	0.0	4	6.7
21-30	15	25.0	16	26.7
31-40	15	25.0	4	6.7
41-50	7	11.7	22	36.7
51-60	21	35.0	11	18.2
> 60	2	3.3	3	5.0
Total	60	100	60	100
Mean	43.45		42.28	

Source: Field survey, 2011

The results showed that majority of respondents, from both the Fadama III and non-Fadama III beneficiary rice farmers, fall within the productive age of 20-50 years. The mean age of Fadama III beneficiary rice farmers was 43 years while the mean age of non-Fadama III beneficiary rice farmers was 42 years. Although the mean age for the two groups was lower than the one given in the research findings of UNEP (2002) which put the average age of the Niger State rice farmers at 48 years, in both cases here, the average is moving towards the declining productivity of greater than 50 years. This implies that most of these farmers will be productive for some years, but unless capable young hands are encouraged to take to farming, the level of productivity will decline in about a decade. In their study on Technical Efficiency Differentials in Rice Production Technology in Nigeria, Ogundele and Okoruwa(2006) put the mean age of traditional technology rice farmers at 42 years and that of improved technology rice farmers at 45 years, both of which are very close to the findings of this study.

4.1.2 Gender of Respondents:

Gender refers to the sex of the respondents-either male or female. In relation to rice farming activities in Niger State, male farmers are more involved in on-farm production like land preparation, planting, weeding and harvesting while female farmers dominate off-farm activities such as processing and marketing.

The gender distribution of the respondents is presented in table 4.2.

Table 4.2: Gender of Respondents:

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Gender	Frequency	Percentage	Frequency	Percentage
Male	57	95	60	100
Female	3	5	0	0
Total	60	100	60	100

Source: Field survey, 2011

The results showed that 95 percent of the Fadama III beneficiary rice farmers were males and 5 percent were females, while 100 percent of the non-Fadama III beneficiary rice farmers were males. This is in agreement with a study conducted by UNEP (2002) which reported that rice cultivation in Niger State was an exclusive male affair, after reporting that 100 percent of the sampled rice farmers in Niger State were males. The 5 percent female respondents recorded among Fadama III rice farmers may not be unconnected with the gender and vulnerable group advocacy conducted by the project facilitators during PRA facilitation. The women are involved in processing and marketing aspects of rice in Niger State (UNEP, 2002).

4.1.3 Marital Status of Respondents:

Marital status refers to a state of being single, married or divorced. Married farmers have more advantages in terms of farm labour supply compared to unmarried farmers. Table 4.3 shows the marital status of respondents.

Table 4.3: Marital Status of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Marital Status	Frequency	Percentage	Frequency	Percentage
Single	2	3.4	0	0
Married	58	96.6	60	100
Total	60	100	60	100

Source: Field survey, 2011

Most of the rice farmers (96.6 percent of the Fadama III beneficiaries and 100 percent of the non-beneficiaries) were married. This implies that most farmers will have more labour supply for farming operations. The unmarried young men either assist their parents on the farms or provide hired labour to others.

4.1.4 Household Size of Respondents:

A farming household comprises the head of the household, the spouse(s), the children and all other relatives or individuals living and feeding in the same pot with the household head (Ogundele and Okoruwa, 2006). The household size of Respondents is presented in table 4.4.

Table 4.4: Household Size of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Household size	Frequency	Percentage	Frequency	Percentage
1-5	11	18.4	24	40.0
6-10	27	45.0	17	28.4
11-15	20	33.3	17	28.3
16-20	2	3.3	2	3.3
Total	60	100	60	100
Mean	9.4		7.6	

Source: Field survey, 2011

About 78.3 percent and 56.7 percent of the Fadama III and non-Fadama III beneficiary rice farmers respectively had a household size of 6-15. The mean household size of 9.42 and 7.95 were recorded for the Fadama III and non-Fadama III rice farmers respectively. This was very close to the research finding of Ogundele and Okoruwa (2006) which put the average household size of improved technology farmers at 10 and their traditional technology farmers at 8, and averred that household size played significant role in subsistence farming in Nigeria where farmers rely on household members for supply of about 80 percent of the farm labour requirement. This implies that there will be enough hands to participate in the labour intensive rice farming operations.

4.1.5 Farm Size of Respondents:

Farm sizes in Nigeria have been described as small, medium or large scale, if they fall into category of less than 5 hectares, between 5 and 10 hectares or more than 10 hectares (Uptown, 1972).The farm size of respondents is presented in table 4.5.

Table 4.5: Farm Size of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Farm size	Frequency	Percentage	Frequency	Percentage
< 1	0	0.0	0	0.0
1-2	16	26.7	27	45.0
3-4	34	56.7	33	55.0
5-6	10	16.6	0	0.0
Total	60	100	60	100
Mean	3.3		2.6	

Source: Field survey, 2011

The results revealed that 26.7 percent and 45.0 percent of the Fadama III and non-Fadama III rice beneficiary farmers respectively had farm sizes of 1-2 hectares; 56.7 percent and 55.0 percent of the Fadama III and non-Fadama III beneficiary rice farmers had farm sizes of 3-4 hectares. The mean farm size of Fadama III beneficiary rice farmers is 3.3 hectares and that of the non-Fadama III rice farmers is 2.6 hectares, both of which are not far from the mean farm size of 2.6 hectares that Umeh and Atarboh (2006) reported in their research findings. This implies that majority of rice farmers in Niger State are small scale rice farmers that will require access to more land to be effectively transformed into large scale rice farming.

4.1.6 Farming Experience of Respondents:

Farming experience refers to years that farmers have been involved in on-farm operation. It varies from one farmer to another, and experiences acquired are expected to impact positively on farmersô productivity and farm output. The farmersô farming experience is a measure of the level of expertise in the management of farm resources for greater efficiency. Farming experience of respondents is presented table 4.6.

