



## **ACCESS TO CREDIT AND RICE PRODUCTION EFFICIENCY OF RURAL HOUSEHOLDS IN BENUE STATE, NIGERIA**

**Ogebe Ozoko Francis, Abah Daniel and Olagunju Ishaaqa Oladapo**

Department of Agricultural Economics, Federal University of Agriculture,  
PMB 2373 Makurdi, Benue State, Nigeria.

**Corresponding Author's E-mail:** frankozoko@gmail.com **Tel.:** +2347035945500.

### **ABSTRACT**

The study was conducted to examine access to credit and rice production efficiency of rural households in Benue State, Nigeria. The study focuses particularly on the effects of both formal and informal credits on production levels and production efficiency by using a stochastic frontal analysis. Data were randomly collected from 650 farmers consisting of 339 borrowers and 311 non-borrowers by means of well-structured questionnaire which were analyzed through descriptive statistics and stochastic frontier analysis. The results of the SFA showed a clear effect of credit on rice production levels and production efficiency of farmers. Rice production in the borrower group was significantly higher ( $P < 0.05$ ) than that of non-borrowers. Borrowers planted more rice, and spent more on inputs for rice production such as fertilizers, pesticides and hired machinery than non-borrowers except for expenditure on seeds. The borrowers used on average, 0.23 tons seeds and 0.24 tons fertilizer per hectare compared to an average of 0.22 tons and 0.21 tons with corresponding yields of 6.6 tons/ha and 6.0 tons/ha, respectively, for non-borrowers. Findings revealed that, the accessed credits help rice farmers to purchase inputs and improve farming technologies which ultimately transformed into higher productivity of the borrowers. The calculated technical efficiency (TE) of rice farmers ranged from 16.5% to 98.5%, with an average of 85.20%, indicating that almost all farmers achieved rather high technically efficient production. In addition, findings showed that the technical efficiency levels of borrowers were higher than those of non-borrowers confirming the positive influence of credit on production and production efficiency. Furthermore, the study showed that age, farming experience, family size, gender and access to credit are major determinants of TE in the study area. The study concluded that in order to improve the rice production outcomes, various policy recommendations needed to be considered such as expansion of rural credit systems, establishment of more branches of agricultural and community banks and formation of "Savings and Credit Cooperative Unions" (SACCOS) for collective responsibilities and paying loans.

**Keywords:** Stochastic frontier analysis, Access to credit, Rural households, Production efficiency.

### **INTRODUCTION**

Nigeria is currently the highest rice producer in West Africa, producing an average of 4.9 million metric tons in 2020 and 5.0 million metric tons in 2021 (USDA, 2014). It is also the largest consuming nation in the region, with the growing demand amounting to 4.1 million tons with domestic production meeting only about half of that demand (FAO, 2014). Although rice production and consumption have increased recently, the production was not sufficient to match the consumption increase. It is estimated that only 57% of the 6.7 million metric tons of rice consumed in Nigeria annually is locally produced, leading to a deficit of about 2 million metric tons, which is either imported or smuggled into the country illegally (USDA, 2014). A major factor



in the shift in consumer preference towards rice in Nigeria is the rapid rate of urbanization. Besides, rice is easy to prepare compared to other traditional cereals, thereby reducing the chore of food preparation and fitting more easily in the urban lifestyles of rich and poor alike. As at 2011, rice accounted for 10% of the household food spending, and 6.6% of total household spending (USDA, 2014). Given the importance of rice as a staple food in Nigeria, boosting its production has been accorded high priority by the government in the past 7 years. Significant progress has been recorded as rice production in Nigeria reached a peak of 5.0 million metric tons in 2021 (FAO, 2014). Despite this improvement, comparatively Nigeria's rice statistics suggest there is enormous potential to increase productivity. Yields have remained at 2 tons per hectare, which is about half of the average achieved in Asia. In addition, as population increases, along with rural to urban migration, ensuring food security in key staples become critical (FAO, 2014).

Rice production in Nigeria has been going on in some selected States in the country. About 29 States are engaged in the cultivation of rice as part of the plan of the federal government to make the nation an agricultural zone for the production of rice in the world. Just last year, the land set aside for rice cultivation was 3.90 million hectares, which saw an increase in total output of 7% as compared to the 3.17 million hectares for 2018. Benue State is second on the list of highest rice producing States in the country, producing a capacity 1,500,000 MT per year (Nigerian Infopedia, 2022). Yet not all farmers seem to produce at their optimal level. There may possibly be room for improvement which could contribute to the rural household income and continue to increase Nigeria's rice production. Credit access can be important in the further improvement of a farming system because of its ability to create access to other production factors (Oladeebo and Oladeebo, 2008). Similarly, Rashid *et al.* (2002) found that farmers without credit in Bangladesh allocated less land to rice farms. The availability of credit can affect fixed production cost and farmers will use fewer seeds and fertilizer if they are credit constrained (Brambilla and Porto, 2005). More so, provision of credit enhanced timely purchases and efficient allocation of factors input to produce maximum output as well as influence farmers' participation in marketing systems and increase their ability to create higher incomes.

