



# **Profit Efficiency and Poverty Status of Farmers in Selected Rice Growing Communities in Cross River State, Nigeria**

**Idiong C. Idiong<sup>1\*</sup> and Michael A. Iko<sup>1</sup>**

<sup>1</sup>*Department of Agricultural Economics, University of Calabar, Nigeria.*

## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

**Aim:** This study analyzed the profit efficiency and poverty status of rice farmers in selected rice growing communities in Cross River State, Nigeria.

**Methodology:** The multistage random sampling was used to select rice farming households in the study area. Primary data were collected by means of questionnaire. The mean per capita household expenditure (MPCHHE) and the P-alpha measures of poverty were used for the measurement of poverty while the Stochastic Profit Frontier (SPF) was used to obtain the efficiency estimates and determinants among the rice farming households. The logit regression model was also used to show the effect of some factors on poverty status of the rice farmers.

**Results and Discussion:** The results showed that, out of the 64.32% of the farmers who were generally poor, 40.85% and 23.47% of them were assessed to extremely and moderately poor respectively. The incidence, depth and severity of poverty were 65.32%, 27.84% and 16.38% respectively. The study further showed that profit efficiency ranged between 0.34 and 1.0 with mean efficiency of 0.73, suggesting that there are opportunities for rice farmers in the State to increase their farm income with a view of reducing their poverty levels. The result indicate that educational level, farm size and efficiency negatively influenced poverty while sex, age, educational

\*Corresponding author: E-mail: [chrisdiiong@yahoo.com](mailto:chrisdiiong@yahoo.com);

level, farm size, household size and farming experience were the main determinants of profit efficiency. Inadequate credit access, capital and supply of farm inputs; high cost of labour, poor marketing outlets, and near absence of modern processing facilities were the rice production constraints.

**Conclusion and Recommendations:** The study has shown that rice farmers in the State were majorly poor and relatively efficient with opportunities for improvement. To improve the profit efficiency of rice farmers and reduce their household poverty status would require addressing some vital policy indicators that influenced them. Such policies should encourage experienced rice farmers to remain in production, the raising of the level of education of the poor through adult education, and provision of single digit interest loans and input subsidies to enable the farmers increase their farm sizes.

**Keywords:** Efficiency; farmers; poverty; profit and rice.

## 1. INTRODUCTION

Agriculture plays a very unique and pivotal role in Africa. It is a very important sector in Nigeria's economy and plays a vital role in poverty reduction, human development and food security. In spite of this, the Nigeria's agriculture is made up largely of small-scale farmers who are resource poor and who produce the bulk of the food requirements in the country. The sectoral contribution of agriculture to GDP was put at 21.97 percent in 2013 [1]. The poor growth recorded in this sector is a reflection of food crisis currently experienced in the country in which the rate of population growth exceeds the rate of food production. Food growth rate has been put at 2.5 percent and population growth rate at 3.5 percent leaving a food deficit at 1 percent currently experienced in the country" Central Bank of Nigeria [2].

In Nigeria, rice has become a major staple food in most homes with an increasing per capita consumption of 7.3 percent annually due to changing consumers' preferences from traditional staples such as yam and Cocoyam and urbanization among others" [3]. Regrettably, the food shortages being experienced in the country has not been met by the local production of this crop.

The food crisis in Nigeria according to Idiong [3] has been exacerbated by the low level of productivity of resources used in recent times. Various studies including [4,5,6], observed that "the prevailing low level of productivity in food crop production reflects low levels of allocative, technical and economic efficiencies. Therefore, the productivity of the farm vis a vis efficiency are necessary in view of eminent food shortage experienced in the country and the resultant poverty of food crop farmers in Nigeria [2].

The per capita rice consumption in Nigeria has rapidly increased in the last three decades at an average of 7.3 percent annually [3]. This increase in domestic demand for rice would have gingered increased production by farmers, given the favourable output price. Favourable output prices and increase in demand for rice would have translated into enhanced income and a reduction in the poverty status of farmers. But the extent to which this has been achieved is one of the reasons that necessitated this study [7,8].