Table 4.6: Years of Farming Experience of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Years of experience	Frequency	Percentage	Frequency	Percentage
1-5	10	16.7	7	11.6
6-10	11	18.3	12	20.0
11-15	6	10.0	9	15.0
16-20	12	20.0	10	16.7
>21	21	35.0	22	36.7
Total	60	100	60	100
Mean	19.78		18.28	

Source: Field survey, 2011

The result showed that 16.7 percent of the Fadama III beneficiary rice farmers, against 11.7 percent of the non-Fadama III beneficiary rice farmers, had farming experience of 1-5 years; while 35.0 percent of the Fadama III beneficiary rice farmers against 36.7 percent of the non-Fadama III beneficiary rice farmers, had farming experience of more than 21 years. The mean farming experience of the Fadama III and non-Fadama III beneficiary rice farmers are 19.8 and 18.28 respectively. Umeh and Attarboh (2006) put the mean farming experience of rice farmers in Kogi State at 17.6 years which is close to the finding of this research. The implication of this finding is that sampled respondents have had a considerable amount of farming experiences and should be able to use resources optimally and produce profitably.

4.1.7 Educational Qualification of Respondents:

Farmersô level of education could influence their ability to use improved seeds, agrochemicals and to assimilate better during extension contact or sessions of Fadama advisory services. Farmersô level of education is presented in table 4.7.

Table 4.7: Educational Qualification of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Education qual.	Frequency	Percentage	Frequency	Percentage
No formal edu .	41	68.3	27	45.0
Pry education	4	6.7	6	10.0
Sec education	7	11.7	14	23.4
Tertiary edu.	8	13.3	5	8.3
Quranic edu.	0	00.0	8	13.3
Total	60	100	60	100

Source: Field survey, 2011

The result showed that 68.4 percent and 45.0 percent of the Fadama III and non-Fadama III beneficiary rice farmers, respectively, had no formal education, leaving only 31.6 percent of the Fadama III beneficiaries against 55.0 percent of the non-Fadama III beneficiary rice farmers as the ones that have acquired various levels of formal education. Since level of education plays a significant role in skill acquisition and in application of new ideas, the implication of this finding is that most rice farmers in the study area will accept and adopt new ideas slowly. Therefore, extension agents and Fadama III facilitators should put this into consideration as they reach out to these rice farmers.

4.1.8 Major Occupation of the Respondents:

Although most rural dwellers have crop farming as a major occupation, some may be part-time farmers that have other areas of earning a livelihood as their major occupation. The frequency distribution of the respondentsô major occupation is presented on table 4.8.

Table 4.8: Major Occupation of Respondents

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Major occupation	Frequency	Percentage	Frequency	Percentage
Crop farming	60	100	50	83.4
Trading	0	0.0	6	10.0
Artisan	0	0.0	2	3.3
Civil servant	0	0.0	5	3.3
Total	60	100	60	100

Source: Field survey, 2011

It is clear from table 4.8 above that 100 percent of the Fadama III beneficiary rice farmers had crop farming as a major occupation against 83.4 percent for the non-Fadama III rice farmers. The result also revealed that about 16.6 percent of the non-Fadama III rice farmers had other livelihoods. This implies that some of the non-Fadama III beneficiary rice farmers will divide their attention between crop farming and other occupation unlike the beneficiary rice farmers that will devote all their time to farming.

4.2.1 Technical Efficiency of Fadama III and non-Fadama III Beneficiary Rice Farmers in Niger State:

The technical efficiency indices were derived from MLE results of the stochastic production function, using computer programme FRONTIER 4.1.The result of the maximum likelihood estimates for the Fadama III and non-Fadama III beneficiary rice farmers is presented in table 4.9 on the next page.

Table 4.9: Maximum Likelihood Estimates of Parameters of the Cobb-Douglas Frontier Function for Fadama III and non-Fadama III beneficiary Rice Farmers in Niger State

		Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Variables	Parameter	Coefficients	t-ratio	Coefficients	t-ratio
Production factor					
Intercept	$ɓ_0$	-2.679	-4.185	-1.899	-0.724
Farm size	$ɓ_1$	0.231	1.541	0.596	1.124
Seed	$ɓ_2$	0.479	4.007 **	0.229	0.891
Fertilizer	$ɓ_3$	-0.063	-1.282	0.069	3.090**
Labour	$ɓ_4$	0.445	3.795**	0.258	0.388
Herbicides	$ɓ_5$	0.093	2.905**	0.025	0.248
Pesticides	$ɓ_6$	0.185	1.003	-0.009	-0.006
Inefficiency Factors					
Constant	Z_0	1.083	3.896	-0.613	-0.098
Age	Z_1	-0.029	-6.108**	-0.005	-0.059
Household size	Z_2	-0.002	-0.089	-0.035	-0.080
Educational level	Z_3	-0.019	-2.191 *	0.005	0.608
Farming experience	Z_4	0.009	1.787	0.032	0.779
Sex	Z_5	0.361	2.426	0.691	0.211
Extension contact	Z_6	-0.002	-0.037	-0.254	-2.128*
Fadama Advisory Service	Z_7	-0.071	-0.141	0.000	0.000
Fadama Input Supports	Z_8	0.187	1.578	-0.257	-0.054
Diagnostic statistics					
Sigma-squared	ŭ	0.478	4.137	0.327	0.815
Gamma	γ	0.657	5.414	0.456	0.283
Log likelihood ratio		3.61	4.136		
LR Test		21.87	3.764		

Source: Field survey, 2011

**, *; Significant at 1% and 5%, respectively

The results of the maximum likelihood estimates for the Fadama III beneficiary rice farmers revealed that farm size, seed, labour, herbicides and pesticides give positive coefficients of 0.231, 0.479, 0.445, 0.093 and 0.185 respectively, thereby conforming to *a priori* expectation. From these results, seeds appear to be the most important factor of production with an elasticity of 0.479, suggesting that a unit increase in seed results in 0.479 increases in output, given the existing technology. The second most important factor input is labour, followed by farm size, pesticide and herbicide.

From the t-ratio, seed, labour and herbicides contributed significantly to the technical efficiency of the Fadama III beneficiary rice farmers. This implies that seeds, labour and herbicides are significant factors influencing changes in output of rice among Fadama III beneficiary rice farmers. The significance of seeds may imply that the group used the right seed and the right spacing; the significance of labour indicates that rice farming in the group is labour intensive and so its availability reflects the outputs; the significance of herbicides shows the groupôs increased use of better weed control method. Fertilizer was found to be curiously inversely related to output but not significant in the Fadama III beneficiaries, indicating that the soil nutrients requirements and the type of inorganic fertilizer applied to a specific land is as important as the quantity of fertilizer used. For the non-Fadama III beneficiary rice farmers, except for pesticide with a negative coefficient of ï 0.009, all the remaining inputs of farm size, seeds, fertilizer, labour, and herbicides gave positive coefficients of 0.596, 0.229, 0.069, 0.258 and 0.025. From the results, the most important factor of production in the non Fadama III beneficiary farmers is farm size with a coefficient of 0.596, followed by labour with 0.258, seed with 0.229, fertilizer (0.069) and herbicides (0.025). From the t-ratio, fertilizer is the only input contributing significantly to output of the non-Fadama III beneficiary rice farmers.

