Original Research Article

Determinants of Profit Efficiency among Small Scale Rice Farmers in North Central, Nigeria: A Profit Function Approach.

ABSTRACT

The study employed a stochastic frontier profit function to measure profit efficiency among rice farmers in North central, Nigeria. A multi-stage sampling procedure was employed in selecting 218 rice farming household heads in six Local Government Areas of North Central, Nigeria. The results showed that rice production is profitable with an estimated net farm income and Gross margin of ₦67,808.31 and ₦ 70,273.56 per hectare and the return on investment of ₦1.26 was realized as profit for every one naira invested in production of rice in North central Nigeria. The gross ratio of 0.46 and the operating ratio of 0.44 are indicators that rice production was profitable in the study area. Furthermore, the result of tranlog stochastic function revealed that rice farmers in North central were not all fully profit efficient and thus an average farmer in study area could potentially increase profit level if resources are more efficiently utilized. However, the results show that fertilizer, labour, agrochemical, farm size, age, household size, education, farming experience, awareness of climate change and access to climate information had significant effects on the profit efficiency of rice farmers in the study area. The study recommended that since the area has a great potential to increase rice production and farmers' income, efforts

should be made by encouraging rice farmers to adopt improved varieties of rice in order to increase their output. Now that the present administration change mantra is geared towards agriculture, youths in the country could be encouraged by government at all levels and Non-Governmental Organizations (NGOs) to venture into rice farming agribusiness that will serve as potential employment source.

Keywords: Rice, Profit Efficiency, Production, Farmer, inefficiency factors

1. INTRODUCTION (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

Agriculture being a key sector of Nigeria economy accounting for between 60 and 70% of the labour force and contributing between 30 and 40% of the nation's GDP is an indication that more still need to be done to resuscitate the sector [1]. The poor growth recorded in agricultural sector is a reflection of food crisis presently experienced in Nigeria in which the rate of population growth rate exceeds the rate of food production National Bureau of Statistics [2]. Rice forms a significant portion of food consumed in most households in Nigeria. however, Food and Agriculture Organization (FAO) [3] reported that rice is the World's most important food crop, being the staple food of over 50 percent of the world population. It is one of the major cereals, which have assumed cash crop status in Nigeria, especially in the producing areas, where it can play a crucial role in contributing to food and nutritional security, income generation, poverty alleviation and socio-economic growth as a result of the activities that take place along the distribution chains from cultivation to consumption.

Nigeria however, has the potential to be self-sufficient in rice production as virtually all the ecological zones are suitable for rice cultivation either as swamp, upland or under irrigation Foreign Agricultural Services [4]. Despite the availability of cultivable land area, rice production has failed to meet local demand and thus resulted in increase in Nigeria's food import bill Central Bank of Nigeria [1]. For instance, the current level of demand for rice in Nigeria is about 5 million metric tonnes which is more than twice 2.2 million metric tonnes produced. This assertion is corroborated to the authors of [5, 6, 7], that Nigeria is the highest producer, consumer and importer of rice in West African Sub-region. Annual domestic production of the commodity hovers around 3 million metric tons, while demand is as high as about 5 million metric tons, leaving a huge gap of 2 million metric tons annually which is often filled by importation. The author of [3] reported that Nigeria is spending more than $356 billion annually on rice importation as a measure to ensure rice food security by eliminating scarcity. This situation has placed a lot of pressure on Nigeria's limited foreign reserve. Therefore, to prevent food importation from consuming an unbearable proportion of the nation's foreign exchange, both military and civilian administrations, have launched in the past a number of programmes to make the country self-reliant in rice production. The federal government in 2009 spent more than 66.67 billion US Dollars in public-private partnership schemes to improve the irrigation systems and set up about 17 new rice processing mills [8]. Consequently, the imposition of ban on the importation of rice and other food stuff that can be produced locally in the country is an indication that rice growers in the country must leave up to the expectation of meeting the local demand. To achieve this objective, effort must be taken to examine the productive efficiency of the rice farmers in the study area using profit efficiency model that is based on perfect competitive market.