This paper investigates the contribution of credit to production and technical efficiency levels of rice production in rural households of Benue State, Nigeria. Specifically, it describes the socio-economic characteristics of rice farmers in the study area, ascertains the sources of loan of the respondents, compares the household and farm characteristics of borrowers and non-borrowers and estimates efficiency levels for rice production. Several studies on effects of credit on agricultural productivity have been conducted in different parts of the world. Martey *et al.* (2015) studied the impact of credit on technical efficiency of maize producing households in Northern Ghana and found that credit impacted positively on farmers' technical efficiency. The implication is that provision of credit enhanced timely purchases and efficient allocation of factors input to produce maximum output. Similarly, Ammani (2012) investigated the relationship between formal credit supply and agricultural production in Nigeria using the Stochastic Frontier Model and Tobit model. The findings showed positive effect of the decision to invest credit to purchase better quality of pesticides, herbicides, fertilizers. Magreta *et al.* (2013) studied the economic efficiency of rice production in smallholder irrigation schemes in Malawi using a parametric frontier approach and found that average technical, allocative and economic efficiency levels were 65%, 59%, and 53%, respectively, indicating access to credit has affected the efficiency levels of smallholder rice farmers. In Nigeria, most researches have been limited to economic analysis and resource-use efficiency in rice production. For instance, Odoemenem and Inakwu (2011) studied

the economic analysis of rice production in Cross River State. Similarly, Tijani *et al.* (2010) and Sani *et al.* (2010) studied resource-use efficiency in rice production in Bornu State and Kano State, respectively. However, little or no studies have been conducted on access to credit and production efficiency of rice farmers in Benue State, Nigeria. This research therefore, fills the gap.

Several empirical studies have examined the relationship between credit supply and agricultural output. For instance, Anthony (2010) found that agricultural credit has influence the growth of export in Nigeria. Similarly, Adetiloye (2012) findings showed that in Nigeria, agricultural credit has impacted positively in the agricultural sector. Using logit regression analysis, Hussain and Taqi (2014) concluded that agricultural credit has positive influence on agricultural output in Pakistan. Also, employing a simple regression model, Ammani (2012) showed that through agricultural credit, agricultural output has been increased. Furthermore, Anetor *et al.* (2016) concluded that credit supply affects agricultural output positively. Using the ordinary least square method of multiple regressions, Imoisi and Sogules (2012) research findings revealed that in Nigeria, agricultural credit has positively influenced agricultural output. Furthermore, Chisasa (2014) concludes that in South Africa, agricultural credit has a significant impact on agricultural output. In addition, Khan *et al.* (2015) findings showed that agricultural credit positively influenced agricultural output in Pakistan. Research findings by Nnamocha and Charles (2015) indicated that in Nigeria, the relationship between agricultural credit and agricultural output is a long-run relationship. In a similar vein, Osa-Afiana and Kelikime (2015) concludes that credit supply influence agricultural output positively.

In the literature, studies have been conducted to investigate whether credit supply positively influence rice output. For instance, Odu *et al.* (2011) showed that access to formal credit significantly improved rice farming. Similarly, the study of Chandio *et al.* (2017) revealed that credit supply has positively and significantly impacted rice output in Sindh, Pakistan. Furthermore, several researches have been conducted on technical efficiency in rice production (Moses and Adebayo, 2007). In Vietnam, a number of studies have analyzed rice production efficiency. For instance, Linh (2015) studied “productive efficiency of rice farming households in Vietnam and the findings indicated that the age of head of household, the family size, extension services and access to credit are the main factors affecting the technical efficiency of rice and maize crops. More so, Nguyen (2003) studied technical efficiency of rice production in the Mekong Delta-Vietnam using Stochastic Frontier Analysis. The findings showed that the most significant factors having positive influence on technical efficiency levels are intensive labor in rice cultivation, irrigation and education. Based on review of literature, empirical studies have shown that access to credit has a positive and significant effect on rice production efficiency.

## MATERIALS AND METHODS

### The Study Area

The study area was Benue State, located in the middle belt of Nigeria. The State is second on the list of highest rice producing States in the country, producing a capacity of 1,500,000 MT per year (Nigerian Infopedia, 2022). Its geographic coordinates are longitudes 6° 35 and 10° 0E, and latitudes 6° 30 and 8° 10N with a population of 5,741,800 people with 413,159 farm families/households (NPC, 2007). The State shares boundaries with five other States namely; Nasarawa State to the North, Taraba State to the East, Cross Rivers to the south, Enugu to the South-West and Kogi to the West. The State also shares a common boundary with the Republic of Cameroun to the South-East, and it occupies a total landmass of 32, 518km<sup>2</sup>. Benue State has a

tropical sub-humid climate, with two distinct seasons which are wet season and dry season. The wet season lasts for seven months and is between April and October with annual rainfall ranging from 1500 – 1800 mm. The dry season comes between November and March. Temperatures are generally very high during the day with average daily temperatures ranging between 21<sup>0</sup>c – 35<sup>0</sup>c in the summer and 16<sup>0</sup>C – 37<sup>0</sup>C in the winter. Most of the people are farmers while the inhabitants of the riverine areas engage in fishing as their primary occupation. About 80% of the population is estimated to earn their living from agricultural production (BNARDA, 2004). The State is the major producer of food crops such as, yam, cassava, sorghum and maize. The major cash crops include rice, soybeans, and beniseeds. Citrus, sugar cane, oil-palm and banana are other economic crops grown in the State. Livestock rearing such as cattle, sheep, goats, pigs and poultry are also practiced in the State, hence the name, ‘Food Basket of the Nation’.

