PRODUCTION EFFICIENCY AND PROFITABILITY OF CERTIFIED RICE SEED PRODUCTION AMONG OUTGROWERS IN KATSINA STATE, NIGERIA

BY

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

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APRIL, 2016

DECLARATION

I hereby declare that this dissertation titled "**Production Efficiency and Profitability of Certified rice seed Production among Outgrowers in Katsina State, Nigeria"** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another Degree or Diploma in this or any other Institution. All borrowed information have been duly acknowledged in the text and a list of reference provided.

_____ _____

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CERTIFICATION

This dissertation titled '**Production Efficiency and Profitability of Certified Rice Seed Production among Outgrowers in Katsina State, Nigeria',** by Olusegun **OSUNDIYA** meets the regulations governing the award of the Degree of Master of Science in Agricultural Economics of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to God Almighty who made it possible for me to complete this research work in good Health and sound mind, May your Name be praised forever.

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ABSTRACT

Viable seed is a requirement for a stable agricultural system and for establishing food security to farmers and the nation at large. This study focused on economic evaluation of certified rice seed production among out-growers in Katsina state, Nigeria. A two-stage sampling technique was used to purposively select four out of the five registered seed companies in Katsina State based on their involvement with rice outgrowers. This was followed by a random selection of 127 respondents from the list of rice out-growers used by the selected companies. Primary data were collected with the aid of structured questionnaire administered to the farmers. The tools used to analyze the data collected were descriptive statistics, net farm income, stochastic production and costs frontier functions. The results of the analysis revealed that the mean age of the respondents is 40 years and that of the household size is 10. About 65% of the farmers were literate with an average of 5 years of schooling. The mean years of experience in rice seed production was found to be 5 years and the mean years spent on cooperative society is 2 years, average number of extension contact with extension agents is 3 visits per year. The average amount of credit obtained is ₦154000. The total revenue realized from sale of certified rice seed was ₦69,767.129/ha while the total cost was ₦32,160.68/ha. The net farm income was estimated at ₦37,606.449/ha and the returns per Naira invested was 1.17. The results of stochastic frontier analysis revealed the mean technical, allocative and economic efficiency of 0.66, 0.55 and 0.37 respectively. The study thus suggest that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he could realize about 76.83 % cost savings while on the other hand, the least economic efficient farmers will have about 112% cost savings to become the most efficient farmer. The variables that significantly influenced economic efficiency were education, experience in rice seed production and amount of credit obtained at 1%, 1% and 5% levels of probability respectively. Though, the rice seed outgrowers in the study area were economically inefficient, the study revealed that the enterprise is profitable returning ₦1.17 to every ₦1.00 spent. It is therefore recommended that farmers should be encouraged to join cooperative societies, so as to access inputs, especially, credit at low cost and also enhance market outlet. The ADPs and/or seed companies should intensify extension services to educate and encourage farmers to adopt modern cultural practices in order to promote efficient utilization of existing knowledge and skills to increase their economic efficiency.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Nigeria's socio-economic history and development has been very closely tied to its agricultural sector (Egbuna, 2008). The country is blessed with varied climatic zones, enormous resources, and has the potential of producing, processing, marketing and exporting different agricultural commodities. In Nigeria, before and immediately after independence, agriculture was the mainstay of the economy. However, its contribution to the economy has been declining since the oil boom of 1970's. The contribution of agriculture to Gross Domestic Product (GDP) which was 65% on the average in the 60's dropped to 22.4% between 1976 and 1980 even though it rose to about 39.2% in the year 2005 and 40.2 in 2013 (CBN, 2006).

Despite the importance of petroleum as a major contributor to gross domestic product (GDP), the role of agriculture remains most significant in Nigerian economic since independence. Agriculture provides employment for most rural dwellers and it accounts for more than one third of total gross domestic product (GDP) and labour force for the majority of rural Nigerians, Akinyemi (2009). The agricultural sector contributes about 41% of the gross domestic product and employs about 65% of the total population and about 80% of Nigerian rural populations, Adegeye (2008). Agriculture also provides about 90% of the nation's total food requirements and merits priority attention from policy makers not only because of its economic significance but also because of its importance in the war against hunger and poverty, and its significant role in rural development, Ega (2010).

Technological change was identified as a way to achieve increased agricultural production. National and International research programs were then set up to develop new technologies in general. In particular, the development of new cultivars was given top priority, because the low yields and inadequate response to fertilization by local cultivars were seen as major factors hindering agricultural production. New cultivars with high yield potential have been developed to increase agricultural output and to improve outgrowers' income, This is important since quality seed is one of the primary requirement for establishing food security to outgrowers and the nation at large (FAO, 1999).

The adoption of these new cultivars has been rather disappointing to most experts and African outgrowers who are still mostly using traditional cultivars. Among the causes of this low rate of adoption of the improved varieties is inadequate seeds. Most farmers in sub-Saharan Africa have little or no access to improved seeds and continue to recycle seeds that have become exhausted after generations of cultivation (Zulu, 2004). The resultant effects of depending on these poor quality seeds have been poor yield and persistent food insecurity.

Rice is an important staple crop in Nigeria. Its cultivation, processing and marketing offer employment opportunities for farm and non-farming households. Since the early 1960s, the West Africa Rice Development Association (WARDA) has made several efforts focused on achieving self-sufficiency in rice production in West Africa, and thus, eliminating dependence on rice imports from outside the region. Nonetheless, a wide gap continues to exist between domestic rice supply and demand in the region, and

more particularly, in Nigeria. As a consequence, imported rice has continued to be sourced yearly to supplement domestic production.

1.2 Problem Statement

The Nigerian rice sub-sector has witnessed some remarkable improvement in output given rise to position of prominence in the past years (Akande, 2001). Since the mid-1970s, the rice consumption in Nigeria has risen tremendously at about 10 % per annum due to changing in consumer preferences. However, production has never been able to meet demand, leading to considerable imports which today stood at about 1 million metric tonnes yearly. The imports are procured in the world market with Nigeria spending annually over 300 million United States dollar on rice import only (Akande, 2001). The amount spent on rice importation in Nigeria has risen to 365 billion annually (CBN, 2013). In an attempt to address the nation rice demand-supply gap, the Nigeria government has interfered in the rice sub-sector over the past few decades through the adoption of new cultivars. However, the public policy has neither been consistent nor appropriate and domestic production has continued to lag behind demand (Akande, 2001).

The inability of Nigeria rice sub-sector to meet the domestic demand could be attributed to low productivity, inefficiency in the use of resources, little or no access to improved seeds, disincentives from macro-economic environment and production in the hand of small scale outgrowers who use traditional technologies (Federal Ministry of Agriculture, 1995). Nigeria has experienced falling yield of rice from 2069.54kg/ha in 1990 to 1754.40kg in 2008 (FAO, 2010). The problem therefore identified centres on the low accessibility of farmers to improved seeds and productivity and efficiency

levels at which farmers use resources on these rice farms. It also borders on how the various factors that explain seed production and efficiency in these rice systems can be examined so as to improve rice production in the country. Based on these the following research questions are put forward

i. What are the socioeconomic characteristics of certified rice seed outgrowers in Katsina State?

ii. What is the level of profitability of certified rice seed production?

iii What are the economic efficiencies of farmers involved in rice seed production?

iv What are the factors influencing economic efficiency of certified rice seed production?

v. What are the constraints encountered by farmers involved in certified rice seed production in the study area?

1.3 Objectives of the Study

The broad objective of this study was to carry out an economic evaluation of certified rice seed production among outgrowers in Katsina state, Nigeria. The specific objectives were to:

i. describe the socioeconomic characteristics of outgrowers of certified rice seed in Katsina state;

ii. determine the level of profitability of certified rice seed farming;

iii. determine the economic efficiency of certified rice seed production

iv. estimate the socioeconomic and institutional factors influencing economic efficiency of certified rice seed production and

v. Identify the constraints faced by rice seed outgrowers in the study area.

1.4 Justification of Study

Seeds are first and foremost, the source of most food, at least of plant origin, and therefore have the greatest socioeconomic benefit to human welfare of any known biological device. According to Louwaars and Marrewijk (1999), the development and use of high yielding seed varieties have been the technological forces behind the successful green revolution, the availability of food at prices profitable for outgrowers and affordable by the populace, and a reduction in rural poverty. Thus, seed provision, both in normal and disaster years, is a prerequisite for increasing food production, improving outgrowers' income, alleviating poverty, and ensuring food security.

This study is however, expected to arouse farmer's interest in certified seed production through highlighting its level of profitability and efficiency and to bridge the knowledge gap prevalent in this area of agricultural production. The result of this study can also be used by policy makers as a guide to the development of the appropriate institutional support needed to increase output and hence its level of profitability.

1.5 Hypothesis

There is no significant relationship between costs and return in certified rice seed production in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Economic Importance of Rice in Nigeria

Rice is an increasingly important crop in Nigeria and has been found to thrive under four main ecologies suitable for different rice varieties. These are: rain-fed upland, shallow swamps and inland valley swamps (rain-fed lowland), irrigated lowland and mangrove or tidal swamp ecology (Imolehin and Wada, 2005). Irrigated lowland accounts for ten to fifteen per cent of national rice production. However, rainfed lowland and upland ecologies constitute 80-85% of the national cultivated rice land and contribute 73-80% of total rice production. While these two rice ecologies (rainfed lowland and upland) have the potential to meet national demand, their average rice yield (1.8tons/ha) fall short of the expected national average yield of 5.0tons/ha and 3.0tons/ha respectively (Ogundele and Okoruwa, 2006). In Nigeria, the most important rice production system has been acknowledged to be the rainfed lowland (Akpokodje *et al*, 2001) which accounts for 43-53% of the total rice production (Imolehin and Wada, 2005; UNEP, 2005; Fashola *et al*, 2011).

Rice cultivation, processing and marketing offer employment opportunities for farm and non-farming households. Since the early 1960s, the West Africa Rice Development Association (WARDA) has made several efforts focused on achieving self-sufficiency in rice production in West Africa, and thus, eliminating dependence on rice imports from outside the region. Nonetheless, a wide gap continues to exist between domestic rice supplies and demand in the region, and more particularly, in Nigeria. As a

consequence, imported rice has continued to be sourced yearly to supplement domestic production.

2.2 Evolution of Seed Sector Activities in Nigeria

The evolution of Nigeria‘s seed supply mechanism can be roughly characterized by describing how the activities for production, marketing, and regulation of seeds and the administration of the seed sector have been delegated to specialized institutions and bodies.

Over the past four decades, the government of Nigeria has assigned the production of seeds (breeder, foundation, and certified seeds) to different seed-related institutions. Breeder seed in the formal seed sector has been and continues to be produced solely through Nigeria‘s National Agricultural Research Institute (NARI). In 1975, the former National Seed Service (NSS) was mandated to produce foundation and certified seeds. Later, the Agricultural Development Program‘s (ADP) seed multiplication units joined NSS in producing foundation seeds, and distribute them through the farm-service centers of the Federal Ministry of Agricultural and Rural Development (FMARD) and ADP (Adejobi, *et al* 2005). More recently, private companies have been increasingly involved in the production of foundation seeds and distribution of certified seeds to outgrowers. Supply has also been bolstered by private companies contracting outgrowers to produce foundation seed as well as public sector production through the ADP and National Agricultural Seed Council (Omonona, 2006). With the growing role of the private sector and the escalating involvement of outgrowers in seed production it is expected that the capacity of the seed sector to develop suitable seeds for diverse agro-ecological environments will also increase.