However, considerable efforts have been directed at examining productive efficiency of farmers that is exclusively focused on technical efficiency of the farmers in Nigeria [9, 10 and 11]. Little attention has been given to measuring profit efficiency of farmers even when the prices of output and input are known in an attempt to examine the allocative efficiency of the

farmers. The physical productivity considerations (Technical efficiency) are important improvement in production efficiency, but profit efficiency will lead to greater benefits to agricultural producer in the country like Nigeria. The objective of this paper to examine profit function among small scale rice farms in North Central Nigeria, estimate the cost and returns of rice production in the study area and will in addition ascertain the determinants of profit efficiency among rice farmers in the study area.

The following hypothesis formulated is subject to empirical validation.

Ho1: The explanatory variables included in the inefficiency model do not significantly explain the profit efficiency of rice farmers.

METHODOLOGY

The Description of Study Area

The study was conducted in North central zone of Nigeria in which Niger and Nasarawa States were selected because of their track record in rice production. The two States are located in the North central zone of Nigeria. The North central zone covers a land area of about 296,898 square kilometers which is about 32% of the total land area of the country. About 85% of this land area is arable. The Niger State is located in the Guinea Savanna Vegetation zone in the north central part of Nigeria between latitudes 30201 and 70401N and longitudes 80 and 11031E [12]. The State is bordered by Zamfara State, Kebbi State, Kogi State, Kwara State. Kaduna State and the Federal Capital Territory (FCT) Abuja respectively. The State shares a common boundary with the Republic of Benin along Borgu Local Government Area (LGA). This gives rise to common cross border trade with the State. Niger State is primarily called the “Power State” of Nigeria by virtue of the location of the three hydro-electricity dams in the State, namely, the Kainji, Shiroro and Jebba Dams.

The State experience two distinct climatic seasons in a year (rainy and dry season). Rainfall (1,100mm – 1,600mm per annum) is steady and is evenly distributed falling usually between mid April and November, peaking in August. Average monthly temperature ranges from 230C to 370C [13].

The vegetation consists mainly of short grasses, shrubs and scattered trees, soils are predominantly light and well drained. Fadama and depression are accessible in many communities. These soils are fragile and subject to loss of nutrients in the rainy season once their vegetation cover is removed [13].

Niger State has a population of about three million nine hundred and fifty thousand two hundred and forty nine people (3,950,249) National Population Commission [14]. Farming is the primary occupation of 85 percent of the State’s population, which 15 percent are engaged in industrial and other businesses or vocational jobs like craft and arts. However, agriculture in Niger State is predominantly in the hands of rural dwellers who work small

holdings. The major crops grown include rice, sugar cane, maize, millet, melon, yam, groundnut, sorghum and cowpea. Livestock reared include cattle, sheep, goats and poultry [12]. Nasarawa State is located between latitude 080351N and longitude 080331E [15]. The State is bordered by Kaduna State, Kogi and Benue States, The Federal Capital Territory (FCT) Abuja, Taraba and Plateau States respectively. The State experience two distinct climatic seasons in a year. These are the raining (April to October) (131.73mm – 145mm per annum) and dry (November to March) seasons. Average monthly temperature ranges from 250C in October to about 370C in March [15]. The major occupation of the people in the State is farming and the predominant crops grown are rice, maize, sorghum and yam Nasarawa State Ministry of Information [16].

Sampling Procedure

Multi-stage sampling was used to select farmers for the study. The primary data were obtained from rice farmers through the administration of structured questionnaires .The States have three agricultural zones each namely. Zone 1, Zone 11, and Zone 111 agricultural zones for Niger State while Nasarswa South, Nasarawa North, and Nasarawa West agricultural zones are for Nasarawa State. In the first stage, one Local Government Area (LGA) was purposively selected from each agricultural zone in each States making a total of six (LGAs). This was based on the concentration of rice farmers in the LGAs. In the second stage four communities were selected randomly from each LGA, making a total of twenty four communities. In the third stage, random sampling technique was use to select nine rice farmers per village because of the homogenous nature of the communities. In all, two hundred and eighteen (218) rice farmers were selected and interviewed.