### Sampling Procedure

The population of this study consists of rice farmers. The study used households as a sampling frame. The secondary data were obtained from Benue Agricultural and Rural Development Authority (BNARDA, 2017). A multi-stage sampling method was used in the selection of respondents. The first stage was selection of two (2) Local Government Areas (LGAs) from each of the three (3) agricultural zones in Benue State purposively due to high concentration of production in these zones, making a total of six (6) LGAs. From each of the selected LGAs, rural family households were randomly selected using list of rice producing households as sampling frame. The final stage was simple random proportionate sampling of 650 households from sample frame of 9,160 households using Taro Yamane’s formula at 8% precision. Taro Yamane’ formula stated thus:

$$N = 1 + \frac{N}{1 + N(e)^2} \quad \dots(1)$$

where;

N = population size

1 = unity of constant

E = is the level of precision or sampling error (the range in which the true value of the Population estimated to be). Primary data such as information on socio-economic characteristics of the farmers, inputs used in rice production and sources of agricultural credit were collected using well-structured questionnaire.

### Analytical Techniques

The data from the study were subjected to both descriptive and inferential statistics. Simple descriptive tools such as averages, frequency distribution and standard deviation were used to describe the socio-economic characteristics and sources of credit of the respondents. Stochastic Frontier Analysis (SFA) was used to determine farm efficiency levels of the rice farmers.

Estimation of Stochastic Frontier Analysis (SFA) as modified by Jondrow *et al.* (1982) was adopted as it is popular in determining farm efficiency levels for cross-sectional data. It specifies the relationship between output and input levels using two error terms: traditional normal error term with mean zero and variance constant; and the other is the technical inefficiency level, expressed as half normal (truncated normal) or two parameter gamma distribution (Coelli, 1996a). The two error terms in the maximum likelihood estimation of the production function determine inefficiency levels. Following (Greene, 2008), in a SFA, output  $Y_i$  is a function of inputs  $X_i$  as follows:

$$Y_i = f(X_i, \beta) + \varepsilon_i = f(X_i, \beta) + (V_i - U_i) \quad i=1 \dots N \quad \dots(2)$$



where;

$Y_i$  = production level (or log production of  $i$ -th farm and  $X_i$  is a  $1 \times K$  vector of transformation of input into quantities of  $i$ th farm. The function  $f(.)$  is typically a Cobb-Douglas production technology. This paper assumes a Cobb-Douglas model as a trans-log specification would require a large sample and may increase the probability of multicollinearity. The error term in equation (1) is composed of two components (Aigner *et al.*, 1977);  $\epsilon_i = V_i - U_i$  Where  $V_i$  is the symmetric component which accounts for random variation in output due to factors outside the farmer's control such as weather and diseases and which is assumed to be independently and identically distributed with  $N(0, \delta V^2)$ .  $U_i$  captures technical inefficiency in production and is also assumed to be independently and identically distributed non-negative truncation of the  $N(\psi, \delta U^2)$  distribution. In this paper,  $U_i$  is assumed to be half-normally distributed as specified by Greene (2008).

The SF was also used to estimate parameters and standard errors by using maximum likelihood methods. The parameter vectors  $\beta$  and  $\delta$  are estimated together with the variance parameter (Coelli *et al.*, 1998).

$$\delta^2 = \delta v^2 + \delta u^2 \text{ and } \psi = \delta^2 u / \delta^2 = \delta^2 u / \delta v^2 + \delta^2 v \quad \dots(3)$$

Variable Definition and Measurement of the study are:

Variables	Units	Definition
Rice production ( $Y$ )	Kg/hectare	Quantity of rice produced
Area rice( $X_1$ )	Hectares	Land area for rice planted
Pesticides ( $X_2$ )	Liter/hectare	Expenditure on pesticides/hectare
Seeds ( $X_3$ )	Kg/hectare	Expenditure on seeds
Hired labor ( $X_4$ )	Hours/hectare	Total hourly of labor hired/hectare
Fertilizer( $X_5$ )	Kg/hectare	Total chemical fertilizer used/hectare
Family labor( $X_6$ )	Hours/hectare	Total family labor /hectare

## RESULTS AND DISCUSSION

### Socio-economic Characteristics of the Respondents

The result in Table 1 shows that 87.0% of the households were males and 13.0% were females. Male headed households are more prevalent in Benue State probably because of the religions belief that only male should be the head of the family. The study corroborates the findings of Asogwa *et al.* (2014) who noted that small-scale farming is been carried out mostly by males, while females are mostly involve in light farm operations such as processing, harvesting and marketing of agricultural produce. Also, the male dominance in rice production could be as a result of the laborious nature of farming operations which their female counterparts cannot easily undertake.