The finding here conforms to some research finding of Shehu and Mshelia (2006), Umeh and Attarboh (2006) and Aye and Oboh (2006), which listed labour and herbicides among inputs contributing significantly to output. However, points of divergence from the research finding in these works still exist. Shehu and Mshelia (2006) and Umeh and Attarboh (2006) included farm size and fertilizer as factors contributing significantly to technical efficiency of rice farmers, but in this study, fertilizer contributed significantly only to the technical efficiency of the non-Fadama rice farmers while farm size which had a positive correlation with output in the two groups was not significant. However, Ogundele and Okoruwa (2006) found that contribution of fertilizer to rice output was not significant, while Muhammed, Ojo and Olaleye (2009) also discovered an inverse relationship between fertilizer used and yam output.

The result of inefficiency model from the estimated coefficients of inefficiency is also in table 4.9. The estimated coefficients of the inefficiency function provide some explanations for the relative efficiency levels among individual farms (Muhammed, Ojo and Olaleye, 2009). Since the dependent variable of the inefficiency function represents the mode of inefficiency; a positive sign of an estimated parameter implies that the associated variable has a negative effect on efficiency and a negative sign indicates the reverse.

For Fadama III beneficiary rice farmers, age, household size, educational level, extension contact and Fadama Advisory Services are correctly signed, conforming to *a priori* expectations; but only age and educational level are significant at 5% level. For the non-fadama III beneficiary, age, household size, extension contact and Fadama input support are correctly signed confirming to *a priori* expectation but only extension contact is significant at 5% level. In other words, these variables have positive effects on technical efficiency in rice production, which means they are crucial for effective utilization of the stated inputs in rice production in Niger State, Nigeria. The negative coefficients of age, household size, educational level, extension contact and Fadama advisory services/training among Fadama III beneficiaries implies that as farmers get older, and as their household size increase, their technical efficiency increase probably due to acquisition of more skills and availability of more hands to till the land in the labour intensive rice farming in the state. The findings on age and household size conform to the research finding of Umeh and Attarboh (2006). The negative and significant coefficient of educational level, extensions contact and Fadama Advisory Services shows that farmers with greater years of formal schooling and larger extension contact tend to be more technically efficient. This agrees with the research finding of Seyoun *et al* (1998), Amaza and Tashikalma (2003) Amos *et al* (2004), Amaza and Maurice (2005) and Shehu and Mshelia (2007). The finding on Advisory Services and Training conforms to the finding of Adama (2010)

It is puzzling that Fadama inputs support, which contributed though not significantly to the technical inefficiency of fadma III beneficiary rice farmers significantly add to the technical efficiencies of the non-Fadama III beneficiary rice farmers, who purchased some of their inputs from the Fadama III beneficiaries that got their inputs directly from the project. This is probably due to the fact that the inputs may be too small for the Fadama III beneficiaries who cultivate an average farm size of 3.3 ha against the non-Fadama beneficiaries with average farm size of 2.6. ha

4.2.2 Diagnostic Statistics:

The estimated *sigma squared* for Fadama III is 0.478 and statistically significant at 1%. This indicates a good fit and the correctness of the specified assumption of the composite error term.

Furthermore, the gamma ratio of 0.657 which is significant at 1% implied that 65.7% of the variations in the output of Fadama III beneficiaries results from the differences in their technical efficiencies. For the non-Fadama III rice farmers, the estimated sigma squared is 0.327 and the gamma ration is 0.450, which implies that 45% of the variation in output of the non-Fadama III rice farmers results from differences in their technical efficiencies. The implication here is that there are larger variables for variation in output among the non-Fadama III beneficiary rice farmers, which could not be attributed to technical inefficiency of the farmers. This could include soil fertility, weather, health of the farmers, including the farmerǿs state of mind, distance to their farms and means of movement to their respective farms, amongst others.

4.2.3 Frequency distribution of the Technical Efficiency among Fadama III and Non-Fadama III beneficiaries.

The frequency distribution of the technical efficiencies among the two groups is presented in table 4:10.

Table 4.10 Frequency Distribution of the Technical Efficiency of Fadama III and non-Fadama III Rice Farmers in Niger State

	Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Efficiency class	Frequency	Percentage	Frequency	Percentage
0.00-0.30	0	0.0	0	0.0
0.31-0.40	0	0.0	0	0.0
0.41-0.50	5	8.3	4	6.7
0.51-0.60	8	13.3	4	6.7
0.61-0.70	11	81.4	9	15.0
0.71-0.80	8	13.3	9	15.0
0.81-0.90	1	1.7	10	16.6
0.91-01.0	27	45.0	24	40.0
Total	60	100.0	60	100.0
Mean	0.79		0.81	
Maximum	1.0		0.98	
Minimum	0.41		0.43	

Source: Field survey, 2011

The results showed that 5 percent of the Fadama III beneficiary rice farmers had a technical efficiency of between 0.41 ï 081 and 45 percent of the group had a technical efficiency of between 0.81 ï 1.0 while 43.4 percent of the non-Fadama III beneficiary rice farmers had a technical efficiency of 041 ï 081 while 56.6 percent of the group recorded a technical efficiency of 0.81 ï 0.98. From this distribution, the farmer specific indices of technical efficiency vary widely ranging between 0.411 and 1.00 in the Fadama III beneficiaries, and 0.435 and 0.989 in the non-Fadama III beneficiaries. The mean technical efficiency of 0.79 for the Fadama III beneficiary rice farmers indicates that technical efficiency in rice production in this group could be increased by 21 percent while the mean technical efficiency of 0.81 for the non-

Fadama beneficiary farmers suggests that rice production in this group could be increased by 19 percent through better use of available resources, given the current state of technology. The increase could be achieved through farmer specific factors that include age, household size, and opportunity for more education, increased extension contact, and access to input supports.

4.2.4 Elasticity of Factor Inputs and Return to Scale of Fadama III and Non Fadama III Beneficiary Rice Farmers:

The input elasticity of production for the Fadama III and Non Fadama III beneficiaries are presented in table 4.11.