In the meantime, Nigeria has been organizing and institutionalizing its seed sector administration, Seed policy was given a legal status with the enactment of the Agricultural Seed Decree No 72 of 1992 (Kormawa, Okorji, and Okechukwu, 2002). The regulatory functions such as the control and registration of released varieties, testing, and certification of seeds were assigned to the National Agricultural Seeds Council (NASC) which was established by the Seed Decree. The Decree also established various institutions such as the Crop Variety Registration and Release Committee, the Seed Standards Committee, the Seed Industry and Skill Development Committee, and the Department of Training, Information and Seed Extension, to streamline the implementation of each regulatory function both at the national and state level. However, the seed supply sector continues to face numerous challenges in raising outgrowers 'adoption of improved seeds. Seed policy has remained a decree enacted during the military era, but not yet supported by evidence-based policy guidelines. The NASC is currently in the process of drafting a seed policy document. The capacity for many public institutions to implement their operations has been limited due to constraints including insufficient funding and its irregular release.

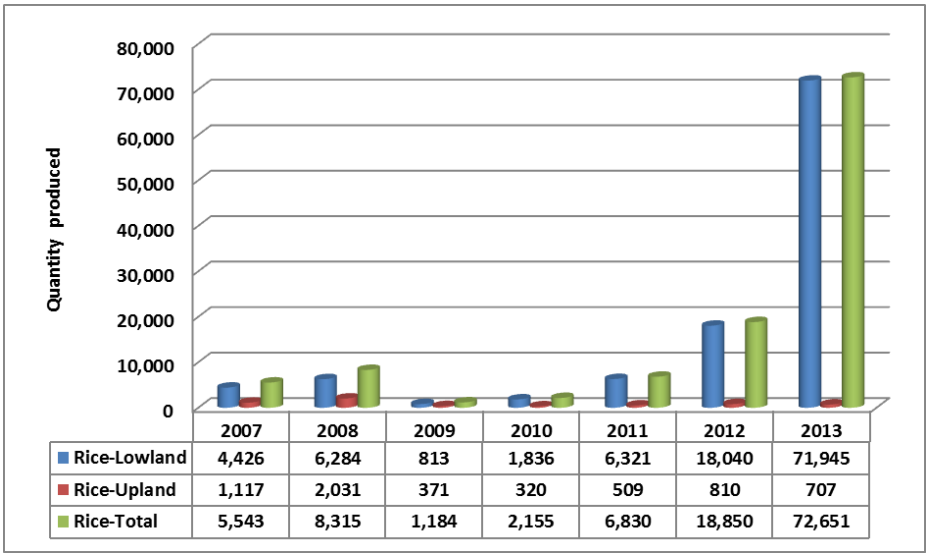
2.3 Seed Production in Nigeria

Seed constitutes an important input in arable crop production. Without seeds, it would be virtually impossible to develop a stable agricultural system by man. Copeland (1976), poetically posits that "desolate indeed would be our world without seeds and without men's propensity to culture them." Thus, even if all other factors of production are available, meaningful crop production may be virtually impossible without viable seeds. And hence, seed has the most profound influence on crop yield because it is the

carrier of genetic potential of crop plants, while other inputs simply build favorable environment for the manifestation of the genetic potential of the crop.

Producing enough seed is one of the most difficult problems facing many countries. Douglas (1980), strongly asserts that a country's seed programme takes a giant step towards success if it is able to find answers to certain questions and establish clear policies on the seed industry. These questions are: should seeds be produced locally or imported? Who should produce the seed? How can a seed enterprise be started and who should be involved in its management? Can foreign seed firms help get a commercial seed industry started? And what is actually involved in getting a seed industry started?

Joshua (1992) further observed that the current production of improved seeds for different crops by public sector agencies in Nigeria is just about 8-12 % of the total seed requirements. Substantial increase over this level can be met with the active participation of the private sector in the seed industry, of which the contract out growers scheme seem to be the only hope at achieving this aim. This led to agreat increase in the production of all classes of seeds as well as the number of seed enterprises established during the year 2013. The production of certified seeds rose from 44,487 MT in 2012 to 149,726 MT of grain equivalent in 2013 showing an increase of 237 %. (NASC, 2013)



	2007	2008	2009	2010	2011	2012	2013
Rice-Lowland	4,426	6,284	813	1,836	6,321	18,040	71,945
Rice-Upland	1,117	2,031	371	320	509	810	707
Rice-Total	5,543	8,315	1,184	2,155	6,830	18,850	72,651

Figure 1: National Rice Seed Production by Type and Year (NASC, 2013)

2.4 Outgrower or Contract Farming Scheme

The increase in farmer income from contract farming comes from several sources. The primary source is farmer access to the market. In many developing countries, farms are small and outgrowers lack education, technology, and financial resources. Their agricultural products can only be used by themselves or sold locally at low prices. Contract farming provides the opportunity to produce and sell higher valued commodities, or the same commodities but at higher quality (Masakure and Henson 2005; Simmons *et al.* 2005; Bijman 2008). The second source is farmer access to better technology and inputs provided by the contracting firms, which upgrades their productivity (Gulati et al. 2007; Leung et al. 2008; Miyata *et al.* 2009). The third is that outgrowers receive other supports – such as loans and insurance from financial institutes, government agencies, and the NGOs when contracted (Zhu and Wang 2007; Bijman 2008; Michelson 2013).

In addition to financial and social benefits, the impact of contract farming on productivity is also important, because it increases total welfare instead of just redistributing it among different groups. Morrison Paul *et al*. (2004), Key and McBride (2007), find a positive impact of contract farming on productivity in the U.S. In developing countries, the agricultural sector tends to be laidback and slow in receiving technology transfers from developed countries. Advanced farming technology such as mechanization is often based on large scale farming; these techniques are difficult to apply on small scale, fragmented operations in developing countries. Contract farming helps facilitate technology transfers and improves productivity.

Processors may provide inputs such as seeds, chemicals livestock feed, and veterinary assistance for livestock growers. They also provide technical training and other consulting services as part of the contract. Such production efficiency improvements are found among poultry growers in India (Ramaswami *et al*, 2006), Indonesia (Simmons *et al*, 2005), Bangladesh (Begum et al, 2012), and dairy growers in India (Birthal *et al*, 2005). Studies also revealed crop yields increased for potato contractors in India (Tripathi *et al*, 2005), new technology was adopted in Lao (Leung et al, 2008) and costs decreased but output increased in China (Zhu 2007)

On top of technical efficiency, financial constraints have always prevented farms from gaining higher economic efficiency. This is especially true for small and poor farms without credit or collateral to obtain financing in developing countries. Contract farming can help outgrowers receive credit from financial institutions, and in-kind credit such as seeds, fertilizers, and other inputs directly from the firms (Simmons *et al*, 2005; Ma *et al*, 2011).

Beyond the farm gate, Contract farming also improves the efficiency for downstream links of the supply chain. The agribusiness firms can now have a reliable supply of raw materials of their required variety and quality with less price uncertainty (Allen and Lueck 1995; Ma *et al*, 2011). The transaction cost is reduced through contracting (Gray and Boehlje 2005; Liu et al. 2009), and contract farming also protects the industry investment in research and development (Hobbs and Young 1999).

2.5 Measurement of Efficiency in Agriculture

Variations in productivity are a function of differences in scale of operation, production technology, operating environment and operating efficiency (Fried *et al*. 2008). Increases in productivity can be achieved by improvements in technology such as introduction of new machinery, pesticides, and improved seed varieties among others. Alternatively, productivity can be improved by changing factors that improve the efficiency by which inputs are being transformed into output such that higher outputs are produced from the same level of inputs and technology (Bravo-Ureta and Pinheiro, 1997; Coelli, 1995).

To measure efficiency, the efficient production function needs to be known. In most empirical studies, the efficient frontier is unknown and has to be estimated from data on which efficiency is to be measured. The nature of the assumptions made in estimating the frontier divides the efficiency measurement into non-parametric and parametric. The parametric methods of estimating efficiency make a priori assumptions about the functional form of the production function and the inefficiency term. In the non-parametric methods such as Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH), the form of the production function is taken as unknown.

2.5.1 Parametric methods

The parametric methods involve econometric modeling of the production process making assumptions a priori on the functional form of the production function and the distribution of the inefficiency term. The common functional forms of the production function in the literature are the Cobb-Douglas (and its modifications) and the trans-log models. The estimated frontier can be deterministic or stochastic depending on the treatment of deviations of an observation from the frontier. Deterministic frontiers are regression based and attribute all deviations to inefficiency. Deterministic frontiers may be estimated using Corrected Ordinary Least Squares (COLS) or Modified Ordinary Least Squares (MOLS). Unbiased estimates of the slope parameters in both estimation procedures are obtained using OLS followed by a correction of the intercept. In COLS, using the largest positive observed residual while MOLS modifies the intercept using the mean of the assumed one-sided distributed disturbance term (Kumbhakar and Lovell 2000).

Stochastic frontiers take into account stochastic error by decomposing the error term into stochastic and inefficiency components. In Stochastic Frontier Analysis (SFA), the error term is decomposed by parameterizing the distribution of the inefficiency term (Fried *et al*. 2007). This entails making assumptions on the distribution of the inefficiency term, usually half-normal or exponential, and that the stochastic error and inefficiency are independent of each other and the independent variables (see for example, Coelli and Battesse, 1998; Emokaro and Ekunwe, 2009 among others). Other distributions of the inefficiency term are available. The stochastic frontier can be estimated using maximum likelihood estimation (MLE) to obtain consistent estimates of the slope parameters. The conditional distribution of the estimates can be used to obtain

conditional expected values of inefficiency for each observation. Stochastic distance frontiers are also available for measuring efficiency.

2.5.2 The non-parametric methods

The nonparametric methods use mathematical programming methods to measure relative efficiency of units commonly referred to as Decision Making Units (DMUs). The most common nonparametric methods are the DEA and the more general FDH. A piecewise frontier is constructed based on data points that use the least inputs in producing a particular level of outputs. Relative efficiency is measured by comparing observed performance against best-practice performance. The nonparametric methods differ from the parametric in that the former does not make any a priori assumptions about the functional form of the production function and the inefficiency term. The DEA makes general assumptions of monotonicity and convexity, resulting in a flexible frontier that allows the production functional form to vary across DMUs. Relaxing the convexity assumption in DEA leads to FDH which has a step frontier (De Borger *et al*, 1994). The basic DEA and FDH are deterministic, thus attributing all deviations from the frontier to inefficiency.

The most common method of estimating efficiency in DEA is a radial measure based on Farrell's (1957) concept of radial contraction of inputs to the least level necessary for production of a specific level of output. In output space, the radial measure can be thought of as radial expansion of output obtainable from a given combination of inputs. Other methods of estimating efficiency in DEA include the use of a target DMU for each DMU under study, and other non-radial measures such as the additive model, Russell measure, range-adjusted measure, slack-based measure, geometric distance

function, hyperbolic and dimensional efficiency models (see Fried *et al*, 2009) for a detailed discussion of each of these methods). The flexible functional form of the nonparametric methods has won favor in the efficiency literature. Also, other than just measuring efficiency, the nonparametric techniques of DEA and FDH also provide information on the shadow prices of inputs and outputs of the DMUs. These are obtainable from the weights which can be unrestricted or restricted within acceptable ranges (Mahlberg and Obersteiner, 2001). DEA is also able to handle multiple outputs and multiple inputs without requiring price data (Collier et al. 2011). The deterministic nature of the basic DEA is usually cited as its main weakness as it fails to account for stochastic noise in data which could potentially bias the estimated efficiency scores (Coelli and Battesse, 1996; Onumah et al. 2009). The DEA is also argued to be less robust to outliers and extreme values and lacks parameters for economic interpretation (Daraio and Simar, 2007).

2.6 Concept of Efficiency in Agriculture

2.6.1 Technical efficiency

This is a major component of productivity being used in measuring farm performance. It is used to measure the ability of a farm to obtain maximum output from a given set of inputs. A technically efficient farm operates on the production frontier while a technically inefficient farm operates below the frontier and could be made efficient by increasing its output with the same input level or using fewer inputs to produce the same level of output. As such, the closer a farm gets to the frontier the more technically efficient it becomes (Ogunyinka and Ajibefun, 2003).