In his famous book "Transforming Traditional Agriculture", Schultz [9] posited that farmers are poor but efficient in resource allocation. To what extent the assertion was right has not been verified in Cross River State. Several studies have been carried out on rice production and efficiency in Nigeria and the rest of the world including [6,10,11,12], however, only few have been carried out in Cross River State. For instance, [3], in his study revealed that rice farmers were not fully technically efficient. More so these studies never considered the poverty status of the farmers nor did they indicate the relationship between poverty and efficiency of the rice farmers. It is for these reasons that this research has been designed to address the following research questions:

- i. What is the poverty status of rice farmers in selected rice growing communities in Cross River State?
- ii. What are their levels of profit efficiency?
- iii. What are the factors that influence their poverty status and profit efficiency levels of the rice farmers?
- iv. Does poverty have any influence on rice farmers profit efficiency?

### 1.1 Objectives of the Study

The major objective of this study is to empirically study the poverty status and profit efficiency of

rice farmers in selected rice growing communities in Cross River State, Nigeria. The following were the specific objectives to;

- 1) Determine the poverty status of rice farmers in selected rice growing communities in Cross River State.
- 2) Analyze the profit efficiency levels of rice farmers in selected rice growing communities in Cross River State,
- 3) Determine the influence of some socioeconomic characteristics of the farmers on their poverty status and profit efficiency levels.
- 4) Ascertain the relationship between the poverty status of rice farmers and their profit efficiency levels in the selected rice growing communities of the State.

## 2. RESEARCH METHODOLOGY

### 2.1 Study Area

The study was conducted in Cross River State, which is an important rice producing State in Nigeria. The State comprises 18 Local government Areas (LGAs) that are divided into three (3) Agricultural zones, namely: Calabar, comprising Akamkpa, Akpabuyo, Bakassi, Biase, Calabar Municipality, Calabar South and Odukpani Local Government Areas. Ikom Zone made up of Abi, Boki, Etung, Ikom, Obubra and Yakurr LGAs and the Ogoja Zone comprising Bekwara, Obanliku, Obudu, Ogoja and Yala LGAs. Seven of these LGAs (i.e, Abi, Biase, Obubra, Obudu, Ogoja, Yakkur and Bekwarra) are known for rice cultivation.

Cross River State is located in the Niger Delta and "lies within Latitude 5°45' North and 8°30' East and between Longitude 8° and 9° East of the equator. The vegetation of the State spans

from the Mangrove swamp and Rainforest in the south to a Derived Savannah in the North. The State occupies 20,156 square Km and shares boundaries with Benue State to the North, Enugu and Abia States to the West, to the East by Cameroon Republic and to the South by Akwa Ibom State and the Atlantic Ocean. The State experiences two seasons; the dry season and the wet season with a temperature range of 24°C and 37°C. It is predominantly rural with an estimated 75% of the population engaged in rain-fed subsistence agriculture. Many crops are grown in the State including Cassava, yam, oil palm, cocoa and vegetables. Other economic activities undertaken by the people of the State are fishing, trading and mining. The major tribes are Efik, Ejagham, Yakurr, Agbo, Bakor and Bekwara. It is popularly known as "The People's Paradise" with its headquarters in Calabar.

### 2.2 Sampling Procedure/Sample Size

As shown in Table 1, a multistage sampling technique was used for the sample selection as follows; in the first stage, three (3) Local Government Areas (LGAs) were purposively selected from the Calabar, Ikom and Ogoja agricultural zones of the State.

The purposive selection was based on the higher levels of production of rice obtained from these LGAs. The second stage involved the purposive selection of three rice farming communities from each of the selected LGAs, based on the intensity of rice cultivation in these communities. In the third and final stage, the list of rice farmers obtained from the Cross River State Agricultural Development Programme (CRADP) in each community was used and a proportionate random sample of 30 percent of 713 rice farming households were selected, giving a total of 213 farming households used for the study.

**Table 1. Sampling and sample size**

Agric zones	No. of LGAs	Sampled LGA	No. of communities sampled	Names of communities	No. of registered farmers/ Community	Sample size/ Community at 30%
Calabar	7	Biase	3	Abredang	30	9
				Abayong	43	13
				Adim	85	26
Ikom	6	Abi	3	Ediba	21	6
				Ekureku	71	23
				Usumutong	67	20
Ogoja	5	Ogoja	3	Bansara	231	69
				Ishibori	120	36
				Nkumlbore/Irede	38	11
Total	18		9		712	213

Source: Field survey 2017

### 2.3 Data Collection

Collection of data was mainly from primary sources. Information on the socio-economic characteristics and production inputs of the rice farmers were obtained from the farmers using structured questionnaire and interview schedules. Data so collected were for the last season of production i.e. 2017.