Table 4.11 Estimated Elasticity of Factor Inputs and Returns to Scale of Fadama III and non-Fadama III Beneficiary Rice Farmers in Niger State

	Fadama III Beneficiaries	Non-Fadama III Beneficiaries
Variable	Coefficient (Elasticity of production)	Coefficient (Elasticity of of production)
Farm size	0.230	0.596
Seed	0.479	0.229
Inorganic fertilizer	-0.063	0.069
Labour	0.445	0.258
Herbicides	0.093	0.025
Pesticides	0.185	-0.009
Return to Scale	**1.432**	**1.168**

Source: Field survey, 2011

The summation of the elasticity for the Fadama III beneficiaries gives 1.432 while that of the non-Fadama III beneficiaries give 1.168, both of which indicate increasing return to scale. This means that rice production in the two groups is still in stage 1 of the production of the production function. Therefore, farmers could improve the productivity of inputs by increasing their levels of use as efficiency of rice production in the area is sub-optimal. Umeh and Attarboh (2006) recorded an increasing return to scale of 1.82 for rice farmers in Kogi State and thus averred that there are potentials for rice output expansion in the study area.

4.3 Assessment of the Allocative Efficiency of Fadama III and Non-Fadama III Beneficiary Rice Farmers:

The Allocative efficiency of Fadama III and non-Fadama III beneficiary rice farmers is derived using the OLS estimates of the Cobb-Douglas frontier production function. The result of OLS estimates is presented in table 4.12.

Table 4.12: OLS Estimates of Parameters of the Cobb-Douglas Frontier Function for Fadama III and non-Fadama III beneficiary Rice Farmers in Niger State

		Fadama III Beneficiaries		Non-Fadama III Beneficiaries	
Variables	Parameter	Coefficients	t-ratio	Coefficients	t-ratio
Production factor					
Intercept	β_0	-3.020	-0.464	-2.821	-7.660**
Farm size	β_1	0.360	2.261*	0.606	4.061**
Seed	β_2	0.198	1.671	0.184	2.399*
Fertilizer	β_3	-0.376	-0.674	0.192	4.197**
Labour	β_4	0.677	6.210**	0.332	3.917**
Herbicides	β_5	0.149	4.35**	0.013	0.259*
Pesticides	β_6	-0.116	-0.688	0.079	1.247
Sigma-squared	ŭ	0.65		0.77	

Source: Field survey, 2011

**, *; Significant at 1% and 5% significant level, respectively

The estimated OLS results showed that coefficients of farm size, labour and herbicides of the Fadama III rice farmers are significant, while the coefficients of all investigated parameters of the non-Fadama III beneficiary rice farmers, except that of pesticides are significant at either 1% or 5% level of significant.

4.3.1 Allocative Efficiency of Fadama III Beneficiary Rice Farmers:

Allocative efficiency is interpreted as the extent to which farmers make efficient decisions by using inputs up to the level at which their marginal contribution to output value is equal to the marginal factor cost. Allocative efficiency of Fadama III beneficiary rice farmers is presented in table 4.13

Table 4.13 Allocative Efficiency of Fadama III Beneficiary Rice Farmers

Variable	MFC_i	B_i	P_y	MVP ($MPP.P_y$)	Ki (MVP_i/MFC_i	Deviation from Optimality ($1-K_i$)
Farm size	8,500	0.360	50,000	18,000	2.12	-1.12
Seed	4,800	0.198	50,000	9,900	2.06	-1.06
Labour	2,000	0.677	50,000	3,385	1.69	-0.69
Herbicides	1,200	0.149	50,000	7,450	6.20	-5.20

Source: Field survey, 2011

Only variables with positive coefficients from the OLS estimates were considered

The result showed that the factor inputs of farm size, seed, labour and herbicides give MVP/MFC ratio of 2.12, 2.06, 1.69 and 6.20 respectively, which means that these inputs are underutilized. Therefore, avenues that will encourage farmers to increase the use of these inputs should be explored..

4.3.2 Allocative Efficiency of Non Fadama III Beneficiary Rice Farmers:

The Allocative efficiency of the non Fadama III beneficiary rice farmers is presented in table 4.14.

Table 4.14 Allocative Efficiency of Non Fadama III Beneficiary Rice Farmers

Variable	MFC_i	B_i	P_y	MVP ($MPP.P_y$)	Ki (MVP_i/MFC_i	Deviation from Optimality ($1-K_i$)
Farm size	8,500	0.606	50,000	30,000	3.56	-2.56
Seed	4,800	0.184	50,000	9,200	1.96	-0.96
Fertilizer	4,000	0.192	50,000	9,600	2.4	-1.4
Labour	2,000	0.332	50,000	16,600	8.3	-7.3
Herbicides	1,200	0.126	50,000	6,300	5.25	-4.2
Pesticide	1,100	0.791	50,000	39,550	35.95	-34.95

Source: Field survey, 2011

Only variables with positive coefficients from the OLS estimates were considered

The results showed that factor inputs of farm size, seed, fertilizer, labour, herbicides and pesticides give MVP,/MFC ratio of 3.56, 1.96, 2.4, 8.3, 5.25 and 35.95 respectively, which shows that the inputs are underutilized. Therefore, avenues that will encourage farmers to increase the use of these inputs should be explored and exploited.

As Schmidt (1986) had noted, Allocative efficiency measures the potential reduction in cost from using optional input proportions. Therefore, the implication of these findings is that farmers may be making profit, but not at the maximum level where $MVP_{X1} = P_{X1.}$ Therefore, for the underutilized inputs here, additional inputs should be employed to attain optimal level.

4.4 Cost and Returns of Fadama III and non-Fadama III Beneficiary Rice Farmers in Niger State:

Farmers who sold their produce early received lower price than those who sold later. Paddy rice sold at farm gate is the cheapest in a season. The cost and returns to Fadama III and non-Fadama III beneficiary rice farmers in Niger State is in table 4 .15.

Table 4. 15: Costs and Returns of Fadama III and non-Fadama III Beneficiary Rice Farmers in Niger State.