**Table 1: Socio-economic Characteristics of the Respondents**

Variables	Frequency	Percentage
<b>Sex</b>		
Male	565	87.0
Female	85	13.0
<b>Total</b>	<b>650</b>	<b>100.0</b>
<b>Age (years)</b>		
20-30	74	11.4
31-40	120	18.5
41-50	390	60.0
51-60	66	10.1
<b>Total (mean)</b>	<b>650 (45)</b>	<b>100.0</b>
<b>Marital status</b>		
Married	435	66.9
Single	86	13.3
Widow	71	10.9
Divorced	58	8.9
<b>Total</b>	<b>650</b>	<b>100.0</b>
<b>Family size(number)</b>		
1-5	120	18.5
6-10	500	76.9
11-15	30	04.6
<b>Total (mean)</b>	<b>650(10)</b>	<b>100.0</b>
<b>Education level</b>		
Primary	89	13.7
Secondary	140	21.6
Tertiary	294	45.2
Non formal	127	19.5
<b>Total (mean)</b>	<b>650(8)</b>	<b>100.0</b>
<b>Farm size (hectares)</b>		
1-3	297	45.6
4-6	315	48.5
7-9	20	3.1
10-12	18	2.8
<b>Total (mean)</b>	<b>650(4.0)</b>	<b>100.0</b>
<b>Annual farm income (₦'000)</b>		
201-300	98	15.1
301-400	123	18.0
401-500	247	38.0
501-600	77	11.8
601-700	64	09.8
701-800	22	03.4
801-900	12	01.8
901-1000	7	01.1
<b>Total (mean)</b>	<b>650(498)</b>	<b>100.0</b>

Source: Author's Computation, 2022

The result shows that 60% of the respondents were within the productivity age range of 41-50 years with mean age of 45 years and are married. This implies that majority of the respondents can actively and effectively use their energies on agricultural and economic activities. More so, the fact that these household heads were married and with children implies large family sizes that would be utilized as source of family labor for rice production as a substitute to paid

labor. The average household size was 10 persons per household which is considered relatively high enough as source of family labor to avoid spending on hiring labor which are often expensive. This corroborates the findings of Osondu *et al.* (2015), who found that in the presence of constraints to farm labor availability, large households tend to use family members as sources of labor. In this case, credit obtained could be efficiently utilized for agricultural productivity.

Majority (80.5%) of the respondents were educated (Table 1) with various forms of education and the average number of years spent in school was 8.0 years. As the years of schooling increased, it is expected that majority of these respondents will be articulate enough in their decision-making process, managerial skills and high level of awareness of credit facilities for increased, sustainable and profitable production. Although, the mean farm size was 4.0 hectares indicative that farmers in the study area are small scale farmers with relatively small farm holdings. It is expected that credit access can help the farmers expand their scope of production through income generation and possibly increase their hectareage. The result agrees with the findings of Olawepo (2010) who found that over 90% of the Nigeria's local food production comes from small scale farms usually not more than 5.0 hectares. The mean annual farm income of households was (₦498,000) indicating low income earning which may have negative impact of rice productivity in the absence of credit availability to the farmers.

### Sources and Size of Credit to Rice Farming Households

Formal financial institutions (FFIs) such as commercial banks, Bank of Agriculture (BOA), and Microfinance banks are the sources of credit to farmers in the study area while informal sources included money lenders, friends/ relatives and Cooperative societies. Table 2 shows that the main type of credit available to the farmers in the study area was informal credit with 68% of rice farming households accessing this source compared to 29% accessing credit exclusively from formal sources. This result agrees with the findings of Ogebe and Ogah (2020) who found that 76% of smallholder farmers in North-Central of Nigeria accessed credit from informal sources compared to 26% accessing credit exclusively from formal sources. The implication is that credit from non-institutional sources is more attractive, as there is little or no insistence on collateral security. On the contrary, formal sources of credit had low patronage from the farmers, and this is due to delay in approval and disbursement of loan and insistence of collateral security. In the case of informal credit, some financial lenders provide credit based on a verbal agreement on the interest rate and payback period and in some cases, the borrower have to produce one or two witnesses and the credit has to be paid back within a mutually agreed period of time. This is consistent with Ali *et al.* (2017) who observed the credit from formal institutions meet only a small portion of the total credit demand of the agricultural sector. The results further revealed that on average, the volume of credit received by rice farmers from informal source was higher compared to that obtained exclusively from formal sources thus, indicating their better access to informal rather than formal credit. Around 4% of rice farming households obtained credit partially from semi-formal sources. The relative amounts of credit received is smaller as most households complained that the amount of credit received these sources was not sufficient for meaningful investment in agriculture. This has a negative implication on the farmers' productivity as size of credit to some extent determines the farmer's ability to purchase inputs and adopt new innovation that can increase his productive efficiency.