2.6.2 Allocative efficiency

This reflects the ability of a farm to use inputs in optimal proportions given their respective prices and the production technology (Chirwa, 2003). Under competitive conditions, a farm is said to be allocatively efficient if it equates the marginal returns of factor inputs to the market price of output (Fan, 1999). Allocative efficiency deals with the extent to which outgrowers make efficient decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost (Akinwumi and Djato, 1996).

2.6.3 Economic efficiency

Economic efficiency is derived from product of the technical and allocative efficiency (that is, Technical efficiency x Allocative efficiency). Economic efficiency is concerned with the realization of maximum output in monetary term with the minimum available resources. It occurs when a farm chooses resources and enterprises in such a way to attain economic optimum (Ellis, 1988; Akinwumi and Djato, 1997).

A farm that is economically efficient should by definition be both technically and allocatively efficient. However, this is not always the case as Akinwumi and Djato (1997) pointed out. It is possible for a farm to have either technical or allocative efficiency without having economic efficiency. The reason may be that the farmer, in this case, is unable to make efficient decisions as far as the use of inputs is concerned. In some cases, a farmer might fail to equate marginal input cost to marginal value of product. If technical and allocative efficiency occur together they are both necessary and sufficient conditions for economic efficiency. This assumes that the farmer has

made right decision to minimize costs and maximize profits implying operating on the profit frontier.

2.7 The Stochastic Frontier Function

2.7.1 Stochastic frontier production function

The Stochastic frontier production function according to Battese and Coelli (1992) assumed that a random sample of farms is observed over T period such that the production of the N farms over time is a function of given input variables and random variable which involve the traditional random error and non-negative random variables which are associated with technical inefficiencies of production.

For a given combination of input leve1s, it is assumed that the realized production of a farm is bounded above by the sum of a parametric function of known inputs, involving unknown parameters, and a random error, associated with measurement error of the level of production or other factors, such as the effects of weather, strikes, damaged product etc. The greater the amount by which the realized production falls short of this stochastic frontier production, the greater the level of technical inefficiency (Battese and Coelli, 1993).

An appropriate stochastic formulation is: $Yi = f\,(Xi)\; TE_i \quad V_I$……………………………………….(I)

Where ***Yi*** is the output, ***Xi*** is input, ***TE*** denotes technical efficiency and $\boldsymbol{V_I}$ is unrestricted.

The latter term embodies measurement errors, any other statistical noise, and random variation of the frontier across farms. The reformulated model is $lnYi = \alpha + \beta xi + vi - ui$…… *(II)*

ui>0, but ***vi*** may take any value. A symmetric distribution, such as the normal distribution, is usually assumed for *vi*. Thus, the stochastic frontier is = $\alpha + \beta xi + vi$ and *ui* represents the inefficiency.

2.7.2 Stochastic frontier cost function

Specification of cost function involves alteration of error term from (Vi – Ui) to (Vi +Ui).

For example, this substitution would transform the production function into cost function:

Yi = Xi β (vi + ui), i = 1, …… N ……(III)

Where ***Yi*** is the cost of production of the **ith** farm;

Xi is a **k x 1** vector of input prices of the ith farm

β is a vector of unknown parameters

The *vi* are random variables which are assumed to be N(0, δv^2) and independent of the *ui* which are nonnegative random variables which account for the cost inefficiency in production, often assumed to be / N(0, δu^2)/, in this cost function the u now defines how far the firm operates above the cost frontier.

The main weakness of stochastic frontier analysis lies in its parametric nature. The need to specify the functional form of the production function a priori makes it susceptible to bias resulting from functional form misspecifications. Another argument in the literature relates to the comparison of individual units against an average practice frontier rather than best practice in the sample being analyzed in SFA. Also, SFA fails to allow for analysis of technical efficiency in multiple outputs without output price information (Collier *et al*., 2011).

With multiple outputs, the output variable is usually measured as an aggregate monetary value rather than physical units. The use of SFA for multiple outputs is argued to be inappropriate as it may underestimate efficiency (Alene et al. 2006; Solis et al. 2009; Ajibefun, 2008). The use of methods likes stochastic distance frontiers, DEA or efficiency scores computed from a combination of SFA and DEA is recommended as more appropriate. Collier et al. (2011) also argue that cross sectional SFA is no better than DEA with regard to efficiency rankings of observations because the conditional expected values of inefficiency are perfectly correlated with the composite error term. As such, the rankings of efficiency that are based on distributional assumptions of the inefficiency term are not expected to differ from those based on DEA scores. Ondrich and Ruggeiro (2001) provide evidence supporting this argument.

2.8. Farm Profitability Analysis

Despite the numerous constraints faced by farmers in the production process like the small size of farm holdings and the use of rudimentary inputs, studies of farming establishments across the country show that farming is generally a profitable enterprise for small scale outgrowers. Profitability measures the ability of outgrowers to cover their costs and is an important concept, because it provides incentives for entry into and

longevity in the farming business. While many studies of Nigerian farms across the country report profitability, profit margins are often very small.

In general, Nigerian farmers can be described as rational profit maximizers who respond to price instruments (Ajani 2000). In the Southwest, several crop production enterprises were found to yield positive returns and they include food crop production in Ekiti State (Peke 2008), rainfed upland rice production in Oyo and Osun states (Oladeebo 2006), as well as cassava production in Ogun (Adeyemo, Oke, and Akinola 2010), Osun (Fanegan 2010) and Ondo (Fasoranti 2006) states, respectively. Several studies from the North Central region also revealed profitable farm enterprises. Egwuda's 2001 study of lowland rice producers in Kogi State revealed a profit of 37 kobo for every one naira invested on average for the 120 farmers surveyed. Yam production in Kogi State was also found to be a profitable venture (Adejoh 2009; Ekunwe and Orewa 2007). Adejoh (2009) reported a profit of 53 kobo for every one naira invested in yam production in the state. Yam farming was also profitable in the South South as Oviasogie (2005) found yam based cropping systems to be profitable in Edo State particularly for farmers who practiced mixed cropping.

Studies of profitability in the North East of Nigeria revealed relatively high profit margins. For instance, Haruna et al.'s 2009 study of cotton farmers in Gombe state revealed a net return of 2.10 naira for every naira invested. Similarly a study of Fadama food crop farmers in Bauchi revealed a return on naira invested of 3.14 naira (David et al. 2009). Farms in the northwest have been found to be similarly profitable as a number of studies reveal some profitable crops in this region including cowpea and maize in Katsina State (Zakari 1997), cowpea in Kebbi State (Abubakar 2006), and groundnuts in Kano State, with farmers making a profit of 0.47 naira for every naira invested (Yaro 1999). Zakari's 1997 study in Katsina revealed a return of 72k per naira spent for maize,

and 38k per naira spent for cowpea. For cowpea production in Kebbi, the three-crop mixture (cowpea/ pearl millet/sorghum) was the most profitable cropping pattern.

CHAPTER THREE

METHODOLOGY

3.1 Description of Study Area

The study was conducted in Katsina state, North-Western Nigeria. Katsina State has a total land size of 23,938 square kilometers located between longitudes11^0 and 13^0 East; and latitude 6^0 and 9^0 North with a projected population of 7,221,539 in 2013 from the 2006 figure of 5,792,578 at a growth rate of 3.2 % per annum (National Population Commission 2006). It is a land locked state neighbouring Niger Republic to the North; jigawa and Kano states to the East; Kaduna to the South and Zamfara to the West.

The major economic activity of the State is agriculture which is the main stay of the people of the State. Both farming and rearing of animals occupy the lives of about 80% of the total population of the State. Food and cash crops are produced in large quantities. Some of the crops grown are; maize, cotton, groundnut guinea corn, millet, rice, beans and soya beans. The range of Livestock is essentially cattle, sheep and goats. During the dry season people are engaged in irrigation activities in fadama areas and river basins. Local crafts (blacksmith, pottery etc.) are also practiced.

The soil has a texture ranging from sandy loam to sandy with an annual rainfall of 600-1000 millimeters in the driest and wettest parts of the state respectively. Katsina state is situated within three ecological zone namely; Sahel, Sudan and Northern Guinea

savannah. It occupies a total land area of about 2.4millon hectares, out of which 1.64 million hectares is under both rained and irrigated farming (KTARDA, 1998).

The state is divided into three Agricultural Development Zones. The headquarters of zone 1 is Ajiwa which is in the northern part bordering the Sahel, and Local Government under Ajiwa zone 1 (Charanchi, Batagarawa, Katsina. Jibia. Rimi, Kaita, Mani, Bindawa, Ingawa, Sandamu, Baure, Mashi, Zango,). Zone III has its headquarters in Funtua and lies in the south between the northern Guinea and southern Sudan savanna zone with Local Government (Funtua, Malunfashi, Kankara, Faskari, Danja, Kafur, Dandume, Sabuwa, Bakori, and zone II, with headquarter in Dutsin-ma with the Local Government (Dutsinma, Kankia, Matazu, Danmusa, Musawa, Kusada, Safana, Batsari Kurfi), is in the center of the other of the two zones (Ogunbile *et al,* 1999).

The rainfall pattern in the state is unimodel with the peak in August. The rainfall ranges between 350 and 500mm in the Sahel (zone1), 600 and 850mm in the Sudan savanna (zone 11) and between 900- 1000mm in the Northern Guinea Savanna, (zone111). The variations in rainfall in the zones contribute to major differences in agricultural production in terms of the choice of crop, input level and average yield. The growing period of the major crops covers about 180 days. Although this is short, the distribution of annual rainfall is well suited to a number of crops. This, however, requires that all crops activities be done within a limited period. The mean annual temperature is between 29 and 39 degrees Celsius. The relative humidity is constantly below 40% expected in few wet mouths when it sometimes goes up to average of 60%. The duration of dry season is about six to eight mouths. This starts from September to April.

The agro-climatic condition of Katsina state, where the study was conducted is favorable for production of crops and livestock in the three zones of the state. The major crops grown in the state are millet, sorghum, maize, groundnut, cotton, cowpea, rice, and soybean. They are grown either as sole crops or combinations of two to four crops. The relative important of these crops vary according to the location. Sorghum, maize, rice, cotton and cowpea are the most important crops in the most humid southern parts of the state (zone 11). As one moves northwards into the middle belt of the Sudan savannah (zone 111), millet, sorghum, groundnut, cotton and cowpea become dominant. Millet, followed by sorghum, cowpea and groundnut are the most important crops in the northern part (zone 11).

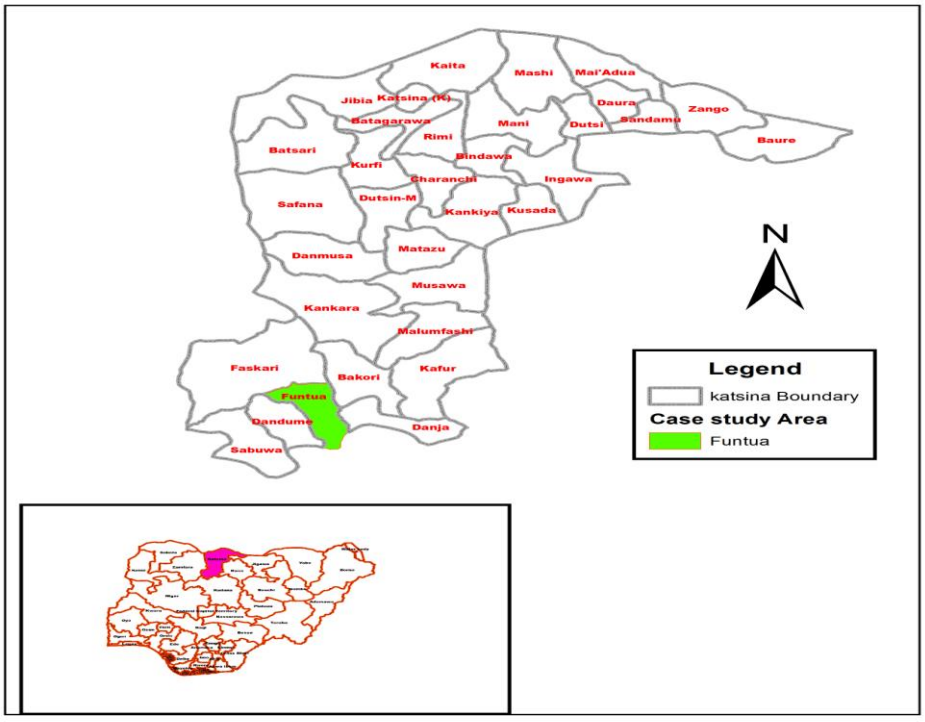


Figure I: Showing the map of the study area.