	Fadama III Beneficiary		Non-Fadama III Beneficiaries	
Average Yield/ha in tons	2.16		1.17	
Unit Price (N/ton)	N49,808.07		48,957.15	
Variables	Cost (N/ha)	% of Total Cost	Cos(N/ha)	% of Total Costs
Variable Costs				
Seed	2,502.51	6.25	3,458.33	12.03
Seed Chemical	166.10	0.41	177.77	0.62
Inorganic Fertilizer	6,394.98	15.98	2,135.42	7.43
Herbicides	3,220.1	8.06	2,167.37	7.54
Pesticides	117.59	0.29	354.86	1.24
Packaging Material	2,871.16	7.17	879.86	3.06
Labour	23,024.62	57.52	17,855.9	62.16
Total Variable Cost	**38,297.06**	**95.68**	**27,095.51**	**94.08**
Fixed Cost				
Depreciation on cutlasses	155.77	0.39	158.78	0.55
Depreciation on hoes	717.16	1.79	573.47	1.99
Depreciation on axes	64.73	0.16	37.67	0.13
Depreciation on sprayers	651.56	1.64	315.73	1.09
Depreciation on sickles	139.24	0.34	216.29	0.75
Depreciation on irr pump	0.0	0.0	398.15	1.39
Total Fixed Cost	**1,728.46**	**4.32**	**1,700.09**	**5.92**
Total Costs	**40,025.52**		**28,729.6**	
Returns				
Gross Income	107,585.43		57,279.86	
Gross Margin	69,288.37		30,250.36	
Net Farm Income	67,559.91		28,550.26	
Returns on Naira Invested	1.81		1.12	

Source: Field survey, 2011

The results showed that the Fadama III beneficiary rice farmers produce an average yield of 2.16 tons per hectare and sold at an average price of N 49, 808.07 per ton while the non-Fadama III beneficiary rice farmers produce an average yield of 1.17 tons per hectare and sold at an average price of N 48,957.15. The results reveal that the total cost of production for Fadama III beneficiary rice farmers was N40,025.52 per ha against N28,729.6 per ha for the non-Fadama III beneficiary rice farmers. The Total Variable Cost for the Fadama III rice farmers was N38,297.06 against N27,095.51 per ha for the non-Fadama III rice farmers. The Total Variable Cost constitutes 95.68% and 94.08% of the Total Cost for the Fadama III and non-Fadama III rice farmers respectively. This reflects the small scale nature of rice production in Niger State with Fixed Costs accounting for only 4.32% and 5.92% of the Total Costs for the Fadama III and non-Fadama III beneficiary rice farmers respectively in Niger State. This low proportion of Fixed Cost tallies with the research finding of Baba (2010), which reported low fixed cost that reflect low investment on capital items. Labour cost account for 57.52% and 62.16% of the Total Cost for the Fadama III and non-Fadama III rice farmers respectively, reflecting the labour intensive nature of rice farming in the state. This conforms to the research finding of UNEP (2002) which reported that labour cost component account for the highest share of production cost across three agro-ecological zones in Nigeria and put the Niger State share of the labour cost at 79.74% of the total cost.

Fadama III rice farmers made a gross margin of N69,288.37 per ha and a net farm income of N67,559.91 per ha while the non-Fadama III rice farmers made a gross margin of N30,250.36 per ha and a net farm income of N28,550.26 per ha. The Fadama III rice farmers recoded a return on Naira invested of 1.81 while the non-Fadama III rice farmers made a return on Naira invested of 1.21. This means that on every Naira invested, the Fadama III rice farmers made 1.181 Naira while the non-Fadama III beneficiary rice farmers made 1.121 naira. The research findings here are not far away from the research finding of Nwoye (1997) who studied the economics of rice production in Anambra State, and reported that the rice farmer made 1.59 in revenue for every one Naira spent.

4.5 Constraints of Rice Farming in Niger State as perceived by the Farmers:

Rice farmers in Niger State face various types of constraints that have not allowed them operate more profitably and optimally. The mean distribution of rice farming constraints as perceived by rice farmers in Niger State is presented in table 4.16

Table 4.16: Mean Distribution of Rice Production Constraints as Perceived by Rice Farmers in Niger State:

	Fadama III Beneficiaries	Non-Fadama III Beneficiaries
Constraints	Mean	Mean
Land Acquisition	1.37*	2.48**
Lack of tractor hiring service	3.65***	3.85***
Lack of high yielding seeds	1.15*	3.65***
Scarcity of labpour	1.88*	1.55*
Low fertility of soil	3.00***	3.03***
Lack of finance	3.87***	2.71***
Low price of local rice	2.58***	2.61***
Competition from imported rice	2.56***	2.71***
Inadequate access to fertilizer	1.18*	1.00*
High cost of fertilizer	2.58***	2.56***
High cost of herbicides/pesticides	1.82*	2.33*
High cost of production	2.46**	2.48**
Inadequate storage facilities	2.77***	2.93***
Inadequate education	1.30*	1.38*
Poor credit accessibility	3.06***	1.23*

Source: Field survey, 2011

* Not serious constraint

** Serious constraint

*** Very serious constraint

The result showed that lack of tractor hiring service, low soil fertility, lack of finance, low price of local rice, competition from imported rice, high cost of fertilizer and inadequate storage facilities are regarded as very serious constraints by both Fadama III and non-Fadama III beneficiary rice farmers. In addition, Fadama III beneficiary rice farmers also see poor credit accessibility as a very serious constraint while the non Fadama III beneficiaries in addition see lack of high yielding seeds as a very serious constraint. Both groups regarded high production cost as a serious constraint. In addition, the non-Fadama III beneficiary rice farmers also see land acquisition as a serious constraint, a constraint that the Fadama III rice farmers regarded as not serious.

Both Fadama III and non-Fadama III rice farmers perceived scarcity of labour, inadequate access to fertilizer, inadequate herbicides/pesticides, and inadequate education/technical skill constraints as not serious.

Lack of tractor hiring service is considered as a serious constraint by both groups in spite of WARDA (2003) position that mechanization is common in flood plains. This constraint could be as a result of ageing tractors and inadequate new ones to replace the old ones. The non-Fadama III beneficiary rice farmers considered the constraint of lack of high yielding seed as serious, thereby conforming to the position of WARDA (2003) which reported limited dissemination of improved varieties.

The perceptions that the two groups have about the constraints of low price of local rice and competition from imported rice is in agreement with WARDA (2003), which reported that even though imported rice is about 30% more expensive than local rice, many consumers still prefer to buy imported rice because it is cleaner and has a better appearance. Therefore, in Strategy for Rice Sector Revitalization in Nigeria, WARDA (2003) asserted that maintenance of some degree of rice protection is needed. However, the paper warned that rice imports should not be banned, as they provide a competitive environment needed to continuously mobilize innovation and entrepreneurship for the development of the rice sector.