**Table 2:** Sources and Size of Credit to Rice Farming Households in the Study Area

Types of credit	Credit sources	No. of Farmers (n=339)	Total credit received per year
Exclusively formal	Microfinance bank	43	12,900,0000
	Agricultural Development bank	32	8,000,000
	Commercial bank	18	3,600,000
	Rural community bank	05	16135000
	<b>Total farmers/Average credit received</b>	<b>98 (28.9)*</b>	<b>40,635,000</b>
Exclusively informal	Cooperative society	120	32300
	Friends and relatives	62	30000
	Money lenders	48	20055
	<b>Total farmers/Average credit received</b>	<b>230 (67.8)*</b>	<b>53,691,000</b>
Semi-formal lenders (job creation funds and social political associations)	<b>Total</b>	<b>11 (3.3)*</b>	<b>2,875,000</b>
Average amount of credit received			<b>97,201,100</b>

\*Note: figures in parenthesis shows ratio of farmers, e.g., exclusively formal =  $98/339 \times 100 = 28.9\%$ .  
Source: Survey Author's Computation, 2022.

### Households and Farm Characteristics of Borrowers and Non-borrowers

The results of descriptive statistics (Table 3) showed that there was no difference in the two groups in terms of age, farming experience and family size though the household age of the borrower group have on average higher education levels. However, there was significant difference in the levels of rice production among the two groups. Rice production in the borrower group was significantly higher ( $P < 0.05$ ) than that of non-borrowers. Borrowers planted more rice, and spent more on inputs for rice production such as fertilizers, pesticides and hired labor than non-borrowers except for expenditure on seeds. The borrowers used on average, 0.23 tons seeds and 0.24 tons fertilizer per hectare compared to an average of 0.22 tons and 0.21 tons, respectively, for non-borrowers. The accessed credits from various credit sources helped the borrower group to purchase inputs such as fertilizers and improve farming technologies (Green, 2008).

Among the non-borrower group, it was found that credit constraints reduced their rice outputs. This is in line with study by Ammani (2012) who found that credit constraints reduced agricultural output by 26%. However, the study suggested that access to credit by rice farmers is important but not sufficient by itself to have optional farm productivity. It needs other factors such as extension services and efficient markets to compliment credit accessibility in order to have optimal farm



productivity. The study shows that the household age of the borrower group has on average higher education levels.

**Table 3:** Households and Farm Characteristics of Borrowers and Non-borrowers

Variables	Borrowers (339)	Non-borrowers (311)	t-test
Age (years)	45.0	46.0	1.31
Household size (person)	10.0	10.1	-0.26
Farming experience (years)	20.0	20.5	1.53
Education (years)	8.9	8.8	0.48
Rice production(tons/ha)	6.4	6.0	-0.33**
Area with rice(ha)	31.90	21.60	1.38
Seeds(tons/ha)	0.23	0.22	-1.80*
Fertilizer (tons/ha)	0.24	0.21	1.22
Pesticides (liters/ha)	6.12	5.20	1.30
Hired labor(hours)	16.40	14.10	-0.43
Family labor (hours)	23.20	23.80	1.18
Distance to market Centre (km)	5.8	5.2	-1.86**

Note: \*, \*\*: Significant at 10% and 5%

Source: Author's Computation, 2022.

### Technical Efficiency and Determinants of Rice Farming Households

Table 4 reveals the maximum likelihood estimates (MLE) of the pooled household model with dummy variables for the household who took formal and informal credit. The variance parameters Sigma ( $\delta^2$ ) was 0.324 and was statistically significant at 1% level of probability. This indicates a good fit and correctness of the distribution form assumed for the composite error term. The value of gamma ( $\psi$ ) is estimated to be 0.407 and it was highly significant at 1% level of probability. This is consistent with the theory that the  $\psi$ -value be greater than zero. This implies that 41% of random variation in the yield of the farmers was due to the farmers "inefficiency". Since these factors are under the control of farmers, reducing the influence of the effect of  $\psi$  will greatly enhance the technical efficiency of the farmers and improve their yield. The average technical efficiency of rice farmers was about 85%. This implies that farmers still had the possibility to improve their efficiency by an average of 15%. The coefficients of areas with rice, expenditure on pesticides, seeds, fertilizer and hired labor were positive and were statistically significant at 1% probability level implying that rice yields are positively associated with these variables except family labor which is negative and statistically significant at 5%.

The estimates of the coefficients of the technical inefficiency model are also shown in Table 4. Generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The result shows that age, farming experience, family size and access to credit have negative signs while educational level and distance to the market centre have positive signs. The coefficients of age (-0.139), farming experience (-0.618), family size (-0.004), gender (-0.015), formal credit (-0.036) and informal credit (-0.078) were negative and statistically significant implying these variables increase technical efficiency which agree with a prior expectation. The coefficient of education (0.247) was positive and significant 5% level. This indicates that the level of education attained reduce technical efficiency. This means high level of education is not desired for farming of rice and indeed, educated people opt for salaried employment in the study area. The coefficients of access

to formal credit were negatively significant in the technical inefficiency regression, implying that access to credit is likely to increase the production and technical efficiency of rice farmers. In fact, the financial constraints in farming are likely to be relieved through credit, which allows the purchase of more inputs, which in turn increases revenue and profit (Hyuha *et al.*, 2007).