### 2.4 Analytical Techniques

The following analytical tools were used in the study; Poverty status of the farmers was determined by using the mean per capita household expenditure (MPCHHE) and the P-alpha poverty measures.

Oladeebo [13] defined the MPCHHE as;

$$\text{MPCHHE} = \frac{\text{Total per capita expenditure}}{\text{Total number of household in the sample}} \quad (1)$$

Total per capita expenditure is the total sum, that is, aggregate of all total expenditure incurred by the total number of individuals in the household during the production period

P-alpha poverty measures (Foster-Greer-Thorbecke index): Foster; Greer and Thorbecke [14], proposed a family of poverty indices based on a single formula capable of incorporating any degree of concern about poverty through the poverty aversion parameter  $\alpha$ . This is called P-alpha measure of poverty or the poverty gap index". The index is defined as;

$$P_{\alpha} = \frac{1}{N} \sum_{i=1}^q \frac{(z - y_i)^{\alpha}}{z} \quad (2)$$

where,  $z$  is the poverty line,  $q$  is the number of households below the poverty line,  $N$  is the total sample population,  $y_i$  is the per capita expenditure of the  $i^{\text{th}}$  household, and  $\alpha$  is the (14) parameter, which takes the value 0, 1 and 2, respectively, depending on the degree of concern about poverty. The quantity in parentheses is the proportionate shortfall of expenditure or income below the poverty line. By increasing the value  $\alpha$ , the aversion to poverty as measured by the index is increased. For example, where there is no aversion to poverty  $\alpha = 0$ , the index is simply:

$$P_0 = \frac{1}{N} q = \frac{q}{N} = H \quad (3)$$

which is equal to the head count ratio. This index measures the incidence of poverty. If the degree of aversion to poverty is increased, so that  $\alpha = 1$ , the index becomes:

$$P_1 = \frac{1}{N} \sum_{i=1}^q \frac{(z - y_i)}{z} = HI \quad (4)$$

Here the head-count ratio is multiplied by the income gap between the average poor person and the line. This index measures the depth of poverty; it is also referred to as income gap or poverty gap measure".

Profit efficiency levels of rice farmers in selected rice growing communities in Cross River State, was analyzed using the stochastic frontier profit model.

Profit efficiency according to Adesina and Djato [15] is defined as profit gained from operating on the profit frontier, taking into consideration farm specific prices and factors. They stated that, when considering a farm that maximizes profit subject to perfect competitive input and markets and a singular output markets and a singular output technology that is quasi-concave in the  $(n \times 1)$  vector of variable inputs, and the  $(m \times 1)$  vector of fixed factors ( $Z$ ), the actual normalized profit function which is assumed to be well behaved can be derived as follows:

$$(\Pi) = \sum (TR - TVC) = \sum (PQ - WX_i) \quad (5)$$

When the profit ( $\Pi$ ) is divided on both sides of the equation above by the market price ( $P$ ) of rice, the profit function is normalized. That is:

$$\frac{\Pi(P, Z)}{P} = \frac{\sum (PQ - WX_i)}{P} = Q - \frac{WX_i}{P} = \frac{f(X_i, Z)}{P} - \sum P_i X_i \quad (6)$$

Where: TR represents total revenue, TC represents total cost,  $P$  represents price of output ( $Q$ ),  $x$  represents normalized price of input  $x_i$  while  $f(X_i, Z)$  represent production function".

The Cobb-Douglas profit function in implicit form which specifies production efficiency of the farmers is expressed as follows:

$$\Pi_i = f(P_i, Z) \exp (V_i - U_i), i=1, 2, \dots n. \quad (7)$$

Where,  $\Pi$ ,  $P_i$  and  $Z$  are as defined above. The  $V_i$ 's are assumed to be independent and identically distributed random errors, having

normal  $N(0, \sigma^2_v)$  distribution, independent of the  $U_i$ 's. The  $U_i$ 's are profit inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution  $N(\mu, \sigma^2_u)$ .