3.2 Sampling Procedure and Sample Size

A two-stage sampling technique was used to select respondents for this study. The first stage involved a purposive selection of four out of the five registered seed companies in Katsina state which are Wacot seeds, Jamy Nagari, Inganchi, and Manoma (Dan-dutse Seeds Limited exempted because it does not have rice outgrowers).

Finally, a simple random sampling was employed to select rice outgrowers from each of the sampled seed companies. 70% of the sample frame was used as the sample size. A total of 127 outgrowers were selected for the study. The respondents were selected through balloting method by writing the names of the registered outgrowers of the selected seed companies in a box and randomly selecting the desired sample size. The sample frame of the respondents was obtained from National Agricultural Seeds Council (NASC, 2013)

Table 3.1: Sampling frame and sample size of outgrowers

SEED COYS	***Sample frame**	**Sample size (70%)**
WACOT	84	59
JAMY NAGARI	36	25
INGANCHI	18	13
MANOMA	44	31
Total	182	127

3.3 Data Collection

Primary data were used for this study. These were collected with the aid of structured questionnaire administered to the sampled outgrowers. The data collected include;

(a) Farmer's socio-economic characteristics such as age, gender, household size, educational status, farming experience, amount of credit received, numbers of extension contact, years spent on the cooperative, farm size, income.

(b) Production data; farm size, level of inputs used such as labour fertilizer, herbicides, pesticides and output.

(c) Costs of inputs and total return to the outgrowers.

(d) Constraints faced by the outgrowers.

3.4 Analytical Techniques

The tools of analysis used were: Descriptive statistics, Net farm income and Stochastic production and cost function

3.4.1 Descriptive statistics.

Descriptive statistics was used to achieve objective (i) and (v) of the study. It involves the use of measures of central tendency such as mean, frequency distribution and percentages to describe the socio-economic characteristics of certified rice seed

outgrowers in the study area, (objective i), and the constraint confronting the outgrower rice seed producers, objective (v).

3.4.2 Net farm income

The net farm income NFI was employed to achieve objective (ii). It was used to estimate the cost and returns of outgrower rice seed production. The formula for net farm income is stated as follows.

NFI = TR-TC

Where

NFI = Net Farm Income (₦)

TR= Total Revenue (₦)

TC = Total Cost of production (₦) = TVC +TFC.

Returns per naira invested (RNI) is the gross income (GI) divided by the total cost of production (TC). RNI = GI/TC.

The components of TR, TC, TVC and TFC for this study are;

1. Cash expenses are: Foundation seeds, Fertilizers, Manure
2. Labour expenses are: planting, first weeding, second weeding, third weeding, fertilizer application, rogueing and harvest
3. Total Variable Cost TVC (1 + 2)
4. Total Fixed Cost TFC (a + b)

a) Cost of renting land

b) Depreciation of tools. Straight line method of depreciation was used:

$$Dep = \frac{P - S}{N}$$

Where:

P = Purchase value.

S = Salvage Value.

N = Lifespan of the tool.

3.4.3 Stochastic frontier production function

This was used to achieve part of objective iii of the study

Model specification: The stochastic frontier production function was specified as:

$Q = f(X. \boldsymbol{\alpha}) + e_i$ .....(2)

$e_i = Vi - Ui$ ……(3)

Where

Q = Output of paddy of ith farm (kg)

X = Vector of quantity of inputs used by ith farm

$\boldsymbol{\alpha}$ = Vector of unknown parameters (parameters to be estimated)

ε_i = Composed error term

Vi = random errors outside farmer's control

Ui = technical inefficiency effects

Stochastic frontier model used in this study is specified as;

$Ln\ Q = Ln\ \alpha_0 X_1 + \alpha_1 LnX_1 + \alpha_2 Ln\ X_2 + \alpha_3 Ln\ X_3 + \alpha_4 Ln\ X_4$

$+ \alpha_5 Ln\ X_5 + (V_i - U_i)$ …………………………………………………………...…(4)

Q = Output of harvested paddy in kg.

X_1 = Labour in man-days

X_2 = Fertilizer applied in kg

X_3 = Quantity of seed in kg

X_4 = quantity of agrochemicals used in litres

X_5= Land size in Ha

L_n = Natural logarithm

$\alpha_1 - \alpha_4$ = Parameters to be estimated

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

U_i = deviation from maximum potential output attributable to technically inefficiency

$U_i = \sigma_0 + \sigma_1 \ln Z_I + \sigma_2 \ln Z_2 + \sigma_3 \ln Z_3 + \sigma_4 \ln Z_4 + \sigma_5 \ln Z_5$

$+ \sigma_6 \ln Z_6 + \sigma_7 \ln Z_7 + \sigma_8 \ln Z_8 + \sigma_9 \ln Z_9$……………………………………………………………(5)

Where;

U_1 = technical inefficiency effect

Z_I = level of education (years of schooling)

Z_2 = Age of outgrowers in years

Z_3 = Farm size in hectares

Z_4 = Years of experience in certified seed production (years)

Z_5 = Household size (number of household members)

Z_6 = Membership of cooperative/outgrowers organization (number of years of participation)

Z_7 = Extension contact (number of extension visit/year)

Z_8 = Credit access (amount of credit received)

Z_9 = Sex (dummy) 1 = Male, 0 = Female

σ_0= Constant

σ_1- σ_9= Parameters to be estimated.

The stochastic frontier cost model was used to measure allocative efficiency of the farm as stated thus.

$C = F(W_i, Y_{i;}\ \alpha) \exp e_i = 1, 2 \ldots\ldots\ldots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$

Where;

C = Represents the cost associated with rice seed production

W = Vector of input prices

Y = Rice seed output

α = Vector of parameters

e_i = Composite error term

The stochastic frontier cost model can be stated explicitly as:

$LnC = \beta_O + \beta_l lnX_1 i + \beta_2 lnX_2 i + \beta_3 lnX_3 i + \beta_4 lnX_4 i + (Vi-Ui)$……(6)

Where

Ln = natural logarithm

C= Total cost of production

X_1= cost of seed in Naira

X_2= cost of fertilizer in Naira

X_3= cost of labour in Naira

X_4= cost of agrochemicals in Naira

X5= Quantity of output in kg

β_O =constant term

$\beta_l - \beta_4$ =regression coefficients

V_1 = random variability in the production that cannot be influenced by the farmer

U_1 = deviation from maximum potential output attributable to technical inefficiency.

Economic efficiency is derived from product of the Technical and Allocative efficiency (that is Technical efficiency x Allocative efficiency).

The economic efficiency was calculated as TE*AE as specified by (Akinwunmi and Djato, 1997). The socioeconomic characteristics and the institutional factors affecting economic efficiency of the outgrowers are specified as:

$EE = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + e$…….. (7)

Where;

EE = Economic efficiency of the i^{th} farmer

X1 = Education (Year of Schooling)

X2 = Age of outgrowers in years

X3 = Sex (dummy) 1 = Male, 0 = Female

X4 = Farming experience in years

X5 = Household size (numbers of household members)

X6=Membership of cooperative/outgrowers organization (number of years of participation)

X7 = Extension contact (number of extension visit/year)

X8 = Credit access (amount of credit received)

α_0= Constant

β_1 - β_8= Parameters to be estimated.

ε=composite error term.

3.4.4 Measurement and *a priori* expectation of variables

(i) Age: This refers to the number of years of an individual attained from birth. It is a continuous variable and was measured in years. Hofferth (2003) argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming activities. More also, older household heads are expected to have better access to land than younger heads, because younger men either wait for a land distribution, or have to share land with their families. The estimated coefficient of age is expected to be negatively related to technical inefficiency.

(ii) Household size: This means the total number of people in the house which includes the wives, children and dependents that reside within the same house and eat from the pot. This will provide appreciable number of family labour supply to accomplish various farm operations. It was measured in numbers. The estimated coefficient of household size will be expected to be negatively related to technical inefficiency because more family labour is expected to be provided from the household members.

(iii) Educational status: This refers to the acquisition of knowledge through formal schooling. This was measured by the number of years spent in school. The estimated coefficient of education is expected to be negatively related to technical inefficiency.

(iv) Amount of credit received: This refers to amount of credit received from both formal and informal sources of credit. It is needed to acquire or develop rice seed enterprise; its availability could determine the extent of production capacity and also have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural sorghum farming communities. It was measured as

the actual money/credit borrowed. The estimated coefficient of credit obtained is expected to be negatively related to technical inefficiency.

(v) Numbers of extension contact: This refers to the number of contacts between extension agent and the respondents in the production cycle. It was measured in numbers. The estimated coefficient of extension services is expected to be negatively related to technical inefficiency.

(vi) Years spent in Cooperatives: This variable was used to measure the number of years the respondent registered in the cooperative(s). It was measured in years. The estimated coefficient of cooperative membership is expected to be negatively related to technical inefficiency.

(vii) Farm Size: This variable was used to measure the total size of land used for cultivation which determined the economics of scale in production. The estimated coefficient of farm size is expected to be negatively related to technical inefficiency.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Rice Seed Farmers

4.1.1 Age distribution of rice seed farmers

The study revealed that about half of the farmers (50%) were found to be within the age group of 30-39 years which can be considered to be active age group for meaningful agricultural production. The average age of rice farmers was found to be approximately 40 years with minimum of 20 years and maximum of 80 years. This implies that, the farmers are strong, agile, and active and can participate adequately in farming activities.

These findings are consistent with those of Nwanko *et al.,* (2009) and Institute for Agricultural Research (2001), who reported that the most active farmers' age group engaged in agricultural production is within 31- 50 years.

Table 4.1.1 Age distribution of rice seed farmers

Age (years)	Frequency	Percentage
20-29	15	11.81
30-39	63	49.61
40-49	25	19.697
50-59	17	13.39
>60	7	5.51
Total	127	100
Mean	**40**	

Comment [FSI1]: Include Standard error in bracket after the mean

4.1.2 Educational level of rice seed farmers

The results presented in Table 2 revealed that about 35% of the rice seed outgrowers had no formal education while about 65% had one form of formal education or the other. The average number of years of formal schooling was 5 years. Illiteracy is believed to have a negative implication on efficient use of productive resources and adoption of farm innovation. This high literacy level of rice farmers in the study area implied that the farmers would be better exposed to more reliable information and good decision making in their farm production activities. This finding is in line with Amaza (2000), education has a positive and significant impact on farmers' efficiency in

production. Thus, literacy level will greatly influence the decision making and adoption of innovation by farmers, which may bring about increase in productivity.