More so, as presented in Table 4, the coefficient of access to informal credit is larger than that of formal credit, suggesting that access to informal credit had more effect on rice production efficiency. However, access to credit both formal and informal, contributed significantly to production. The coefficient of distance from household dwelling to the market (0.059) suggests that households in remote areas are more likely to have lower technical efficiency levels and rice yields. Poor communication and transportation facilities may lead to lower efficiency levels of households further away from market centre.

**Table 4:** Estimation of SFA and Efficiency Levels for Rice Production

Stochastic frontier analysis (SFA) model				
Production coefficient	Units	Co-efficient	Standard deviation	t-ratio
<b>Dependent variable:</b>				
<b>Log (rice outcome) (tons)</b>				
Constant	$\beta_0$	0.560	0.139	1.289
Area rice	$\beta_1$	0.112	0.077	-0.268***
Seeds	$\beta_2$	0.170	0.119	0.387***
Fertilizer	$\beta_3$	0.100	0.123	0.804***
Pesticides	$\beta_4$	0.133	0.125	0.280***
Hired labor	$\beta_5$	0.154	0.107	0.372***
Family labor	$\beta_6$	-0.504	0.105	0.142**
$\delta^2$		0.324***	0.009	
$\Gamma$		0.407	0.122	
Log likelihood		11.234		
<b>Inefficiency effect model</b>				
Age	$\delta_1$	-0.139*	0.082	-0.469
Family size	$\delta_2$	-0.004**	0.050	-1.416
Experiences	$\delta_3$	-0.618***	0.038	-1.458
Education	$\delta_4$	0.247**	0.085	1.877
Gender	$\delta_5$	-0.015**	0.253	-2.147
Formal credit	$\delta_6$	-0.036***	0.070	-2.448
Informal credit	$\delta_7$	-0.078***	0.078	-0.485
Distance to market	$\delta_8$	0.059	0.118	1.120
$\delta u_2$		0.003		
$\delta v_2$		0.033		
TE		0.852		
LR test of the one-sided error		302.433		

Note: \*, \*\*, \*\*\*: Significant at 10%, 5% and 1%

Source: Author's Computation, 2022

### Technical Efficiency Range of Rice Farmers

Table 5 presents the technical efficiency distribution of the rice farmers in the study area. The mean technical efficiency of sampled farmers in the study area was 0.85, with 0.98 for the best farmer and 0.16 for the least farmer. This means that on the average, output fell by 15% from the maximum possible level due to inefficiency. About 61.5% of the farmers were predicted to have technical efficiency exceeding 80%. This indicated that there are some 16.5% technical inefficient farmers in the study area. The mean technical efficiency is similar to that reported by Maurice (2004) who reported TE of 80% among cereal crop *fadama* farmers in Adamawa State of Nigeria. Furthermore, the estimated TE by implication means that the average farmer in the sample could save 13.50 percent (i.e.,  $1 - [85.2/98.5]$ ) of costs and the most technically inefficient could realize about 83.2% cost savings (i.e.,  $1 - [16.5/98.5]$ ) compared with the TE level of his most efficient counterpart. In addition, the highest TE level ranging from 80% to 90% comprises 308 farms, which is 47.38% of the total. The lowest TE score of fewer than 50 percent comprise 09 farmers or 1.39%, indicating that almost all farmers in Benue achieve rather high technically efficient production. Results in Table 5 further showed that the technical efficiency levels of borrowers were higher than those of non-borrowers.

**Table 5:** Distribution of Technical Efficiency of Rice Farmers

Range	Borrowers				Non-Borrowers			
	All households		Formal borrowers		Informal borrowers			
TE (%)	n	%	N	%	n	%	n	%
>90≤100	92	14.15	10	9.17	10	4.35	0	0
>80≤90	308	47.38	98	89.91	213	92.61	0	0
>70≤80	120	18.46	1	0.92	6	2.61	38	12.22
>60≤70	75	11.54	0	0	1	0.43	200	64.31
>50≤60	46	7.08	0	0	0	0	70	22.51
≤50	09	1.39	0	0	0	0	3	0.96
<b>Total</b>	<b>650</b>	<b>100.0</b>	<b>109</b>	<b>100.0</b>	<b>230</b>	<b>100.0</b>	<b>311</b>	<b>100.0</b>
Mean TE (%)	85.20							
Min. TE (%)	16.50							
Max. (%)	98.50							

Source: Author's Computation, 2022

### CONCLUSIONS AND RECOMMENDATIONS

The paper employed the SFA model to investigate access to credit and technical efficiency and yields of rice farmers in Benue State, identify sources of credit and estimates the determinants of TE of rice farmers in the study area. Most farmers accessed credit easily from informal sources which often do not require collateral security. The TE level of farmers was estimated to be 85.20 percent. This implies that farmers still had the possibility to improve their efficiency by an average of 15%. The determinants of the stochastic production frontier tested included the land area used for rice and expenditure on seeds, hired labor, fertilizer and pesticides. The results of SFA model showed that all the coefficients, except that of family labor variable, were positive and statistically significant, revealing that technical efficiency can be influenced by these variables. The result shows that one of the most important factors affecting an increase in technical efficiency of

households is the utilization of hired labor in rice farming because the coefficient of hired labor variable is statistically significant and bigger compared to other variables at the level of 5 percent. The more intensive the hired labor investment in rice land, the higher the technical efficiency of households and this was made possible because the accessed credit was used to employed labor for rice production.