4.6 Test of Hypotheses:

T-test on the technical efficiencies of the Fadama III and Non-Fadama III rice farmers in Niger State is in table 4.17.

Table 4.17: T-test on technical efficiency of rice farmers

Variables	Mean	N	Std Deviation	Std Error Mean	T-value	T-tab	Sig 2 tail	Decision
Technical Eff. of Beneficiary	79.02	60	.1879750	.0242675				
					-.577	2.001	.566	Accept
Technical Eff. Of Non Beneficiary	81.15	60	.1613507	0208303				

Source: Field survey, 2011

The result showed a mean technical efficiency of 79.02 and 81.15 for the Fadama III and non Fadama III rice farmers respectively, with a t-cal value of ï 0.577 and t-tab value of 2.001 for two-tailed test at 5% level, revealing that there is no significant difference between the means of Fadama III and non Fadama III beneficiary rice farmers. Therefore, the null hypothesis is accepted.

T-test on the profitability of the Fadama III and Non-Fadama III rice farmers in Niger State is in table 4.18

Table 4. 18: T-test on Profitability of Rice Farmers in Niger State

Variables	Mean	N	Std Deviation	Std Error Mean	T-value	T-tab	Sig 2 tail	Decision
Profit sof Beneficiaries	67921.68	60	65,883.711	8505.551				
					6.350	2.001	.000	Reject
Profit of Non Beneficiaries	22591	60	177908.373	22967.872				

Source: Field survey, 2011

The t-test results showed a mean profit of 67921.68 for the Fadama III beneficiary rice farmers against a mean profit of 22591.6 for the non-Fadama III beneficiary rice farmers, and a t-cal value of 6.350 and a t-tab value of 2.001, indicating a significant difference between the profit of the Fadama III and non-Fadama III beneficiary rice farmers, and rejecting the null hypothesis that there is no significant differences between the profitability of Fadama III and non-Fadama III beneficiary rice farmers because t-cal (6.350) > t-tab (2.001) at 5% level of significance.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

This study was carried out to compare the resource use efficiency of Fadama III and non-Fadama III beneficiary rice farmers in Niger State.

Specifically, the study intended to examine and compare the socio-economic characteristics of Fadama III and non-Fadama III rice farmers in Niger State; determine and compare technical and allocative efficiencies of the Fadama III and non-Fadama III beneficiary rice farmers in Niger State; estimate the return to scale of the two groups; determine and compare profitability of the two groups; identify Major constraints of rice farming in Niger State and give recommendations based on the findings of the study.

A multi-stage sampling technique was used in choosing 120 respondents that comprises of 60 Fadama III beneficiary rice farmers and 60 non-Fadama III beneficiary rice farmers across the three agricultural zones of the state. Data were collected based on 2010/2011 cropping season through structured questionnaires/interview schedules.

Data were analyzed using descriptive statistics, stochastic frontier production function, return to scale, gross margin, net farm income and Likert scale rating technique. T-statistics was used to test the study hypotheses.

The results showed that the Fadama III beneficiary rice farmers had a mean age of 43 while the non-beneficiary rice farmers had a mean age of 42. Males constituted 95 percent of the beneficiary rice farmers, and the entire 100 percent of the non-beneficiary rice farmers were males. About 96.6 percent of the beneficiary rice farmers were married while the 100 percent respondents of the non-beneficiary rice farmers were married. Average household sizes of 9.42 and 7.95 were recorded for Fadama III and non Fadama III rice farmers respectively; mean farm sizes of 3.3 and 2.6 hectares were recorded for the Fadama III and non Fadama III beneficiary rice farmers respectively. About 100 percent of the Fadama III beneficiary rice farmers had crop farming as a major occupation against 83.4 percent of the non Fadama III beneficiary with crop farming as a major occupation. The mean farming experience of 19.8 and 18.28 years were recorded for Fadama III and Non-Fadama III beneficiary rice farmers, respectively.

The result from the stochastic frontier production function showed that the technical efficiencies of the Fadama III rice farmers ranged from 0.411 ï 1 with a mean value of 0.79, while that of the non Fadama III beneficiary rice farmers ranged from 0.435 ï 0.989 with a mean value of 0.81 on the scale of 1. The findings revealed that seed, labour and herbicides contribute significantly to changes in the output of rice among Fadama III beneficiary rice farmers while fertilizer is the only input contributing significantly to the technical efficiency of the non Fadama beneficiary rice farmers.

The estimated coefficients of inefficiency for Fadama III beneficiary rice farmers indicated that age, household size, educational level, extension contact and Fadama advisory services are negative, but only age and educational level are significant at 5 percent, while for the non-Fadama III beneficiary rice farmers, age, household size and extension contact are negative with only extension contact being significant at 5 percent level. This suggests that technical inefficiency effects in rice production declined with increase in these variables, meaning that they have positive effects on technical efficiency in rice production for their respective groups.

The return to scale value of 1.432 and 1.168 for the Fadama III and non Fadama III beneficiary rice farmers respectively are both an increasing return to scale since the values are greater than unity, indicating potentials for rice output expansion in Niger State.

The Allocative efficiency analysis shows that for Fadama III beneficiary rice farmers, factor inputs of farm size, seed, labour and herbicides with MVP/MFC ratio of 2.12, 2.06, 6.77 and 7.87 respectively were underutilized. For the non Fadama III beneficiary rice farmers, farm size, seed, fertilizer, labour, herbicides and pesticieds which give MVP/MFC ration of 3.59, 1.96, 2.59, 23.7, 5.25 and 35.95, respectively, were also underutilized.

Fadama III beneficiary rice farmers made a gross margin of ₦69, 288.37, a net farm income of ₦67,599.91 per hectare and a return on Naira invested of 1.81 while the non-Fadama III beneficiary rice farmers made a gross margin of ₦30, 250.36 per ha, a net farm income of ₦28, 550.26 per hectare and a return on Naira invested of 1.12.

Both Fadama III and Non Fadama III beneficiary rice farmers perceived as very serious constrains the challenges of lack of tractor hiring scheme, low price of local rice, competition from imported rice, high cost of fertilizer and inadequate storage facilities.