The profit efficiency is expressed as the ratio of predicted actual profit to the predicted maximum profit for a best practiced rice farmer and this is represented as follows:

$$\text{Profit Efficiency (EP)} = \frac{\Pi = \exp[\Pi(P, Z)] \exp(\ln V) \exp(\ln U) - \theta}{\Pi^{\max} \exp[\Pi(P, Z)] \exp(\ln V) - \theta} \quad (8)$$

Firms specific profit efficiency is again the mean of the conditional distribution of  $U_i$  given by EP and defined as:

$$EP = E[\exp(-U_i)/E_i] \quad (9)$$

EP takes the value between 0 and 1. If  $U_i = 0$  ie on the frontier, obtaining potential maximum profit given the price it faces and the level of fixed factors. If  $U_i > 0$ , the firm/farm is inefficient and losses profit as a result of inefficiency. This study, adapted the model of [16] in specifying the frontier function with the inefficiency factors in one-step maximum likelihood estimation method.

The explicit Cobb-Douglas functional form for the rice farms in the study area was specified as follows;

$$\ln \Pi = \ln \beta_0 + \beta_1 \ln Z_{1i} + \beta_2 \ln P_{1i} + \beta_3 \ln P_{2i} + \beta_4 \ln P_{3i} + \beta_5 \ln P_{4i} + \beta_5 \ln Z_{2i} + (V_i - U_i) \quad (10)$$

Where:  $\Pi_i$  represents normal profit computed as total revenue less variable cost divided by farm specific rice price;  $Z_i$  represents farm size (hectares);  $P_1$  represents average price per man day of labour;  $P_2$  represents average price per kg of fertilizer;  $P_3$  represents average price per kg of seed;  $P_4$  represents price per kg of agrochemical;  $Z_2$  represents average price of farm tools and subscript  $i$  refers to the observation on the  $i$ th farmer".

$$\text{The inefficiency model } (-U_i) = -U_i = \delta_0 + \delta_1 M_{1i} + \delta_2 M_{2i} + \delta_3 M_{3i} + \delta_4 M_{4i} \quad (11)$$

"Where;  $M_1, M_2, M_3, M_4, M_5, M_6, M_7, M_8$  and  $M_9$  represent educational level, age of farmers, farm size, farming experience, household size, membership of cooperative/farmers organization, extension contact, credit access and sex respectively. These socio-economic variables are included in the model to indicate their possible

influence on the profit efficiencies of the rice farmers. The variance of the random errors  $\sigma^2_r$  and that of the profit inefficiency effect  $\sigma^2_u$  and overall variance of the model  $\sigma^2$  are related thus:  $\sigma^2 = \sigma^2_v + \sigma^2_u$ , and measure the total variation of profit from the frontier which can be attributed to profit inefficiency" [17].

Battese and Coelli [18] provided log likelihood function after replacing  $\sigma^2_v$  and  $\sigma^2_u$  with  $\sigma^2 = \sigma^2_v + \sigma^2_u$  and thus estimating gamma ( $\gamma$ ) as  $\gamma = \sigma^2_u / \sigma^2_v + \sigma^2_u$ .

According to Coelli [16], the estimation for all parameters of the stochastic frontier profit function and the inefficiency model are simultaneously obtained using the program Frontier version 4.1c.

Farm profit was measured by;

$$\Pi = \sum (TR - TVC) = \sum (PQ - WX_i) \quad (12)$$

Where:

$\Pi$  = Profit/farmer,  
 $TR$  = Total revenue/farmer,  
 $TC$  = Total cost/farmer,  
 $PQ$  = Price of output (Q)/farmer,  
 $WX_i$  = Input price (Xi)/farmer and  
 $\sum$  = Summation.

The profit efficiency of the farmers was expressed as;

$$\Pi_i = f(P_i, Z) \exp(V_i - U_i), i = 1, 2, \dots, n \quad (13)$$

Where:

$\Pi_i$  = Profit of the  $i$ th farmer,  
 $P_i$  = Output price vector of the  $i$ th farmer,  
 $Z$  = Fixed factors  
 $V_i - U_i$  = Composite error term.

$V_i$ 's are assumed to be independent and identically, distributed random errors, having normal  $N(0, \sigma^2_v)$  distribution, independent of the  $U_i$ 's.  $U_i$  are profit inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution  $N(\mu, \sigma^2_u)$  with mean  $\mu$  and variance  $\sigma^2$ .