Table 4.1.2**:** Distribution of rice farmers according to their level of education

Education (years)	**Frequency**	**Percentage**
No formal education	44	34.6
Primary education	28	22.0
Secondary education	34	26.8
Tertiary education	21	16.5
Total	127	100

4.1.3 Household size

Table 4.1.3 depict the distribution of farmers by household size. Majority of the farmers (69%) had household size that ranged from 1-10 persons. The maximum number of persons was 32 persons with a minimum of 1 person and a mean of 10 persons (Table 3). This implies that the farmers in the study area might have advantage of family labour availability if many household members participate in farming. However, the implication of large household size is that it will increase household consumption expenditure which would compete with production for limited financial resources within the household. According to Okoruwa and Ogundele (2006) large family size does not necessarily translate to higher use of family labour because some of the young able bodied family members may prefer other jobs than farming. This finding is also in

line with Solomon (2008) and Banmeke (2003), who indicated that large household size assist more on farm and other household activities.

Table 4.1.3: Distribution of rice seed farmers according to household size.

Household size (number)	Frequency	Percentage
1-10	88	69.29
11-20	27	21.26
21-30	7	5.51
31-40	5	3.94
Total	127	100
Mean	**10**	

Comment [FSI2]: Provide the standard error in bracket after the mean.

4.1.4 Farmers experience in outgrower rice seed production

The study revealed that 75% of rice farmers had 1-5 years of experience in certified rice seed production. . The maximum farming experience observed was 22 years while the minimum was 1 year with a mean of 5 years. This implies that majority of the farmers are relatively new entrants into rice seed production, as about 95% of them had less or equal to 10 years' experience in rice seed production (Table 4.1.4).

This findings is in line with Ajani (2000) on productivity in food farming in northern area of Oyo State who revealed that year of farming experience increased agricultural productivity among farming households in Nigeria.

Table 4.1.4: Distribution of rice seed farmers according to experience as an outgrower of rice seed

Farming Experience	Frequency	Percentage
1-5	95	74.80
6-10	18	14.17
11-15	9	7.09
16-20	4	3.15
>20	1	0.79
Total	127	100
Mean	**5**	

4.1.5 Membership of cooperative society

Comment [FSI3]: Include the standard error in bracket after the mean.

The result in Table 4.1.5 revealed that about (55%) of rice seed farmers do not participate in any cooperative association while those who were members of cooperative society constituted 45% of the farmers with the minimum and maximum years of membership of 1 and 15, respectively. The average years of membership of cooperative society was 2 years.

This implies that farmers had less opportunity of interacting with other farmers to enhance diffusion of innovations among them. According to Idiong *et al*., (2007), membership of cooperative affords the farmers opportunities of sharing information on modern rice practices. Ajayi (2002) and Ekong (2003) stated that membership of cooperative societies has advantages of accessibility to micro-credit, input subsidy and also as avenue in cross breeding ideas and information.

Table 4.1.5: Distribution of rice seed farmers according to years spent in the cooperative association

Cooperative association	Frequency	Percentage
Non members	70	55.12
1-5 years	37	29.13
6-10 years	12	9.45
11-15	8	6.30
Total	127	100
Mean	**2**	

Comment [FSI4]: Include standard error in bracket after the mean.

4.1.6 Numbers of extension visit

The ultimate aim of extension services is to enhance farmers' ability to efficiently utilize resources through the adoption of new and improved methods of rice production instead of using traditional methods which are inefficient, resulting to low yield. The distribution of the sampled farmers based on numbers of extension visit is presented in table 4.6.

The results presented in Table 4.1.6 revealed that 58% of rice seed farmers in the study area had contact with extension agents with an average of 3 visits per year. This could be attributed to low extension agent-farmers' ratio in the study area. According to Obwona (2000), extension service is very essential to the improvement of farm productivity and efficiency among farmers.

Table 4.6: Distribution of rice seed farmers according to extension visit

Extension Visits (Numbers)	Frequency	Percentage
No visits	50	41.7
1-10	67	50
11-20	8	6.7
21-30	2	1.6
Total	127	100
Mean	**3**	

Comment [FSI5]: Include standard error in bracket after the mean value.

4.1.7 Credit obtain by rice farmers

Adequate funding is required by farmers to finance all rice seed production activities. However, a large number of farmers face serious shortage of funds to finance their rice seed production activities, which in turn limits their level of production.

The study revealed that majority (67%) of the sampled farmers had no access to credit to finance their rice production activities. Those who had access to credit obtained between ₦10,000 - ₦1000, 000 with the minimum and maximum amount of ₦10,000.00 and ₦3,000, 000.00 respectively. This implies that the farmers used their personal saving to purchase farm inputs and adopt farm innovation. This low access to credit could be attributed to the fact that financial institutions seldom grants financial credit to small scale farmer. Ekong (2003) asserts that credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity.

Table 4.7: Distribution of rice seed farmers according to amount of credit obtained.

Variable	Frequency	Percentage

No access to credit	85	66.93
10,000- 1,000,000	38	29.92
1,000,001- 2,000,000	2	1.57
2,000,001-3,000,000	2	1.57
Total	127	100
Mean(SE)	**154,000**	

Comment [FSI6]: Include standard error.

4.2. Costs and Returns of Certified Rice Seed Production

4.2.1 Level of allocation of Inputs and Output from Certified Rice Seed Production

The level of inputs and output from rice seed production in the study area are reported in Table 4.8. The inputs that were used in rice seed production include; farm size, seed, fertilizer, agrochemical and labour.

The result in Table 4.8 revealed the mean land area under rice seed production was 5 hectares. The minimum and maximum land areas were 0.4 ha and 26 ha, respectively with standard deviation of 5.42. The coefficient of variation was 108.9% meaning that the variability in land size for rice seed production was high among the producers in the study area. The large variability implies that the farmer operated at different scales of operation

Table 4.2: Levels of inputs used in rice seed production

Variable	Mean	Minimum	Maximum	Standard Deviation	Coefficient of Variation

land area (Ha)	5	0.4	26	5.42	108.9
Seed (kg/ha)	28.3	2	1000	190.56	133.9
Fertilizer (kg/ha)	78.45	50	1750	349.22	87.91
Agrochemical (litre/ha)	2.18	0	50	10.11	92.75
Labour (kg/ha)	12.18	7	133	28.43	46.68

The average quantity of seed used by rice seed farmers was 142.3 kg. The minimum and maximum seed used were 2.98 kg and 1000 kg, respectively. The coefficient of variation was 133.9% meaning that the variability in rice seed production was high among the producers in the study area. Average fertilizer used by rice seed farmers was 397.22 kg while the minimum and maximum were found to be 50.00 kg and 8780.49 kg respectively. The coefficient of variation was 87.91% meaning that the variability of fertilizer used in rice seed production was high among the producers in the study area. Such a great variation in the level of fertilizer use may be due to overutilization by some of the farmers.

Comment [FSI7]: Is 1000kg/ha of seed realistic?, if not check your data, it may be an outlier which should be removed. Its not per hectare, typographical error

Comment [FSI8]: If you have information on the types of fertilizer used, report them here.

The mean labour recorded was 60.9 mandays while the minimum and maximum were observed to be 7 mandays and 133 mandays, respectively. This is expected, given the tedious operations in rice production. The coefficient of variation was 46% meaning that the variability of labour used in rice seed production was low among the producers compared to other variable used in production in the study area.

Comment [FSI9]: 7 mandays/ha is very very unrealistic, check your data.

The coefficient of variation of all the variable inputs such as the land size, seed, fertilizer and labour were 74.0, 248, 180 and 75.0 respectively. The high coefficient of variation of variable inputs implies high level of variation in the use of variable input among rice seed farmers in the study area. However, the coefficient of variation for land size and labour were lower compared to other variable inputs used for rice seed production. The wide variation in input used by the farmers could be attributed to the fact that they differ in purchasing power

The coefficient of variation in rice output was 12.30 % which implies low inconsistency in output level among rice seed farmers in the study area. This will help the country in attaining food security as greater proportion of farmers produces above average. The instability in output of rice could be attributed to inconsistency and inadequacy of variable inputs among farmers in the study area.

4.2.2 Cost of certified rice seed production

In order to determine the profitability of rice seed production in the study area, the variable and fixed costs component incurred in rice production and returns realized was estimated. The variable cost components incurred in rice production includes cost of farm size, seed, fertilizer, agrochemical and labour while the fixed cost components includes depreciation cost of renting land and tools. The returns realized from the rice production in the study area was obtained by multiplying the seed quantity harvested by the market price as at the time of the survey period. The levels of inputs used in certified rice seed production are presented in Table 4.8.

The quantity of rice seed used was 28.3 kg/ha with an average market price of ₦320 per kg, a total of ₦9056kg/ha was used and this constituted about 52.8% of the total cost of

production. Thus, the rice seed producers can increase their profitability level by exploring the avenue of reducing the costs of seed which constitute the highest cost of production. The quantity of fertilizer was 78.5 kg/ha with an average market price of ₦100 per kg, was used and this constitutes 28.5% of the total cost of production.

Labour costs consist of cost of land preparation, planting, fertilizer application, weeding, replacement and harvesting. The family labour was computed on the basis of opportunity cost in man-day. The wage rate varied according to farm operation to be performed. An average wage rate of ₦400 per man-day was used, giving the average labour cost per hectare to be ₦4872. This indicates that the three most important cost components of rice production in the study area were cost of foundation seeds, cost of fertilizer and cost of labour accounting for a larger proportion (82.6%) of the total cost of rice production.

The total cost of fixed inputs (cost of renting land and depreciation of tools) incurred on rice production was ₦719.88 and this constituted 2.2% of the total fixed cost.

4.2.3 Return to investment in rice seed production

The total revenue realized from rice seed production was ₦69,767.13/ha while the total cost was ₦32,160.68/Ha. From the costs and returns analysis, the net farm income was estimated to be ₦37606.45/Ha which implies that rice seed in the study area was profitable.

From the estimated net farm income and the total cost of production, the average rate of return on investment (return per naira invested) was 1.17, indicating that for every ₦1 invested in certified rice seed production in Katsina state, a profit of ₦1:17kobo was made. Thus, it could be concluded that certified rice seed production in the study area

though on a small scale, was economically viable. This finding is similar to that of Adeola *et al.,* (2011) who observed that rice production is profitable by returning ₦0.45 to every ₦1.00 spent.

Table 4.2.2: Average cost and return per hectare of rice production

Comment [FSI10]: Please reformat this table so that the values will not look scattered.

Items	Amount/ha (₦)	% contribution
Variable cost		
Cost of seed	16,980	52.8
Cost of fertilizer	7844.8	24.4
Cost of agrochemical	1744	5.4
Cost of labour	4872	
Total variable cost (TVC)	31440.8	
Fixed cost		
Cost of renting land	232.54	0.7
Depreciation of tools (hoe and cutlass)	487.34	1.5
Total fixed cost	719.88	2.2
Total cost	32,160.68	100
Revenue	**69,767.129**	
Net Farm Income= (NFI)= (TR - TC)	37606.449	
Return per Naira Invested (NFI/TC)	**1.17**	

4.2.4 Test of hypothesis I of the study

The null hypothesis (H_o) which stated that there is no significant difference between costs and revenue in certified rice seed out-grower production in the study area was tested using a t-test and the result presented in Table 4.10. Calculated t-value was 6.8 and exceeds the critical value (t-critical two tails) of 1.98; therefore H_o is rejected at 5%

level of significance. The result of the analysis indicates that certified rice seed production is profitable

Table 4.2.3: T-test result of profitability of certified rice seed production in Katsina State

Variable	Average costs	Average revenue
Mean	81568.50	66595960.63
Variance	2356097572	1.21425E+16
Observations	127	127
Pearson Correlation	-0.061	
Hypothesized Mean Difference	0	
Df	126	
t Stat	-6.80	
P(T<=t) one-tail	1.85E-10	
t Critical one-tail	1.66	
P(T<=t) two-tail	3.71E-10	
t Critical two-tail	1.98*	

4.3 Economic Efficiency of Certified Rice Seed Farmers

4.3.1 Technical Efficiency of Certified Rice Seed Farmers

The stochastic Frontier Production model specified was estimated by the maximum likelihood method using frontier 4.1 software developed by Coelli (1995). The maximum likelihood production estimates and inefficiency determinants of the specified frontier are presented in Table 4.3.1. The study revealed that the generalized log likelihood function was -142.820. The log likelihood function implies that inefficiency exist in the data set. The value of gamma (γ) is estimated to be 30% and it

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

However, the estimated coefficients of all the parameters of production function (seed, fertilizer, labour, and agrochemical and land size) were positive and significant at 1% level of probability except fertilizer which is negative and not statistically significant. The average technical efficiency for the farmers is 0.66 implying that, on the average the respondents are able to obtain 66% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope (34%) of increasing the efficiency, by adopting the technology and techniques used by the best certified rice seed farmer.