Table 1: Summary of the study sample design

STATES	ZONES (AEZ)	LGAS	COMMUNITIES	SAMPLE SIZE
Niger	Zone 1	Lavun	Doko	9
			Washi	9
			Mambe	10
			Boko	9
	Zone 11	Shiroro	Rafin Kuka	9
			Kuta	9
			Gwada	9
			Zumba	9
	Zone 111	Wushishi	Bankogi	9
			Kanko	9
			Tunga Kawo	9

			Maito	9
Nasarawa	South	Lafia	Gunji	9
			Ileri	9
			Assakio	9
			Gidan Maiakuya	9
	North (Central)	Akwanga	Mochu	9
			Lelle	9
			Agyaga	9
			Anjida Sarki	9
	West	Karu	Angwa Wayo	10
			Tatara Mada	9
			Kube	9
			Gitata	9
Total		**6**	**24**	**218**

Source: Computed from Field Survey, 2016.

Analytical Techniques and Model Specification

Farm budgeting technique was used to achieved objective (i), Objective (ii) was achieved with the use of Translog Stochastic Frontier Profit Function.

Cost and Returns Analysis of Rice Farmers

Farm budgeting techniques was used to estimate the cost and returns of rice production. The model is given in equations 1 and 2. Gross margin is the difference between the Gross Farm Income (GFI) and Total Variable Cost (TVC) as depicted in equation (1) [17].

GM = GFI – TVC---------- (1)
Where GM = Gross Margin, GFI = Gross Farm Income, TVC = Total Variable Cost.
The net farm income is defined as
NFI = GM – TFC ---------- (2)
Where NFI = Net Farm Income, GM = Gross Margin, TFC = Total Fixed Cost.
The profitability of rice production was analyzed and compared using the various financial ratio stated in equation (3), (4) and (5)
Gross Ratio: This is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the return per naira.

$$GR = \frac{TFE}{GI}$$ ---------- (3)

Where GR = Gross Ratio, TFE = Total Farm Expenses and GI = Gross Income.

Operating Ratio: The operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.

$$OR = \frac{TOC}{GI}$$ ---------- (4)

Where OR = operating Ratio, TOC = Total Operating Cost and GI = Gross Income.

Return on Capital Invested: Is a profitability index defined as a measure of the amount that accrues to the enterprise as net income for every naira invested. The higher the return to investment, the more profitable the enterprise.

$$RI = \frac{GM}{TVC}$$ ---------- (5)

Where RI = Return on Capital Invested, GM = Gross Margin, and TVC = Total Variable Cost.

Determinants of Profit Efficiency among Rice Farmers

Translog Stochastic Frontier Profit Function was used to achieve objective which focuses on the determinant of profit efficiency among rice farmers. Farm profit equals the difference between the Total Revenue (TR) and Total Cost (TC). That is

GM (π) = Σ (TR – TVC) = Σ (PQ – WX) ……(6)

To normalize the profit function, farm π is divided by P which is the market price of the output (rice). It is represented as

$$\frac{\pi(p,z)}{P} = \frac{\sum(PQ - WX_i)}{P} \quad \text{.....(7)}$$

$$= Q - \frac{(WX)}{P} \quad \text{.....(8)}$$

= f (Xi, Z) - Σ PiXi ……(9)

Where TR represents total revenue, TC represents total cost, P represents price of output (Q), X represents the quantity of optimized input used, Z represents price of fixed inputs used, pi = W/P which represents normalized price of input Xi, while f (Xi, Z) represents the production function.

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

$$\pi_i = f(p_i, z)\exp(V_i - U_i), i = 1,2,.....n$$ …… (10)

Where π, p_i and z is as defined above. The V_is are assumed to be independent and identically distributed random errors, having normal N(0, σ^2 v) distribution, independent of the U_is. The U_is are profit inefficiency effects, which are assumed to be non-negative truncation of the half-normal distribution N (μ, σ^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:

Profit Efficiency ($(E\pi) = \pi / \pi^{\max}$ …….. (11)

$$= \frac{\exp[\pi(p,z)]\exp(\ln V)\exp(-\ln U) - \theta}{\exp[\pi(p,z)]\exp(\ln V) - \theta} \quad \text{.....(12)}$$

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

$E_{\pi} = E [\exp (-U_i)/E_i]$ …….. (13)

E_{π} takes the value 0 and 1. If $U_i = 0$, this means that farm is on the frontier, obtaining potential maximum profit given the price it faces and the level of fixed factors.