5.2 CONCLUSION:

The study examined the resource use efficiency of Fadama III and non Fadama III rice farmers in Niger State and found an insignificant difference in the technical efficiencies of the Fadama III and non Fadama III rice farmers. However, the research finding revealed a statistically significant difference in the profit of the two groups as Fadama III rice farmers made a return on Naira invested on 1.81 while the non Fadama III rice farmers made return on Naira invested of 1.12. The study also found that both Fadama III and non-Fadama III rice farmers were not making optimal use of resources as shown by return to scale and allocative efficiency analysis.

5.3 RECOMMENDNATIONS:

Based on the findings of this study, the following recommendations, pertaining project implementers, policy makers and possible areas for further studies are presented.

5.3.1 PROJECT IMPLEMENTERS:

i. Projects like Fadama III that adopt CDD approach should put strategies on ground to avoid the challenge of elite capture of the intervention in the communities. It was found in this study that whereas 6.7 percent and 11.7 percent of the Fadama III beneficiary rice farmers had access to primary and secondary education respectively, 10 percent and 23.3 percent of the non-Fadama III beneficiary rice farmers had access to primary and secondary education. However, 13.3 percent of the Fadama III beneficiary rice farmers against 8.3 percent of the non-Fadama III beneficiary rice farmers accessed tertiary education. The edge the beneficiary group had over the other group in the access to tertiary education could be good for the project but it could also explain the movement of elite into the beneficiary communities to capture the intervention.

ii. Advisory services of farmers should be intensified as it contributes positively, though not significantly to the technical efficiency of the beneficiary rice farmers.

iii. Projects should ensure that inputs with which they support beneficiary farmers are used by the farmers in the areas they were intended for, and are not sold off.

5.3.2 POLICY IMPLICATION FOR POLICY MAKERS:

i. As this study and related literature have shown, a positive correlation exist between farm size and rice output, therefore, it is imperative for policy makers to put policies on ground that will make rice farmers access more productive land for increased rice production.

ii Policy makers should facilitate the access and appropriate usage of high yielding seed like NERICA by rice farmers as seed in this study contributes positively to the output of both the Fadama III and non Fadama III beneficiary rice farmers but contribute significantly to only the Fadama III beneficiary rice farmers.

iii. Fertilizer significantly, positively contribute to output of the non beneficiary rice farmers, but had an inverse relationship with the output of beneficiary rice farmers, therefore, it is imperative for government to put effective strategies that will allow for timely and adequate access for inorganic fertilizer by rice farmers. Also farmers should be educated to use the right fertilizer at the right time.

iv. As labour contributes positively to both Fadama III and non Fadama III beneficiary rice farmerôs output, and significantly to the former, it is recommended that due attention should be given to provision of effective and affordable labour saving technology like 3 wheel tractors amongst others for rice farmers.

v. It is hereby also recommended that government should improve rice farmers access to agro-chemicals like herbicides and pesticides.

vi. With regard to farmer specific factors, formal education and extension contact beside farmers age and household size, revealed a positive correlation with technical efficiency, therefore, government should encourage farmers to improve their levels of education through provision of adequate functional adult education centers, and should increases the ratio of the number of extension agents to farmers so that farmers will have greater contact with extension services. At the same time government should ensure better input distribution system.

vii. With both Fadama III and non Fadama III beneficiary perceiving low price of local rice and competition from imported rice as very serious constraints, it is pertinent to recommend that government should periodically review upwards the import tariffs on rice as this has boosted local production in the past. However, according to WARDA (2003) rice import should not be banned, as they provide a competitive environment needed to continuously mobilize innovation and entrepreneurship for the rice sector development. Moreover, during the ban period of 1986 ï 1995, illegal importation went on across the countryœs border. It is important for policy makers to address the quality gap that has made local rice cheaper by empowering producers and processors with knowledge and materials for processing high quality rice.

5.3.2 POSSIBLE AREAS FOR FURTHER STUDIES:

i. Further studies should compare rice production technology in Nigeria with the technologies in other parts of the world like Ivory coast and Senegal where farmers achieve greater output than Nigeria with a view towards not only identifying factors that have given these countries the edge, but also identifying factors that will make Nigerian farmers to adopt those practices that have given these countries greater outputs over the years.

ii. In order to address the quality gap that has made the foreign rice both more expensive and more attractive, further studies to identify factors beside higher price that will make rice processors adopt better processing methods are essential.

iii. With both Fadama III and non-Fadama III beneficiary rice farmers perceiving high cost of fertilizer as a serious constraint and the two groups yet together again perceiving the constraint of inadequate access to fertilizer as not serious, a further study to determine the influence of fertilizer subsidy on fertilizer usage, and on Nigerian rice output is recommended. The study can also determine how advanced economies like the US and the EU amongst others have used subsidies to significantly boost their farmersô production.

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APPENDICES

UNIVERSITY OF NIGERIA, NSUKKA

DEPARTMENT OF AGRICULTURAL ECONOMICS

RESEARCH QUESTIONNAIRE/INTERVIEW SCHEDULE FOR RICE FARMERS IN NIGER STATE.

Dear Rice Farmer,

I am a postgraduate student of the University of Nigeria, Nsukka, conducting a research work on the topic, A Comparative Analysis of Resource Use Efficiency among Fadama III and non-Fadama III Beneficiary Rice Farmers in Niger State..

I shall be happy if you will kindly fill in the attached questionnaire as objectively as you possibly can to enable me to carry out this study successfully. The research work is purely an academic work and has nothing to do with tax payment. Your opinion will be treated confidentially.

Thank you.