Table 4.3.1: Maximum Likelihood Estimates of Frontier Production Function of certified rice seed production

Variables	Parameters	Coefficients	Std. error	T-Value
Production Function				
Constant	β_0	8.907	0.708	12.565***
Seed	β_1	0.136	0.203	5.326***
Fertilizer	β_2	-0.032	0.114	-0.279^{NS}
Labour	β_3	0.052	0.017	3.124***
Agrochemical	β_4	0.188	0.112	-1.679*
Land size	β_5	0.502	0.079	6.353***
Inefficiency model				
Constant	Z_0	0.082	0.451	0.181
Age	Z_1	0.019	0.010	1.911*
Educational status	Z_2	-0.548	0.291	-1.887*
Household size	Z_3	0.002	0.015	0.131
Farming experience	Z_4	-0.005	0.019	-0.286
Cooperative association	Z_5	0.025	0.039	0.664
Amount of credit borrowed	Z_6	-0.00009	0.00005	-1.789*
Extension contact	Z_7	0.00006	0.00003	1.881*
Diagnostic Statistic				
Sigma-square	**(σ^2)**	0.681	0.094	7.223***
Gamma	**(γ)**	0.301	0.097	3.105***
Log likelihood function	*L/f*	-142.820		
LR test		31.633		
Total number of observation		127		

Mean efficiency	0.66

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

The coefficient of seed input (0.136) was observed to be positive and significant at 1% level of probability. This implies direct relationship between seed and rice output. Seed is an important component of farm input that if underutilized or over utilized could affect total output of farmers. This finding agrees with Okoruwa and Ogundele (2006) who examined technical efficiency differentials in rice production technologies in Nigeria. They reported that the coefficient of seed was positive and significant for traditional technology and that increase in seed would increase output levels of rice farmers.

The coefficient of labour and fertilizer were found to be negatively related to the output. Contrary to the a priori expectation, labour and fertilizer had negative and significant coefficients. According to Olayide *et al*., (1980), a negative relationship do exist between family labour and hired labour among the resource-poor rural farmers because the consumption of additional hired labour is meant to supplement available family labour such that as the availability of family labour decreases, additional hired labour is consumed at the limit of the lean resources of the farmers. Due to the high cost of hired labour if additional hired labour must be consumed then additional cost must be incurred. This implies that to maintain the cost of production at the limit of their lean resources when additional hired labour is to be consumed, the resource-poor rural farmers must cut down the level of their rice production.

This explains the negative influence of labour on output as observed among the respondents. This finding is in consonance with the observation of Nweke (2004)

The estimated coefficient for agrochemical was 0.052 which is positive and statistically significant at 1% level. The estimated 0.052 of agrochemical implies that increasing agrochemical use by 1% will increase rice output by 0.05% which means, all things being equal the output is elastic to changes in the quantity of agrochemical used. However, this finding is in line with the findings of Shehu *et al.,* (2010) who observed that the estimated coefficient of agrochemical input was positive as expected and significant at 1% level implying that the more agrochemical is applied the better the output of rice.

The coefficient for farm size (0.52) was positive and significant at 1% level of probability. This implies that increase in farm size would result in increase in output level in certified rice seed production in the study area. This result agrees with the finding of Muhammad–Lawal *et al.,* (2009) farm size was positive and significant and that increase in the farm size would increase output level of farmers.

The estimated result of the inefficiency model is contained in the table Generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The results shows that level of education, farming experience, cooperative association and amount of credit borrowed have a negative sign, and therefore reduce technical inefficiency (or increase technical efficiency) while age, household size and extension contact have positive signs, implying that they increased technical inefficiency (or reducing technical efficiency).

The coefficient of age (0.019) was positive and significant at 10% probability level. This implies that holding other factors constant, a unit increase in the age of certified rice seed producers will increase their technical inefficiency by magnitude of 0.019.

This finding is at variance with Kolawole and Ojo (2007) who in their study of small scale farmers in Nigeria found age to be positively related to inefficiency.

The coefficient of education (-0.548) was positive and significant at 10% probability level. This indicates that level of education attained increase technical efficiency. This could probably be explained by the fact farmers probably employ their educational advantages as opportunity to develop their production capability and inferably would be ready to adopt innovations and technologies for improved productivity. This result agrees with the study of Ajibefun (2002) who posited that any agricultural policy in the country that would attract people with high level of education into farming and/or encourage illiterate farmers to undergo education/training would definitely lead to increase in the level of technical efficiency of the farmers. Also, Onumah and Acquah (2010) noted that formal education that enlightens farmers about the technical aspect is important to enhance efficiency. The coefficient of Household size (0.002) was positive and not statistically significant.

The coefficients of Farming experience (-0.005) and cooperative membership (-0.025) were inversely related to technical inefficiency not significant factors. This means being an experienced farmer was not enough to significantly cause a farmer to attain higher levels of efficiency if he cannot rearrange his inputs to obtain higher output levels with a given technology. This finding is in line with Okoruwa and Ogundele (2006) who examined technical efficiency differentials in rice production technologies in Nigeria. They reported that none of the socio-economic variables had significant effect on the technical efficiency of technology of farming. They also reported that this might be as a result of technical inefficiency of the farmer and as well as other

natural and environmental factors which could not be captured in the model. These factors include land quality, weather, labour quality, and disease and pest infestation.

The coefficient of credit (-0.00009) was negative and significantly influence technical efficiency of certified rice seed producers at 10% probability level. The estimated coefficient of -0.00009 implies the technical efficiency of the certified rice producers will be increased by a magnitude of 0.00009 as the amount of credit obtained increases by one unit. This suggests that credit in certified rice seed production is a very important resource that could be used to enhance the technical efficiency of certified rice seed producers and this is because access to credit by certified rice seed producers enhances their timely acquisition of production inputs that would enhance productivity. This agrees with findings of Nasiru (2010) who noted that access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities.

The coefficient of extension contact (0.00006) was positive and significant at 10% level. This means that an increase in extension contact will lead to increase in technical inefficiency. This finding is at variance with the study of Ajani (2000) who observed that extension contact enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

4.3.2 Allocative Efficiency of Certified Rice Seed Farmers

The Maximum Likelihood (ML) estimates of the stochastic frontier cost function are presented in Table 12. The sigma (σ^2 = 1.34) and the gamma (γ=0.81) were quite high and highly significant at 1.0% level of probability. The high and significant value of the

sigma square (σ^2) indicate the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). The gamma (γ = 0.81) shows that 81% of the variability in the output of certified rice seed farmers that are unexplained by the function is due to allocative inefficiency.

Table 4.3.2: Maximum Likelihood estimates of frontier cost function

Variables	**Parameters**	**Coefficients**	**Std. error**	**T-Value**
Cost Function				
Constant	β_0	14.924	0.789	18.893***
Seed	β_1	0.259	0.065	3.987***
Fertilizer	β_2	0.023	0.128	0.187^{NS}
Agrochemical	β_3	-0.066	0.167	-3.968***
Labour	β_4	-0.567	0.132	-4.308***
Land size	β_5	0.312	0.087	3.565***
Inefficiency model				
Constant	Z_0	-0.605	1.736	-0.348
Age	Z_1	-0.013	0.022	-0.595
Educational status	Z_2	0.346	0.252	1.372
Household size	Z_3	-0.056	0.055	-1.015
Farming experience	Z_4	-0.1018	0.077	-1.326
Cooperative association	Z_5	0.124	0.089	1.386
Amount of credit borrowed	Z_6	-0.00002	0.00003	0.743
Extension contact	Z_7	-0.0003	0.0001	-3.003***

Diagnostic Statistic				
Sigma-square	**(σ^2)**	1.343	0.626	2.145**
Gamma	**(γ)**	0.808	0.115	7.038***
Log likelihood function	*L/f*	-141.791		
LR test	25.690			
Total number of observation	127			
Mean efficiency	0.55			

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

The coefficient of the cost of seed was positive and statistically significant at 1%. This implies that seed are important input in rice production. The result of this research agrees with the findings of Ogundari *et al.*, (2006) where they reported direct effect of output on cost of production in their study on economies of scale and cost efficiency in small scale maize production in Nigeria.

The coefficient of labour and agrochemical were found to be negatively related to cost of production. Contrary to the a priori expectation, labour and agrochemical had negative and significant coefficients. According to Olayide *et al*., (1980), a negative relationship do exist between family labour and hired labour among the resource-poor rural farmers because the consumption of additional hired labour is meant to supplement available family labour such that as the availability of family labour decreases, additional hired labour is consumed at the limit of the lean resources of the farmers. Due to the high cost of hired labour if additional hired labour must be consumed then additional cost must be incurred. This implies that to maintain the cost of production at the limit of their lean resources when additional hired labour is to be consumed, the resource-poor rural farmers must cut down the level of their rice production.

This explains the negative influence of labour on cost as observed among the respondents. This finding is in consonance with the observation of Nweke (2004) that farmers who plant improved certified rice seed varieties have sometimes have to suspend planting because they were unable to hire sufficient labour to harvest previously planted rice fields because of rising wages. Similarly, the coefficient of agrochemical had a negative relationship with cost.

Farm size had a positive coefficient and was highly significant at 1.0% level of probability. This implies that increase in land cost would increase total cost of production in the study area. Also, farmers with small farm holdings are allocative efficient. This confirms Van Zyl, Joahn *et al.,* (1995) who found out that commercial farms could become significantly more efficient if they become smaller.

4.3.3. Factors Influencing Allocative Efficiency of Certified Rice Seed Production

From Table 4.3.3, the coefficient for age was negatively signed and not statistically significant, Age of farmers is expected to have a negative effect on allocative inefficiency effects. This is because older farmer may have developed managerial routines and practices by experience that would help them to improve their ability in making input choices in a cost minimizing way. This was also reported by Idiong (2005) and Hussain *et al.,* (1984).

The coefficient for education was positive and not statistically significant. Education enhances the acquisition and utilization of information on improved technology by the farmers as well as their innovativeness This implies that farmers, majority of who are aged rely on their long years of experience to allocate their resources efficiently. Most of the farmers had little or no education. Lack of education might

not be regarded as a factor causing inefficiency. This agrees with the findings of Amaza and Olayemi (2000) who reported that increasing years of formal education increases a farmer's level of allocative efficiency. Educational attainment of farmer is expected to have a negative effect on allocative inefficiency effects because education improves the ability of the farmer as a decision maker to obtain and process information about prices and technology which in turn increase allocative efficiency of the farming operations.

The coefficient of household size was negative and not significant. Household size is expected to influence allocative inefficiency negatively because the larger the household size the less the hired labour that would be used in the production and the less the total cost of production. This in turn would increase allocative efficiency.

The coefficient of Farming experience was negative and not significant. Farming experience of farmer is expected to have a negative effect on allocative inefficiency effects because cost minimizing input combination and revenue maximizing output requires information about technology and market prices. The more experienced the farmer the better the ability of the farmer as a decision maker to obtain and process information about prices and technology. The coefficient of cooperative association had positive relationship with the allocative inefficiency of certified rice farmers. This implies that cooperative membership is not an important factor that influences allocative efficiency of the farmers.