The profit efficiency was expressed as;

$$EP = \Pi = \exp[\Pi(P, Z)] \exp(\ln V) \exp(-\ln U) - \theta \quad (14)$$

but where  $U_i > 0$ , the farm is inefficient and loss profit as a result of inefficiency. The Coelli [16] model was used "to specify the stochastic profit frontier function for the rice farmers as;

$$\ln \Pi = \ln \beta_0 + \beta_1 \ln Z_i + \beta_2 \ln P_{1i} + \beta_3 \ln P_{2i} + \beta_4 \ln P_{3i} + \beta_5 \ln P_{4i} + (V_i - U_i) \quad (15)$$

Where:

$\Pi_i$  = normalised profit of the farmer,  
 $Z_i$  = capital (₦),  
 $P_1$  = average price per man day of labour,  
 $P_2$  = average price per kg of fertilizer,  
 $P_3$  = average price per kg of seeds,  
 $P_4$  = average price of output,  
 Subscript i = observation of the ith farmer,  
 $V_i - U_i$  = Composite error term,  
 $\beta_0 - \beta_5$  = Parameters to be estimated,  
 $U_i$  = 0 and  
 $\ln$  = natural logarithm

$$\Pi^{\max} \exp [\Pi (P, Z)] \exp (\ln V) - \theta \quad (16)$$

Where;  $\Pi$ ,  $P$ ,  $Z$ ,  $V$ ,  $U$  are as defined above.

$\theta$  = Constant added to attain positive values.

The profit efficiency of an individual farmer will be obtained as;

$$E\Pi = E[\exp (-U_i)/E_i] \quad (17)$$

$E\Pi$  takes the value between 0 and 1.

The logit model that was used in this study to ascertain the factors that influence poverty levels of the rice farmers and specified below:

$$Y_i^* = \beta X_i + U_i \quad (18)$$

Where:

$Y_i$  = 1 (poor and inefficient) if  $Y_i^* > 0$ ,  
 $Y_i$  = 0 (non-poor and efficient) if  $Y_i^* < 0$ ,  
 $U_i$  = error term,  
 $\beta$  = estimated parameter  
 $X_i$  = Vector of independent variables.

Therefore, the probability of a farmer i being poor and inefficient or not could be written as;

$$P_r (Y_i = 1/X_i) = f(X_i\beta) = \frac{\exp(X_i\beta)}{1+\exp (X_i\beta)} \quad (19)$$

Where:

$X_i$  = Age, education, farm size, farming experience, household size, membership of organization, extension contact and access to credit.

The inefficiency model ( $-U_i$ ) is expressed as;

$$-U_i = \delta_0 + \delta_1 M_{1i} + \delta_2 M_{2i} + \delta_3 M_{3i} + \delta_4 M_{4i} + \delta_5 M_{5i} + \delta_6 M_{6i} + \delta_7 M_{7i} + \delta_8 M_{8i} + \delta_9 M_{9i} + \delta_{10} M_{10} \quad (20)$$

Where:

$-U_i$  = Profit inefficiency (dummy)  
 $M_1$  = Education (years of formal schooling),  
 $M_2$  = Age of farmers in years,  
 $M_3$  = Farm size in hectares,  
 $M_4$  = Farming experience in years,  
 $M_5$  = Household size (number),  
 $M_6$  = Membership of cooperative/farmers organization (1=member; 0=non member),  
 $M_7$  = Extension contact (1=contact; 0=non contact),  
 $M_8$  = Credit access (1=access; 0=no access),  
 $M_9$  = Sex (male=1; female=0)  
 $M_{10}$  = Poverty Status (1=non poor; 0=poor)  
 $\delta_0 - \delta_9$  = variance of the coefficient".

### 3. RESULTS AND DISCUSSION

#### 3.1 Profit Efficiency of the Rice Farmers

Table 2 shows the results of the maximum likelihood estimates of the parameters of the stochastic Profit Frontier model. The estimated coefficients of the parameters of the normalized profit functions based on the assumption of competitive market are positive except the cost of labour, price of fertilizer and price of seeds which are negative as expected.