If $U_i > 0$, the farm is inefficient and losses profit.

The Cobb-Douglas translog function was used to achieve objective which focusses on the determinants of profit efficiency among rice farmers in the study area. Using the computer software frontier version 4.1 [18], the model was estimated by a combination of the production and inefficiency factor in a single stage maximum likelihood estimation procedure to identify the determinants of profit efficiency. It is specified explicitly as:

$$InY = \beta_o + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + \beta_5 InX_5 + \frac{1}{2}\beta_{11} InX_1^2 + \frac{1}{2}\beta_{22} InX_2^2 + \frac{1}{2}\beta_{33} InX_3^2 +$$

$$\frac{1}{2}\beta_{44} InX_4^2 + \frac{1}{2}\beta_{55} InX_5^2 + \beta_{12} InX_1 InX_2 + \beta_{13} InX_1 InX_3 + \beta_{14} InX_1 InX_4 + \beta_{15} InX_1 InX_5 + \beta_{23} InX_2 InX_3 +$$

$$\beta_{24} InX_2 InX_4 + \beta_{25} InX_2 InX_5 + \beta_{34} InX_3 InX_4 + \beta_{35} InX_3 InX_5 + \beta_{45} InX_4 InX_5 + Vi - Ui \text{.....} (14)$$

Where

π = Net profit (N)

X_1 = average cost of seed(N)

X_2 = average cost of fertilizer (N)

X_3 = average cost of labour (N)

X_4 = average cost of Agrochemicals (N)

X_5 = Farm size (ha)

$X_1 – X_5$ are factors assumed to affect the level of profit efficiency of the rice farmers and

β_0 =constant,

β_1- β_{45} = are maximum likelihood estimates to be measured,

In is natural Logarithm,

v_i and u_i = composite errors

The inefficiency model (u) for the stochastic profit frontier can be defined as in equation 15

$U = \delta_0 + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \delta_4 z_4 + \delta_5 z_5 + \delta_6 z_6 + \delta_7 z_7 + (v_i - u_i)$ …… (15)

Where:

Z_1 = Age of the farmers (years),

Z_2 = Household size (number of persons),

Z_3 = Educational level measured in number of years Spend in formal school,

Z_4 = Extension contact (Number),

Z_5 = Rice farming experience (years)

Z_6 = Awareness of Climate change (Dummy variables; Yes=1, No= 0)

Z_7 = Access to Climate Information (Dummy variables; Yes=1, No= 0)

δ_0 = constants

$\delta_1 - \delta_7$ = coefficient to be measured

3. RESULTS AND DISCUSSION

Profitability of Rice Production.

Table 2 presents the costs and returns of rice farmers in the study area. The result reveals that rice production is quite profitable and it was also shown that labour cost accounted for 41.48 percent of cost of production. This implies is that high amount of labour is required for production of rice crop. This is in agreement with the findings of the author of [19], who reported that labour constitutes a large percent of the cost of production. It is therefore worthwhile to devise technology that is less labour intensive so as to reduce cost of production. For a hectare of land cultivated to rice farmer, a net farm income of ₦67,808.31 with an average gross margin of ₦ 70,273.56 was realized. The positive net farm income and gross margin show that returns exceeded the cost which indicates that rice production is profitable in the study area. This result is in line with those of [20, 19, 21] who in their separate studies all pointed out that rice production is very profitable enterprise. The result further shows that the returns on investment was ₦1.26 indicating that for every ₦1.00 invested in production of a hectare of rice crop, ₦1.26 was realized as profit in the study area. Also the gross and operating ratios of 0.46 and 0.44 were obtained respectively. This means that all the ratios were less than 1 which indicates that rice production was highly profitable in the study area. This result also agrees with those of [19, 22] who stated that the

lower the gross and operating ratios, the higher the profitability of the farm enterprise and vice versa.