In the inefficiency model, the result showed that access to credit (both formal and informal) contributed significantly to production, although the coefficient of access to informal credit is larger than that of formal credit, suggesting that access to informal credit had more effect on rice production efficiency. Thus, the coefficients of the dummy variables for access to formal and informal credit confirm that borrowers were more likely to have higher rice production outcomes than non-borrowers. Finally, there was a big difference in technical efficiency among borrowers and non-borrowers, suggesting the potential ability of output increase by accessing credit as additional funds from credit markets can be used to invest in rice paddy production, principally by adopting new technologies. Based on the findings of this study, the following recommendations were pertinent:

1. Access to formal credit could be made easier for farmers without the specific commodity requirements. In other word, credit should meet the needs of the farmers, in particular for investment in farm activities.
2. Accessibility to credit by rural households could be improved by establishing more branches of agricultural and community banks in the rural areas, providing innovative credit schemes that overcome problems of smallholder farmers who lack collateral and by reducing the currently long processing times of loan application and other requirements.
3. A further expansion of rural credit systems could enhance and contribute to increased rice production and efficiency in Benue State.

## REFERENCES

- Adetiloye, A. A. (2012). Agricultural financing in Nigeria: An assessment of the agricultural credit guarantee scheme fund (ACGSF) for food security in Nigeria (1978-2006). *Journal of Economics*, **3**(1): 39-48.
- Aigner, D. T., Lovell, C. A. K. and Schmidt, P. (1977). Formulation and estimation of stochastic frontal production function models. *Journal of Econometrics*, **6**(1): 21-37.
- Ali, B. M., Agbo, F. U., Ukwuaba, I. C. and Chiemela, C. J. (2025). The effects of interest rates on access to agro-credit by farmers in Kaduna State, Nigeria. *African Journal of Agricultural Research*, **12**(43): 3160-3168.
- Ammani, A. A. (2012): An investigation into the relationship between agricultural production and formal credit supply in Nigeria. *International Journal of Agriculture and Forestry*, **2**(1): 46-52.
- Anetor, F. O., Ogbechie, C., Kelikume, I. and Ikpesu, F. (2016). Credit supply and agricultural production in Nigeria: A vector autoregressive (VAR) approach. *Journal of Economics and Sustainable Development*, **7**(2): 131-133.
- Anthony, F. (2010). Agricultural credit and economic growth in Nigeria: An empirical analysis. *Business and Economic Journal*, **14**: 1-7.
- Asogwa, B. C., Abu, O. and Ochoche, G. (2014) Analysis of Peasant Farmers' Access to Agricultural Credit in Benue State, Nigeria. *British Journal of Economics, Management and Trade*, **4**(10): 1535-1543.



- Benue Agricultural and Rural Development Authority [BNARDA] (2017). *Annual Report*. Pp. 9-14.
- Brambilla, I. and Porto, G. G. (2005). Farm Productivity and Market Structure: Evidence from Cotton Reforms in Zambia. Accessed March, 29 2022 at <http://www.depeco-econo.unlp.edu.ar/semi/semi030605.pdf>.
- Chandio, A. A., Jiang, Y., Gesesse, A. T. and Dunya, R. (2017). The nexus of agricultural credit, farm size and technical efficiency in Sindh, Pakistan: A stochastic production frontier approach. *Journal of the Saudi Society of Agricultural Sciences*, **3**(4): 125-139.
- Chisasa, J. (2014). *An empirical study of the impact of Bank credit on agricultural output in South Africa*. (PhD. Dissertation).
- Coelli, T. J. (1996a). *Guide to FRONTIER VERSION 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation*. CEPA Working Paper 96/7. Armadale NSW Australia, Department of Econometrics, University of New England.
- Coelli, T., Rao, D. S. P. and Battese, G. E. (1998). *An introduction to efficiency and productivity analysis*. Kluwer Academic Publishers. Boston/Dordrecht/London.
- Food and Agriculture Organization [FAO] (2014). Commodity Balances-Crop Primary Equivalent. Accessed March 11 <https://www.faostat.fao.org>
- Greene, W. H. (2008). *Econometric Analysis*. 6<sup>th</sup> Ed. New Jersey: Prentice Hall.
- Hussain, A. and Taqi, M. (2014). Impact of agricultural credit on agricultural production in Pakistan: An empirical analysis. *International Journal of Advanced Research in Management and Social Sciences*, **3**(4): 125-139.
- Hyuha, T. S., Bashaasha, B., Nkonya, E. and Kraybill, D. (2007). Analysis of Profit Inefficiency in Rice Production in Eastern and Northern Uganda. *African Crop Science Journal*, **15**: 243-253.
- Imoisi, A. I. and Sogules, I. W. (2012). An appraisal of credit facilities on agricultural output and productivity in Nigeria: 1970-2010. *British Journal of Humanities and Social Sciences*, **7**(2): 24-33.
- Jondrow, J., Lovell, C. A. K. and Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, **6**(1): 21-37.
- Khan, A., Azam, M. F. and Qamar, W. (2015). Institutional credit and agricultural production: Empirical evidence from Pakistan. *Journal of Economics and Sustainable Development*, **6**(7): 116-121.
- Linh, H. V. (2015). *Efficiency of Rice Farming Households in Vietnam: A DEA with Bootstrap and Stochastic Frontier Application*. Working Papers, University of Minnesota, Minnesota, USA.
- Magreta, R., Edriss, A. K., Mapemba, L. and Zingora, S. (2013). *Economic Efficiency of Rice Production in Smallholder Irrigation Schemes. A Case of Nkhate Irrigation Scheme in Southern Malawi*. Invited paper presented at the 4<sup>th</sup> International Conference of the African Association of Agricultural Economists, September 22-25 2013, Hammamet, Tunisia.
- Martey, E., Alexander, N. W. and Prince, M. E. (2015). *Impact of Credit on Technical Efficiency of Maize Producing Households in Northern Ghana*. Selected Paper Prepared for Presentation at the Centre for the Study of African Economies (CSAE) Conference 2015, University of Oxford, March 22-24- 2015.