Mamun Mallam
Researcher

SECTION A ï IDENTIFICATION

Question number: ____

1. Name of respondent: ____
2. Name of Fadama Community Association/Farmer Union: _________________________
3. Name of community: ____
4. Local Government Area: ____
5. Agricultural Zone: ____
6. Interview Date: ____
7. Type of respondent: (i) Fadama II beneficiary [ ] (ii) Non-Beneficiary of Fadama II project [ ]

SECTION B ï SOCIO ECONOMIC CHARACTERISTICS OF RESPONDENTS

8. Age of respondent (Years):____
9. Gender of the respondent (a) Female [ ] (b) Male [ ]
10. Marital status of respondent (a) Married [ ] (b) Single [ ] (c) Divorced [ ] (d) Widow (er) [ ]
11. Household size (The number of people in the household): _________________________
12. What is your highest educational qualification? __________________________________
    a. No Formal education [ ]
    b. Primary education [ ]
    c. Secondary education [ ]
    d. Post ï secondary education [ ]
    e. Others [ ]
13. How many years of rice farming experience have you had: __________________________
14. What is your major occupation?
    a. Crop farming [ ] b. Agro-Processing [ ] c. Trading [ ] d. Artisan [ ] e. Livestock farming [ ] f. Civil Servant [ ] g. Commercial motorcyclist [ ] h. Fishing [ ] i. Others [ ]
15. What is your secondary occupation?
    a. Crop farming [ ] b. Agro-Processing [ ] c. Trading [ ] d. Artisan [ ] e. Livestock farming [ ] f. Civil Servant [ ] g. Commercial motorcyclist [ ] h. Fishing [ ] i. Others [ ]
16. How many member of your household participate in rice farming?: __________________
17. How many times do you have access to extension service in the last farming season?
18. How many times do you have access to Fadama II training under capacity building last year?
19. How many times do you have access to Fadama II input support?
20. How many times do you have access to Fadama II advisory services?
21. What is the ownership status of the dwelling you used?
    a. Owns the dwelling
    b. Family dwelling
    c. Rents the dwelling
    d. Nomadic temporary dwelling
    e. Others (Specify): ____

22. How many hectares of land do you own?
    a. Less than 1
    b. 1-2
    c. 3-4
    d. 5 and above.

23. How many heads of cattle and other large livestock do you own?
    a. None
    b. 1-2
    c. 3-4
    d. 5 and above.
24. How many sheep, goats and other medium size animals do you currently own?
    a. None
    b. 1-2
    c. 3-4
    d. 5 and above.
25. Which of the following asset do you own?

		Yes	No
i.	Radio set	[ ]	[ ]
ii.	G.S.M	[ ]	[ ]
iii.	Bed/mantras	[ ]	[ ]
iv.	Bicycle	[ ]	[ ]
v.	Motor cycle	[ ]	[ ]
vi.	Generator	[ ]	[ ]
vii.	Refrigerator	[ ]	[ ]
viii.	Milling machine	[ ]	[ ]
ix.	TV set	[ ]	[ ]
x.	Fans	[ ]	[ ]
xi.	Vehicle	[ ]	[ ]

26. What is the material of the roof of your house?
    a. Mud [ ] b. Thatch [ ] c. Wood [ ] d. Iron sheets [ ] e. Cement concrete [ ] Others ____________________

27. What is the material of the walls of your house?
    a. Mud/mud bricks [ ] b. Stone [ ] c. Burnt bricks [ ] d. Cement [ ] e. Wood/bamboo [ ] f. Iron sheet [ ] g. Others [ ]
28. What is the material of the floor of your house?
    a. Wood/tile [ ] b. Plank [ ] c. Concrete [ ] d. Desk/straw [ ] e. Cement [ ] f. Others [ ]

SECTION C
TECHNICAL EFFICIENCY OF RICE FARMERS

Outputs

29. Please provide the following output information in the last production season.

Area Cultivated	Bags Produced	Tons Produced

Inputs

30. Please provide the following input information of your rice farm last production season.

	Inputs	Quantity
i.	Seed/planting materials (kg)	
ii.	Seed dressing chemical (kg)	
iii.	Inorganic fertilizer (kg)	
iv.	Herbicides (liter)	
v.	Pesticides (liter)	
vi.	Packaging materials (No)	

3.1 Please provide information on the labour usage of your rice farm last production season.

S/N	OPERATION	FAMILY LABOAUR	MANDAYS	HIRED LABOUR	MANDAYS	TOTAL
1.	Land clearing					
2.	Planting					
3.	Watering					
4.	Weeding					
5.	Fertilizer application					
6.	Pest/bird control					

7.	Harvesting					
8.	Packaging					
9.	Transportation					
	Total					

SECTION D: ALLOCATIVE EFFICIENCY/ PROFITABILITY OF RICE FARMING IN NIGER STATE.

INCOME

32 Please provide the following output/income information of your rice production last farming season.

Area cultivate	Quantity produced		Unit price		Total income in Naira	
	Bags	Tons	Bags	Tons	Amount Naira for bags	Amount in Naira for tons

COST OF PRODUCTION:

33. Please provide the following fixed cost information of your rice production last farming season.

S/N	Fixed capital input	Numbers	Cost per unit	Total cost	Year of purchase	Expected life span
i.	Hoes					
ii.	Cutlass					
iii.	Axes					
iv.	Knapsack					
v.	Sprayer					
vi.	Irrigation pump					
vii.	Others specify					

34. Please provide the following variable cost information of your rice production last farming season.

Seed/planting materials			Seed dressing chemical			In organic fertilizer			Herbicides			Pesticides			Packaging materials			Total cost
Qty used	Unit cost	Total cost	Qty used	Unit cost	Total cost	Qty used	Unit cost	Total cost	Qty used	Unit cost	Total cost	Qty used	Unit cost	Total cost	Qty used	Unit cost	Total cost	

35. Please provide information on the cost of labour of your rice farm last production season

S/N	OPERATION	HIRED LABOUR			FAMILY LABOUR			TOTAL COST
	Activity	Man days	Cost/man dayôs	Total cost	Man days	Cost/man dayôs	Total cost	
	Land clearing							
	Land preparation							
	Planting							
	Watering							
	Weeding							
	Fertilizer application							
	Harvesting							
	Packing							
	Transportation							
	Total							

SECTION E: PROBLEMS/CONSTRAINTS OF FADAMA RICE FARMING IN NIGER STATE.

36. How serious do you consider the following problems/constraints in rice farming in your community.

S/N	PROBLEM/CONSTRAINTS	Very serious	Serious	Not serious	Not very serious
1.	Land acquisition				
2.	Unavailability of tractors for land preparation				
3.	Lack of improved/high yielding seeds				
4.	Scarcity of labour				
5.	Low fertility of land				
6.	Lack of finance				
7.	Low price of local rice				
8.	Competition from imported rice				
9.	Lack of/inadequate access to fertilizer				
10.	Lack of/inadequate access to pesticides and herbicides				
11.	High cost of production				
12.	Inadequate storage facilities				
13.	Inadequate education/technical skill				
14.	Poor credit accessibility				
15.	Others, specify _____				