Table 2 Profitability Analysis of Rice Production

Cost Item & Revenue	n=218 Cost (₦ /ha)	%of Total cost
Variable cost		
Labour cost	24,000.25	41.48
Fertilizer/manure cost	11,140.40	19.25
Seed/planting materials	10,150.00	17.54
Agrochemicals	10,100.10	17.45
Total variable cost(a)	55,399.75	95.74
Fixed cost		
Farm tools (depreciation)	1,443.12	2.49
Maintenance of implements	1,023.13	1.77
Total fixed cost(b)	2,466.25	4.26
Total cost (a and b)	57,865.00	
Returns		
Gross farm income	125,673.31	
Gross margin	70,273.56	
Net farm income	67,808.31	
Return on investment	1.26	
Gross ratio	0.46	
Operating ratio	0.44	

Source: Field survey, 2016

Measurement of the Profit Efficiency of the Respondents Using the Stochastic Frontier Profit Model.

The maximum likelihood estimates of the stochastic frontier profit function are presented in Table 3 along with the interacting terms. The results reveal that the sigma-square (δ^2) was 0.8063 in the study area and significant (*P= .01*) probability level, indicating a good fit and the correctness of the specified assumptions of the distribution of the composite error term. The estimated gamma parameter (γ) of 0.89 in Table 3 was highly significant at 1 percent level of significance. This implies that one-sided random inefficiency component strongly dominates the measurements error and other random disturbance indicating that about 89 percent of the variation in actual profit from maximum profit (profit frontier) between farms mainly arose from differences in farmers' practices rather than random variability. The

estimated coefficients of the parameters of the normalized profit function based on the assumption of competitive market are positive except the cost of fertilizer and cost of labour as expected.

The coefficient of fertilizer was negative and statistically significant (*P=.01*), which show that the fertilizer had a negative significant relationship with the farm profit. This means that increase in the factor price of fertilizer holding other variables constant will bring about a marginal decrease in profit efficiency of rice production by 0.35% in the study area. The reason for the negative and significant coefficient of fertilizer would likely be that fertilizer being a critical input in rice production, farmers were spending more on the purchase of the commodity from the open market as a result scarcity or non- availability of the commodity from the government coffers to the farmers during the production season. So, it implies that if price of fertilizer is increased above their present levels, profit efficiency will decrease significantly.

The coefficient of labour was negative and statistically significant (*P=.01*). One percent increase in the factor price of labour will bring about a marginal decrease in profit efficiency of rice farmers by 0.21 percent. The implication of negative and significant coefficient of labour is that since most family labour is unpaid for, farmers were using it to the extent of what is call economical visible point (over utilization of labour). That is, they reach a point where returns to labour become negative. So, if price of labour is increased above their present levels, profit efficiency will decrease significantly.

The coefficient of agrochemical was positive and statistically significant (*P=.01*). One percent increase in the factor price of agrochemical will bring about a marginal increase in profit efficiency by 0.36%. The coefficient of farm size is positive and statistically significant (*P=.01*). This implies that increase in farm size by1% holding other variables constant will bring about increase in profit efficiency by 0.79 percent.

Table 3. Maximum likelihood Estimates of Translog Profit Frontier Function.

Variables	**Parameters**	**Coefficient**	T- Value
Constant	β_0	3.9079	27.49***

Seed	β_1	0.1204	1.23^{NS}
Fertilizer	β_2	-0.3529	-3.01***
Labour	β_3	-0.2053	-3.31***
Agrochemical	β_4	0.3581	2.81***
Farm size	β_5	0.7859	5.63***
Squared Terms			
Seed ×Seed	β_{11}	-1.7398	-1.86*
fertilizer ×fertilizer	β_{22}	-0.0048	-0.76^{NS}
labour ×labour	β_{33}	-0.1057	-1.22^{NS}
agrochem×Agrochem	β_{44}	-0.0025	0.24^{NS}
Farm size ×farm size	β_{55}	0.0058	0.42^{NS}
Interaction Terms			
Seed × fertilizer	β_{12}	-0.0022	0.35^{NS}
Seed × labour	β_{13}	-0.0029	0.42^{NS}
Seed × agrochemical	β_{14}	-0.0051	0.61^{NS}
Seed × farm size	β_{15}	0.1601	2.34**
Fertilizer × labour	β_{23}	0.3442	4.70***
Fertilizer × Agrochem	β_{24}	-0,0002	-0002^{NS}
Fertilizer × farm size	β_{25}	0.1128	1.58^{NS}
labouur × Agrochem	β_{34}	-0.2303	22.64***
labour × farm size	β_{35}	-0.1222	2.99***
Agrochem × farm size	β_{45}	-0.0030	1.58^{NS}
Diagnostic Statistics			
Sigma-Squared		0.8063	2.62***
Gamma		0.8900	23.6522***
Log likelihood	Llf	-108.52492	
	LRT	339.4397	
Inefficiency effects			
Constant	δ_0	2.0192	5.13***
Age	δ_1	-0.0038	-4.43***
Household Size	δ_2	-0.1316	-2.11**
Education	δ_3	-0.1037	-6.22***
Extension Contact	δ_4	0.3272	2.09**
Experience	δ_5	-0.1236	2.23**
Awareness of climate of change	δ_6	-0.6059	-3.12***
Access to climate information	δ_7	-0.1189	-2.98***