**Table 2. Maximum likelihood estimates of stochastic profit function for rice farmers in Cross River State**

Variables	Coefficient	t – ratio
Constant	3.212***	10.380
Labour Wage (₦/man day)	-0.003	0.120
Price of Fertilizer (₦/kg)	-0.053***	3.127
Capital (₦)	0.006	0.4
Price of seed (₦/kg)	-0.050**	4.442
Output Price (₦/kg)	0.286***	2.704
Diagnostic Statistics		
Gamma ( $\gamma$ )	0.990**	4.560
Sigma-Square ( $\delta^2$ )	0.023	3.860
Log likelihood function	-85.720	
LR test	42.130	

\*\*\* Significant at 1%, \*\* Significant at 5%.

Source: Computed from Field Survey 2015 using Frontier version by Coelli [16]

The estimates of the sigma square ( $\delta^2 = 0.023$ ) is significant at 1% level. The correctness of the specified distributional assumptions of the composite error term ( $\epsilon$ ) and also a good fit is shown by the estimates of the sigma square. This signifies that, subjecting the data to Ordinary Least Squares (OLS) estimation procedure would not give an adequate estimate.

Idiong [3] and [19] obtained similar results in their studies. The calculated gamma ( $\gamma$ ) of 0.99 also was significant at the 5% level of significance indicating that, 99% of the difference in actual profit from the highest profit (profit frontier) among the rice farms was mainly due to different approaches in the farmers' practices. The results further showed that, the coefficient of labour price was negative and not significant, indicating that labour had an inverse relationship with. This corroborated with the findings of [20] who in their study of profit efficiency among catfish farmers in Benue State, Nigeria established an inverse relationship between hired labour and gross profit of the respondents.

The results showed that the coefficient of cost of fertilizer was negatively signed and significant at 1% level implying that high cost of fertilizer and wrong application by the rice farmers would result in extra cost incurred by the farmers. Therefore increasing the cost of fertilizer by 10% will decrease farm profit by 5%. Orefi and Damenongo [21] reported similar, but [22] reported a positive relationship between the cost of fertilizer and profit of rice producers in Vietnam's Red River Delta. The coefficient of price of seeds was negative and significant at 5% indicating that, increasing the price of seeds by 10% will decrease farm profit by 5%. This situation is likely caused by high cost of seeds, wastage of seed during planting and use of non-improved varieties of seeds.

The results further showed that the coefficient (0.2856) of output price was positive and significant at 1% level of significance. This implies that, if rice farmers are given the right inputs at the right time, more output of rice per hectare would be harvested as increasing the output by 10% would lead to increase in profit by 29%.

### 3.2 Profit Efficiency Levels of Rice Farmers in Cross River State

The frequency distribution of profit efficiency levels of rice farmers in Cross River State is presented in Table 3. The range of profit efficiency was between 0.341 and 0.999 for the worst and best practice farmers respectively and the mean efficiency score was 0.73. This suggests that, there is a 27% gap for the rice farmers to enhance their efficiency, farm income and consequently reduce their poverty levels. The result is within the range reported by several authors [23,24].

**Table 3. Frequency distribution of profit efficiency levels**

Efficiency	Frequency	Percentage
0.30 – 0.49	11	5.16
0.50 – 0.69	69	32.39
0.70 – 0.90	105	49.30
Above 0.90	28	13.15
Total	213	100
Minimum	0.341	
Maximum	0.999	
Mean	0.728	

*Source: Derived from output of computer program Frontier version 4.1 by Coelli [16]*

### 3.3 Determinants of Profit Efficiency of Rice Farmers in Cross River State

The farm and farmer characteristics were used to identify the sources of inefficiencies for policy purposes. According to Galawat and Yabe [25], the sign of the variables in the inefficiency model is very important in explaining the observed level of profit efficiency of the farmers. A negative sign on the coefficient implies that the variable had an effect of reducing profit inefficiency, while a positive coefficient signifies the effect of increasing profit inefficiency. The coefficients of sex, age, educational level, farm size, farming experience and household size carried the negative signs. However, sex, age, farm size and farming experience were significant at the five percent level while, educational level and household size were significant at the one percent level.

The coefficient of sex had a negative sign and significant at the 5% level. This implies that female rice farmers were less inefficient compared with the males. This result agrees with the findings of Olasunkamni, Otunaiya and Adejumu [26].