The coefficient of extension contact was negative and significant at 1% level. This means that an increase in extension contact will lead to increase in allocative inefficiency effect. This finding agrees with the study of Ajani (2000) who

observed that extension contact enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

4.3.3 Frequency distribution of technical, allocative and economic efficiency estimates of certified rice seed farmers

The distribution of TE, AE and EE estimates of certified Rice Seed farming are presented below, which indicate a technical efficiency range from 0.19 to 0.95 with a mean of 0.66, about 64.35 % of the certified rice seed farmers attained between 0.61 and 1.00 efficiency levels, while 35.65% of the farmers operated at less than 0.6 efficiency levels. This high level of efficiency is an indication that only a small fraction of the output can be attributed to wastage.

The result also indicates that, the average certified rice seed farmers would realize about 35.79 % output, if he or she was to attain the level of the most efficient farmer in the sample. The result further shows that there are allowances for the farmers to improve their efficiency by about 34 %.

Table 4.3.3. Frequency distribution of technical, allocative and economic estimates

Technical Efficiency			**Allocative Efficiency**		**Economic Efficiency**	
Class	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
<0.2	1	0.79	0	0	36	28.34
0.21-0.40	17	13.39	33	25.98	40	31.50
0.41-0.60	26	20.47	40	31.49	27	21.26

0.61-0.80	38	29.92	36	28.34	22	17.32
0.81-1.00	45	35.43	18	14.17	2	1.57
Total	**127**	**100**	**127**	**100**	**127**	**100**
Mean	0.66		0.55		0.37	
Minimum	0.19		0.20		0.08	
Maximum	0.95		0.95		0.82	

Comment [FSI11]: Include standard deviation

The distribution of allocative efficiency estimates presented in Table 4.3.3.2 ranged from 0.21 to 1.00; with a mean of 0.55 The result indicates that average certified rice seed farmer in the state would enjoy cost saving of about 47.37 % if he or she attains the level of the most efficient farmer among the respondents. The most allocative inefficient farmer will have an efficiency gain of 84.21 % in certified rice seed production if he or she is to attain the efficiency level of most allocative efficient farmer in the state.

The study revealed that 2% of the farmers had economic efficiency (EE) of 0.81 and above while 98% of the farmers operate at less than 0.8 efficiency level. The mean economic efficiency of the sampled farmers in the study area was 0.37.This indicates that certified rice seed farms were economically inefficient

The results suggest that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he will need about 76.82 % cost savings while on the other hand, the least economic efficient farmers will have about **112 %** cost savings to become the most efficient farmer.

4.4 Factors Influencing Economic Efficiency of Certified Rice Seed Production

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the economic efficiency of certified rice seed farmers is presented in table 15. The adjusted R square of 0.43 implies that 43 % in the variability in the economic efficiency of certified rice seed farmers in the study area is explained by the explanatory variables (age, family size, education, farming experience, membership of association and credit) specified in the model. The F statistics of 8.721 is statistically significant at 5% probability level and this indicates the joint significance of the specified variables on the economic efficiency of certified rice seed farmers in the study area suggesting that the model has a good explanatory power on the variation in the economic efficiency of certified rice seed farmers. The factors that had significant influence on economic efficiency of certified rice seed farmers in the study area were education, farming experience and credit while age, household size, cooperative membership and extension contact were not statistically significant.

The coefficient of age (-0.001) was inversely related to economic efficiency but not significant. This implies that holding other factors constant, a unit increase in the age of certified rice seed producers will decrease their economic efficiency by magnitude of -0.001.

The coefficient of Education was found to have a direct relationship with the economic efficiency of the farmers and significant at 1% probability level. Its estimated coefficient of 0.070 implies that the economic efficiency of the certified rice seed producers will increase by a magnitude of 0.070 as their level of education increases by one unit *ceteris paribus*. A plausible explanation for this is that higher educational level leads to higher rate adoption of of improved technology and techniques of production. Also, educated farmers are likely to be more successful in gathering information and understanding new practices and the use of modern inputs which in turn will improve

their economic efficiency. Hence, education is a very important policy tool that can be employed to enhance the economic efficiency of certified rice seed producers in the study area.

The coefficient of Household size (0.001) was found to have direct relationship with the economic efficiency of certified rice seed farmers but was not significant. This implies that holding other factors constant, a unit increase in the Household size of certified rice seed producers will increase their economic efficiency by magnitude of -0.001.

The coefficient of Farming experience had a direct relationship with the economic efficiency of the certified rice seed farmers in the study area in line with *a priori* expectation and statistically significant at 1% level of probability. This finding corroborates that of Tsoho *et al.,* (2014) who reported that farming experience was positively related to the economic efficiency of dry season vegetable farmers in Sokoto state, Nigeria

The coefficient of Membership of association had the expected positive relationship with the economic efficiency of the certified rice seed farmers and was significant at 1% probability level. Its estimated coefficient of 0.005 implies that the economic efficiency of the certified rice seed farmers will increase by a magnitude of 0.005 as the number of years of participation in association increases by one unit. This is not far-fetched as membership of association by certified rice seed farmers offers them the opportunity of having easy access to information on best production management practices, access to production input at reduced cost, access to credit facilities and access to marketing information. This result disagrees with that of Sikibo (2012) who reported that membership of association was not significant in influencing economic efficiency.

The coefficient of Credit had the expected positive relationship with the economic efficiency of certified rice seed farmers and was significant at 5% probability level. The estimated coefficient of 7.352E-8 implies that the economic efficiency of the certified rice seed farmers will increase by a magnitude of 7.352E-8 as the amount of credit obtained increases by one unit. This result agrees with that of Adewuyi *et al.,* (2013) who reported that access to credit significantly influenced the economic efficiency of farmers in a study on production efficiency of credit and non-credit users of certified rice seed in Ogun State, Nigeria.

The coefficient of extension contact had the expected positive relationship with the economic efficiency of certified rice seed farmers and was not statistically significant. This implies that holding other factors constant, a unit increase in the Household size of certified rice seed producers will increase their economic efficiency by magnitude of 0.009. This finding is at variance with the study of Ajani (2000) who observed that extension contact enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

Table 4.4.1: Showing the factors influencing economic efficiency of certified rice seed production

Variable	Coefficient	Standard error	T-value
Constant	0.308	0.066	4.69***
Age	-0.001	0.002	-0.69^{NS}
Education	0.070	0.015	4.54***
Household size	0.001	0.002	0.41 ^{NS}
Farming experience	0.140	0.040	3.50***
Cooperative association	0.005	0.004	1.05 ^{NS}

Amount of credit borrowed	7.352E-8	0.0001	2.06**
Extension contact	0.009	0.006	1.401 ^{NS}
R^2=0.539			
R^2 Adjusted=0.430			
F-value= 8.721			
DF=7			

4.5 Constraints Faced by Certified Rice Seed Farmers

The problems faced by certified rice seed farmers in the study area were ranked according to their magnitude as presented in Table 13. high cost of fertilizer was perceived to be the most seriouse constraint by about 35.5% of the farmers. According to the respondents fertilizer is made available when farmers are far into the production period, sometimes at the middle of the raining season. About 27.1% of the rice farmers indicated inadequacy of capital and credit facilities. This affects rice production in the study area, because the meager savings the farmers might have made or the funds generated from relatives is not sufficient to satisfy various activities in rice production.

Marketing is another constraints identified by 23.1% of the respondents. Most of them complained about the contracting companies not coming in time to buy-back the products produced as agreed in their contract terms.

About 17.9% of the rice farmer indicate short of labour as constraints in the study area. According to the farmers, during active period of production-every household would have been engaged in his family farm work. The demand for labour is normally very high and expensive during the peak period of land clearing, ridging, harvesting, processing, weeding and rouging in the study area, these led to labour shortage in rice farming in the study area . About 7.6% of the rice farmers indicated that pest and

disease were the most serious constraint reducing the quality and quantity of rice output in the study area.

Table 4.5.1: Constraints associated with rice seed production

Variable	*Frequency	%age	Rank
Hight cost of fertilizer	89	35.5	1st
Lack/Inadequate capital	68	27.1	2nd
Marketing	45	23.1	3rd
Labour shortage	30	17.9	4th
Pest and disease	19	7.6	5th
Total	251	100	

***** Multiple response was allowed

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study focussed on economic evaluation of certified rice seed production among out-growers in Katsina state, Nigeria. To achieve this, the study came up with five main objectives. These were to: describe the socio-economic characteristics of out-growers, determine the level of profitability of certified rice seed farming, determine the technical, allocative and economic efficiencies in rice seed farming, and estimate the socioeconomic and institutional factors influencing economic efficiency in certified rice seed production and to describe the constraints faced by rice seed out-growers in the study area. Four out of the five registered seed companies in Katsina state and 127 rice out-growers were selected in this area.

The primary data were collected from 127 respondents using structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, net farm income and stochastic production frontier function model.

The result of the analysis shows that (50%) of the respondents fell within the age range of 30-39years, the majority of the farmers (65%) were literate. the household size ranged from 1-10 persons. About 75% had farming experience of 1-5 years. Majority of the farmers, (55%) were not members of a cooperative society. About 58% of the farmers had extension contact while about 67% of the farmers do not have access to credit.

The total revenue realized from rice production was ₦69,767.129/Ha while the total cost was ₦32,160.68/Ha. From the costs and returns, the net farm income was estimated to be ₦37606.449/Ha while the returns per naira invested is 1.17 which implies that production of rice seed in the study area was profitable.

The stochastic frontier production function was estimated to determine technical, allocative and economic efficiencies of the farmers. The results revealed technical efficiency range from 0.19 to 0.95. The mean estimate was 0.66.The efficiency distribution had shown that, about 64.35 % of the certified rice seed farmers attained between 0.61 and 1.00 efficiency levels, while 35.65 of the farmers operated at less than 0.6 efficiency levels. The result also indicates that, the average certified rice seed farmers would realize about 35.79 % in output, if he or she was to attain the level of the most efficient farmer in the sample. The result further shows that there are allowances for the farmers to improve their efficiency by about 34 %.

The distribution of efficiency estimates ranged from 0.21 to 1.00; the mean allocative efficiency was 0.55 The result indicates that average certified rice seed farmer in the

state would enjoy cost saving of about 47.37 % if he or she attains the level of the most efficient farmer among the respondents. The most allocative inefficient farmer will have an efficiency gain of 84.21 % in certified rice seed production if he or she is to attain the efficiency level of most allocative efficient farmer in the state.

The study also suggest that for the average farmer in the study area to achieve economic efficiency of his most efficient counterpart, he could realize about 76.82 % cost savings while on the other hand, the least economic efficient farmers will have about 112 % cost savings to become the most efficient farmer. However, the average economic efficiency of the certified rice seed farmers was 37 %. This indicates that certified rice seed farms were economically inefficient.

The result of the ordinary Least Squares (OLS) regression estimates of the factors influencing the economic efficiency of certified rice seed farmers revealed that the adjusted R square of 0.43 implies that 43 % in the variability of economic efficiency of certified rice seed farmers in the study area is explained by the explanatory variables (age, family size, education, farming experience, membership of association and credit) specified in the model. Only education, farming experience and credit were variables that significantly influence economic efficiency at 1%, 1% and 5% level of probability respectively.

Finally, among the constraints identified in the study area, the majority of the respondent attested to the fact that high cost of fertilizer (35.5%), inadequate capital (27.1%), marketing (23.1%), labour shortage (17.9%) and pest and diseases (7.6%) were major constraints limiting certified rice seed production in the study area.