- Maurice, D. C. (2004). *Resource Productivity in Cereal Crops Production among Fadama Farmers in Adamawa State, Nigeria*. Unpublished M.Sc. Thesis submitted to the Department of Agricultural Economics and Extension, University of Maiduguri, Nigeria.
- Moses, J. and Adebayo, A. F. (2007). Efficiency of Factors Determining Rainfed Rice Production in Ganye Local Government Area, Adamawa State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment*, 3: 20-30.
- National Population Commission [NPC] (2007). *Report on total population of Nigeria*.
- Nguyen, T. M. H. (2003). A Study on Technical Efficiency of Rice Production in the Mekong Delta-Vietnam by Stochastic Frontier Analysis. *Journal of the Faculty of Agriculture, Kyushu University*, 48: 325-357.
- Nigerian infopedia (2022). *Full list of Rice Producing States in Nigeria*.
- Nnamocha, P. N. and Charles, N. E. (2015). Bank credit and agricultural output in Nigeria: An error correction model (ECM) approach. *British Journal of Economics, Management and Trade*, 10(2): 1-12.
- Odoemenem, I. U. and Inakwu, J. A. (2011). Economic analysis of rice production in Cross Rivers State, Nigeria. *Journal of Development and Agricultural Economics*, 3(9): 469-474.
- Odu, O. O., Okoruwa, V. O., Adenegan, K. O. and Olayide, A. O. (2011). Determinants of rice farmers' access to credit in Niger State, Nigeria. *Journal of Rural Economics and Development*, 20(1): 15-20.
- Ogebe, F. O. and Ogah, M. O. (2020). Smallholders' Access to Agricultural Credit in North-Central of Nigeria. *International Journal of Research and Innovation in Applied Science*, 2(3): 134-142.
- Oladeebo, J. O. and Oladeebo, O. E. (2008). Determinants of Loan Repayment among Smallholder Farmers in Ogbomosho Agricultural Zone of Oyo State, Nigeria. *Journal of Social Science*, 17: 59-62.
- Olawepo, R. A. (2010). Determining farmers' income: A rural Nigerian experience. *Journal of African Studies and Development*, 2(4): 99-108.
- Osondu, C. K., Ogbonna, S. I. and Emerole, C. O. (2015) Levels and Determinants of Women Farmers' Access to Informal Credit in Abia State, Nigeria. *Journal of Agricultural Extension, Economics and Sociology*, 7(1): 1-10.
- Osa-Afiana, L. O. and Kelikume, I. (2015). The Impact of Banking Sector Reforms and Credit Supply on Agricultural Sector: Evidence from Nigeria: Available from <https://www.abss.org.au/system/files/published/001080-published-apcbss-2015-kuala-lumpur.pdf>.
- Rashid, S., Sharma, M. and Zeller, M. (2002). Micro-lending for small farmers in Bangladesh. Does it affect farm households' land allocation decision? MSSD Discussion Paper 45, International Food Policy Research Institute.
- Sani, A., Yakubu, A. A. and Bello, A. M. (2010). Resource Use Efficiency in Rice Production under Small Scale Irrigation in Bunkure Local Government Area of Kano State, Nigeria. *Nigerian Journal of Basic and Applied Science*, 18(2): 292-296.
- Tijani, A. A., Abubakar, M., Benisheik, K. and Mustapha, A. A. (2010). Resource Use Efficiency in Rice Production in Jere Local Government Area of Bornu State, Nigeria. *Nigerian Journal of Basic and Applied Science*, 18(1): 27-34.
- United State Department of Agriculture [USDA] (2014). *Food Availability (Per Capita) Data System*. Accessed March 11. <http://www.ers.usda.gov>.