The results of the analysis of the inefficiency model showed that age had a negative coefficient (-0.0526) and significant at the 5% level. This indicates that age reduced profit inefficiency. That is the older rice farmers were more profit efficient. Ogundari [24] had reported that as farmers get older, the more efficient they become, because they might have accumulated experience and opportunities to correct observed errors in the past. However, Nwaru [27] and [28], asserted that younger farmers are more efficient because they are able and willing to bear risk, be innovative and have the physical strength to do the manual work that is common in local rice production.

**Table 4. MLE estimates of the determinants of profit inefficiency of rice farmers in Cross River State**

Variables	Coefficient	Standard Error	t-ratio
Constant	0.3488	0.9763	0.35
Sex	-0.2684**	0.1323	2.15
Age	-0.0526**	0.0257	2.27
Educational Level	-0.6975***	0.2898	3.18
Farm Size	-0.4264**	0.1684	2.53
Household Size	-0.5999***	0.2053	2.92
Farming Experience	-3.2121**	1.2171	2.63

\*\*\* Significant at 1%, \*\* Significant at 5%.

Source: Derived from output of computer program Frontier 4.1 by Coelli [16]

The results also reveal that the coefficient (-0.6975) of education was negative and statistically significant at 1% level. This implies that the level of a farmer's educational attainment reduces his level of profit inefficiency. The result corroborates the findings of several authors [29,30] who found education to be having real impact on profit efficiency of their respondents by adapting to the complexities associated with new innovations. Education is very significant in skill acquisition and technology transfer and improves the capability of farmers to plan, take risks and also adopt modern technology.

The results showed further that farming experience was negative and significant at 5% level. This result is expected, because experience is gained through learning by doing which enables farmers to correct past mistakes and adopt better practices in the farm. This result corroborates that of [23] who concluded that farmers in his study area with more farming experience operated at significantly higher level of profit efficiency. Risks and uncertainties are involved in rice farming therefore, to be capable enough to handle all the tediousness of rice farming, a farmer ought to have been involved in rice farming for quite some time.

Similarly, the result further revealed that coefficient of farm size was negative and significant at 5% level. Implying that increasing farm size will increase profit efficiency (decrease inefficiency).

In this study, the coefficient of household size was negative and significant at 1% level. This means that a larger family size decreased the profit inefficiency of the rice farmers. Ogundele [31] stated that, household size plays a significant role in subsistence farming in Nigeria where farmers rely on household members for the supply of about 80% of farm labour

requirement. However, Effiong [32], had posited that, labour availability with increase family size is dependent on the age structure of the household. Stating that, where majority of the family members are aged or younger ones in school age, increase in household size will not make for labour availability. This means that, where they are available, there will be a resultant over utilization of labour resulting into profit inefficiency given the small farm sizes prevalent in the study area.

### 3.4 Poverty Levels of the Rice Farmers in the Study Area

Table 5 indicates the poverty levels of the rice farmers. The result showed that the poverty line in the study area was ₦5, 589.25/month and that majority (64.32%) of the farmers were below this line and therefore classified as poor. However of this percentage 40.85 were extremely poor. This finding corroborates that of many other studies including [33] who reported most small-scale farmers are poor.

**Table 5. Classification of the rice farmers by poverty level**

Poverty	Frequency	Percentage
Extremely Poor	87	40.85
Moderately Poor	50	23.47
Non – Poor	76	35.68
Total	213	100.00
Poverty Line	₦5, 589.25/month	

Source: Field Survey, 2017

The poverty levels of these farmers will hinder their ability to access to information, adopt modern technologies and skills needed in increasing rice production in the State. It may also inhibit mechanization, thus, making rice production to remain at subsistence level that would lead to decrease in profit efficiency of the farmers.



### 3.5 Poverty Status of the Rice Farmers in the Study Area

Three indicators of poverty were used to analyze the poverty status of the rice farmers as presented in Table 6. They include; the poverty incidence, poverty depth and severity of poverty. The incidence of poverty of the rice farmers was 0.6432. This implies that 64.32% of the sampled respondents were either absolutely or relatively poor. The depth of poverty was 0.2784 indicating that, 27.84% of the poor farmers had average consumption expenditure that was below the poverty line in the study. The severity of poverty which was 0.1638 indicated that 16.38% rice farmers were the poorest among the rice farming households in the study area. The welfare gap was 0.4328, meaning that 43.28% is the socio-economic gap between the poor and the rich rice farmers in the study area.