5.2 Conclusion

Based on the findings of this study, it could be concluded that certified rice seed production in the study area is profitable by returning ₦1.17 to every ₦1.00 spent. However, the study revealed that rice seed out-growers farmers are not economically efficient and therefore there is allowance of efficiency improvement by addressing some important policy variables that influenced farmers' levels of economic efficiency in the study area.

5.3 Contribution of the Study to Knowledge

1. The study revealed that certified rice seed production in the study area is profitable with net farm income of ₦37606.449/ha and a return to naira invested of ₦1.17.
2. The analysis of costs incurred in certified rice seed production revealed that seed was the highest cost component contributing about 52.8% of the total cost of production.
3. It study discovered that rice seed out-growers were economically inefficient, with an average economic efficiency of 37 %. Only about 2% of the farmers had economic efficiency (EE) of 0.81 and above while 98% of the farmers operated at less than 0.8 efficiency level.

5.3 Recommendations

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

i. Rice out-grower farmers should organize themselves together as cooperative societies so as to enable them pool their resources together to access inputs at low cost and also improve their bargaining power in marketing their produce.
ii. The government should ensure that agricultural loan facilities are accessible to rice seed producers at low interest rate to ensure timely and adequate utilization of agricultural inputs for improvement in farm production efficiency.
iii. Extension service should be intensified by state ADPs to educate and encourage farmers to adopt modern cultural practices in order to reduce cost of inputs and promote efficient utilization of existing knowledge and skills to increase their yield.
iv. Contracting seed companies should encourage the outgrowers by meeting their obligations as spelt out in their agreement with the outgrowers especially in the area of seed buy-back.

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PROFITABILITY AND PRODUCTION EFFICIENCY OF CERTIFIED RICE SEED PRODUCTION AMONG OUTGROWERS IN KATSINA STATE, NIGERIA

Dear Respondent,

This questionnaire will be used by a student of the Department of Agricultural Economics and Rural sociology, Ahmadu Bello University, Zaria. Please, fill as appropriate. All information will be treated with confidentiality and strictly for the purpose of research. Thanks for your co-operation.

Village/Community……Seed Company……

A. SOCIO –ECONOMICS CHARATERISTICS

1. Name of farmer…… Tel no. (If any) ……..

2. Sex: Male ( ) Female ( )

3. Age (years)……

4. Marital status: Married ( ) Single ( )

5. Highest level of Education: (a) No Formal Education ( ) (b) Primary school Education ( ) (c) Secondary School Education ( ) (d) Tertiary Education ( )

6. Family Size (All the number of the people depending on you for living)…….

(a) No of Adult Male ( ) (b) No of Adult female ( ) (c) Children >15yrs ( ) (d) Children<15yrs ( )

7. How did you become a rice seed outgrower? a. I got the information from a friend ( ) b. I visited the company on my own ( ) the company invited me. ( )

8. How long have you been in outgrower rice farming? ……

9. Do you belong to any co-operative/Association? Yes ( ) No ( )

10. If yes (name and type of cooperative) ----------

Comment [FS12]: You will know the type from the name

11. If yes, (Years of participation) ----------

12. What benefit did you derive as a member?

13. What is your major source of capital for outgrower rice seed farming?

a .Personal savings ( ) b. credit (borrow) ( ) c. Friends and family ( ) d. Money Lenders (Borrow) ( )

14. If you borrow, what were the sources of the credit? a. commercial bank( ) b. Bank of Agriculture ( ) c. Cooperative Society ( ) d. Money Lenders ( ) e. Friends and Family ( ) f seed company g. Others (specify)……

15. How much did you borrow to finance last production? (Fill the table below for the source you indicated in

Q .14

SOURCE OF LOAN	AMOUNT(₦)	INTERST RATE (%)
Commercial Bank		
Bank of Agriculture		
Cooperative Societies		
Money Lenders		
Friends And Family		
Seed Company		
Others (Specify)		

16. What are the terms of contract between you and the seed company?

a. ……

b ……..

c……

d……..

17. Have you been visited by an extension agent in the last 12 months? Yes ( ) No ( )

18. If Yes, How many times were you visited within the year? …….

19. What activities did the agent teach you? .....

20. Of what benefit were the techniques learnt to you to the success of your farm?

.....

21. Were you trained on Outgrower rice farming? Yes ( ) No ( )

22. If yes, which organization conducted the training?

23. What were you trained on and was the training beneficial to you? (Use the table below to respond to this question)

Type of training*	Benefit**	

**a. Not beneficial ( ) b. somehow beneficial ( ) c. beneficial ( ) d. very beneficial ( )

*a. land preparation for seed production ( ) b. spacing and isolation ( ) c. de-tasseling ( ) d. others specify ……

B. INFORMATION ON INPUTS

(1) Farm size (Ha) for certified rice only……..

Comment [FS13]: For rice or total farm size?

(1) How many certified rice farm plots do you have? ..... Indicate and the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

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

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

1					
2					
3					

(iii) What does it cost to rent one Hectare of land per season in your village? ...…….... Naira

(II) Variable inputs (Last production Cycle)

(i) Foundation Seed (Kg)

Plot No	Quantity of Seed(Kg)	Cost (₦)	Funding Source (farmer or seed company)
1			
2			
3			

(ii).Fertilizer.

Plot No	Fertilizer type	Quantity(Kg)	Cost(₦)	Funding Source (farmer or seed company
1	1 2 3			
2	1 2 3			
3	1 2 3			

Comment [FS14]: There may be more than one type of fertilizer per plot.

(iv).Agrochemical.

Plot No	Agrochemical type	Quantity(litres)	Cost(₦)	Funding Source (farmer or seed

Comment [FS15]: They may use more than one type of agrichemical per plot so make space for them

				company
1	1. 2			
2	1 2			
3	1 2			

(v) Labour input (a) Land preparation

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(b)Planting

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(c) Fertilizer Application

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							

3							

(e) First Weeding

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost(₦)	Please indicate below
1							
2							
3							

(f) Second Weeding

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(g) Third Weeding

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(h) Rogueing

Plot No	Hire Labour	Family Labour	Funding Source (farmer or seed company

	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(i)Harvesting

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(j) threshing

Plot No	Hire Labour			Family Labour			Funding Source (farmer or seed company
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)	Please indicate below
1							
2							
3							

(k)bagging

Plot No	Hire Labour				Family Labour				Funding Source (farmer or seed company
	No of people	No of Hours	Cost of operation (₦)	Cost of bags (₦)	No of people	No of Hours	Cost of operation (₦)	Cost of bags (₦)	Please indicate below
1									
2									

3									

(j) Information on certified outgrower rice farming output

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

Comment [FS16]: Use the unit they are familiar with eg bag!!

Note; 1bag = 75kg

25. When do you sell your produce? a. immediately after harvesting ( ) b. Few months after harvest ( ) off season ( )

26. How do you dispose your product? a. take it to the seed company ( ) b. the seed company representatives come to collect from farm-gate ( ) c. others (specify ……

CONSTRAINTS OF CERTIFIED OUTGROWER RICE FARMING PRODUCTION

S/n	Constraints	Ranking according to severity 1=least severe, 2=moderately severe, 3= severe, 4= more severe, 5= most severe.	Coping Strategy
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Thanks for your Attention

Appendix 1; National Certified Seed Production by Year (MT) Source; NASC. (2013)

s/n	***Seed crop***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	**%change 2012-2013**
1.1	Maize-Hybrid	1,137	2,641	3,150	1,607	1,947	3,335	4,601	38
1.2	Maize-OPVs	2,186	4,567	1,782	1,803	3,367	10,916	53,355	389

1.3	***Maize Total***	***3,323***	***7,208***	***4,931***	***3,409***	***5,313***	***14,251***	**57,956**	***307***
2.1	Rice-Lowland	4,426	6,284	813	1,836	6,321	18,040	71,945	229
2.2	Rice-Upland	1,117	2,031	371	320	509	810	707	-13
2.3	***Rice-Total***	***5,543***	***8,315***	***1,184***	***2,155***	6,830	***18,850***	72,651	***285***
3.1	Sorghum-OPVs	199	2,366	509	250	327	644	1,360	111
3.2	Sorghum-Hybrid	-	-	-	-	-	-	28	-
3.3	***Sorghum Total***	**199**	**2,366**	**509**	**250**	**327**	**644**	1,388	116
4	Millet	161	1,002	939	152	148	171	98	-43
5	Wheat	70	250	92.69	-	-	-	-	-
6	Cowpea	154	1,078	114	153	67	88	50	-43
7	Soybean	415	546	240	151	329	1,081	3,278	203
8	Groundnut	144	404	73	62	15	60	69	15
9	Cotton	94	301	15	70	1,751	9,333	14,177	52
10	Sesame	19	245	3	6	8	10	60	500
	Total	***10,122***	***21,715***	***8,101***	***6,409***	***14,788***	***44,488***	***149,726***	***237***

Appendix 2: Showing Paddy Rice Data (*Hectarage*, *Yield*, *Production* and *Imports*)

	Annual Growth Rate, %				Yearly Average				
	1961 - 1970	1971 - 1980	1981 - 1990	1991-00	1961 - 1970	1971 - 1980	1981 - 1990	1991-00	Actual Value
RICE, PADDY, AREA HARVESTED (ha)									Value 2004
WEST AFRICA	2.05	2.66	2.97	3.09	1,770,059	2,261,592	2,914,271	4,152,248	6,069,192
CENTRAL AFRICA	14.04	1.71	5.66	-0.97	148,926	291,551	405,289	559,647	464,500
EAST AFRICA	3.14	2.90	0.67	1.43	1,055,818	1,390,590	1,542,777	1,716,739	1,705,500
SOUTHERN AFRICA	2.40	0.89	1.06	6.12	95,947	103,866	119,666	167,607	210,700
SUB-SAHARAN AFRICA	3.01	2.62	2.43	3.38	3,070,800	4,047,729	4,981,912	6,594,982	8,459,382
WA wo Nigeria	1.60	2.25	-0.11	2.92	1,563,459	1,951,192	2,064,671	2,313,428	2,365,192
NOTHERN AFRICA	6.73	-1.01	-0.21	3.03	411,123	449,015	413,231	582,748	637,500
CHINA	1.91	-0.38	-0.31	-0.36	30,153,303	35,744,637	33,245,127	31,550,170	28,327,000
INDIA	0.76	0.91	0.60	0.70	36,205,674	38,893,616	40,907,272	43,325,150	42,300,000
OTHER DEVELOPING ASIA	1.32	1.27	0.54	1.31	45,209,233	48,794,377	53,012,373	57,146,515	61,200,162
LATIN AMERICA & CARIBBEAN	3.78	3.31	-1.31	-1.00	5,629,928	7,243,164	7,587,855	6,458,345	6,450,929
OTHER COUNTRIES	0.80	1.69	-0.86	-1.22	4,623,900	4,669,823	4,488,394	4,303,076	3,919,151
WORLD	1.45	0.90	0.29	0.67	125,303,962	139,845,331	144,635,459	149,977,213	151,295,524
RICE, PADDY, YIELD (t/ha)									Value 2004
WEST AFRICA	3.07	1.07	2.71	-0.18	1.07	1.21	1.46	1.64	1.33
CENTRAL AFRICA	-0.20	0.93	0.06	-0.35	0.80	0.80	0.88	0.81	0.99
EAST AFRICA	-0.34	-1.20	3.15	-0.62	1.74	1.74	1.81	1.93	2.32
SOUTHERN AFRICA	-2.41	-7.62	0.73	9.07	1.33	1.12	0.90	0.88	1.11
SUB-SAHARAN AFRICA	1.10	-0.07	2.51	-0.15	1.29	1.36	1.51	1.63	1.50
WA wo Nigeria	2.92	0.26	2.58	1.74	1.04	1.13	1.22	1.59	0.00
NOTHERN AFRICA	9.27	0.86	2.33	1.86	5.47	5.35	5.06	9.14	9.99