**Table 6. Poverty status among rice farmers in Cross River State**

Poverty index	Values
Total Poverty Gap	51, 931.38
Average Poverty Gap	243.81
Poverty Incidence (P0)	
Poverty Depth (P1)	0.2784
Poverty Severity (P2)	0.1638
Welfare Gap (P1/P2)	0.4328

Source: Field Survey, 2017

The available statistics from the National Bureau of Statistics [34], put the poverty incidence in Nigeria, the South-South Region and Cross River State in 2010 at 69.0%, 63.8% and 59.7% respectively. While the National and South-South regional welfare gaps were put at 0.447 and 0.434 respectively. Comparing these statistics, it revealed that the poverty incidence (64.3%) obtained for the rice farming households in this study is higher than those obtained for the South-

South Region and Cross River State but lower than the National poverty incidence. This means that, there is a need for the redistribution of wealth through social transfer and other social expenditure by both the government and other privileged individuals of the society as this will provide a basis for increase in profit efficiency and poverty reduction.

### 3.6 Determinants of Poverty of Rice Farmers in Rice Growing Communities in Cross River State

Table 7 show the results of the determinants of poverty of rice farming households in Cross River State. The result indicates that the coefficients of education, farm size and profit efficiency were negative and significant ( $P < 0.01$ ) in determining the poverty status of rice farmers in the study area. However, sex, age, household size and farming experience were not significant ( $P > 0.05$ ) in predicting the poverty status of the rice farmers. The results show that education had a negative effect of -19.122 implying that the probability of being poor decreased with increasing level of education. The odds ratio of 1.055 means that, a higher educational attainment of rice farmers will enhance efficiency. The result also indicated that farm size had a negative effect of -28.087. This implied that the probability of being poor decreased with increase in farm size. The odds ratio of 1.037 indicated that the rice farmers should be encouraged to increase their farm sizes to encourage large scale production of the farmers.

The coefficient of efficiency was negative and significant at 1% level. This meant that increasing efficiency of farmers will decrease poverty. The odds ratio of 1.0386 implied that falling into the sphere of poverty was smaller with increase in profit efficiency.

**Table 7. Determinants of poverty of rice farming households in Cross River State**

Variables	Coefficient	Std error	Z	Odds ratio	p-value
Education	-9.1222***	3.3453	5.7163	1.0552	<0.00001
Farm Size	-28.088***	4.1859	6.7098	1.0369	<0.00001
Sex	-0.1654	0.4422	0.3740	0.1982	0.70841
Age	0.0056	0.0355	-0.1568	0.0056	0.87542
HHS	0.0537	0.1581	-0.3392	0.0568	0.73446
Exp	-0.2941	0.3023	0.9728	0.4166	0.33063
Efficiency	-26.921***	3.8438	7.0038	1.0386	<0.00001
Mean Dependent Var	0.5962	S. D. Dependent Var			0.51978
Log-likelihood	-73.0211	Akaike Criterion			164.0423
Schwarz Criterion	194.2939	Hannan–Quinn			176.2680

\*\*\* Significant at 1%.

Source: Derived from output of computer program Frontier version 4.1 by Coelli [16]

## 4. CONCLUSION

The study has shown that rice farmers were relatively efficient but majorly poor in the State. There is need for the improvement of profit efficiency and reduction of poverty by addressing some vital policy indicators that influenced farmers' levels of profit efficiency and poverty in the study area. The policy implication is that since poverty reduction is linked to improving farmers profit efficiency, rice farmers have to be profit efficient if their household poverty is to be alleviated.

## 5. RECOMMENDATIONS

In view of the above findings, the following recommendations were made:

1. Policies such as adult education for rural farmers and agricultural extension education which will concentrate on raising the level of education among the rural farmers should be adopted by the government. This is to enable them have the ability to adapt to complexities associated with new innovations leading to enhanced profit efficiency and poverty reduction.
2. Provision of single digit loans and subsidies to poor farmers to enable them increase their farm sizes.
3. Rice farmers should be encouraged to belong to cooperative societies to enable them access productive resources.
4. The government should provide social assistance benefits to poor rice farmers as this will be expected to have a strong income redistributive effect and help bridge the 43.28% poverty gap in this study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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