Note ***, **,*and NS implies statistically significant at (*P=.01*), (*P=.05*), (*P=01*) and Not Significant, respectively. Figures in parentheses are t-ratio
Source: Computed from Field survey, 2016.

The result of the inefficiency factors as shown in Table 3 further reveals that age was negative and statistically significant (*P=.01*). The negative coefficient obtained for age implying that an increase in age would reduce profit inefficiency in the study area. The reason is that age has a significant influence on the decision- making process of farmers with respect to risk aversion, adoption of improved agricultural technologies, and other

production-related decisions which could reduce farmers' profit inefficiency. This result is in agreement with the author of [23] who found a negative coefficient of age and profit inefficiency meaning that as age increases the profit inefficiency of the farmer decreases.

The result of this study further reveals that the coefficients of the household size parameters was negative and statistically significant (*P=.01*). The negative sign for household size implies that increase in household size will result in the reduction in profit inefficiency. The reason for the negative relationship between household size and profit inefficiency could be that household with many productive members possibly contributes the extra labour requirements of the new technology which reduces profit inefficiency or increases profit efficiency of the farmers. Also, large household size could benefit from the use of family labour at the right time when labour is needed. The result agrees with the finding of [24] which states that household size could reduce labour constraints, thereby leading to increase in productivity and increase in profit efficiency.

The estimated coefficient on education is negative and statistically significant (*P= .01*). The negative sign of education indicates reduction in profit inefficiency. This could be due to the fact that educated farmers are able to understand and use information from research and extension more easily than illiterate farmers which reduces profit inefficiency. Furthermore, educated farmers are likely to be less risk-averse and therefore more willing to use modern technologies. The result agrees with the findings of [24] education raises the technical competence of an entrepreneur and enables him or her cope with the complexities associated with adoption of improved technology.

The estimated coefficient associated with experience, carries the expected negative sign and is statistically significant (*P=.01*). The result implies that those with experience are better performers than those without. In other words, rice farmers with more years of experience tend to operate at significantly higher level of profit efficiency. Experience in rice production

enterprise could improve farmers' skills in farm operations, thereby reducing profit inefficiency of the farmers.

The estimated coefficient associated with the extension contact is positive and significant (*P=.01*). The positive sign does not conform to a prior expectation, the reason for the positive sign of extension contact is that farmers in the study area had limited access to extension services which reduces their profit efficiency. This means that limited extension contact with farmers hinders acquisition of new knowledge, skill and practices on improved technology by the farmers as well as their innovativeness. This result is also consistent with findings obtained by [9] who reported positive coefficient with respect to extension contact. This suggests that the extension services are not adequate in the survey area given the recommended extension agent to farmer ratio.

The estimated coefficient awareness of climate to change is negative and significant (*P=.01*). The negative sign of awareness of climate to change indicates reduction in profit inefficiency. This means farmers' awareness of climate change increases the tendency of farmer adapting adaptation strategies available to them which could go a long way to increase their rice productivity and this could have positive effect on profit efficiency.

Again, the coefficient of access to climate information is negative and statistically significant (*P=.01*). The negative sign of access to climate information indicates reduction in profit inefficiency. This could be due to the fact that farmers' access to information on climate change is likely to enhance their probability to perceive climate change, hence adopt new technologies and take-up adaptation techniques which translates to high rice output thereby leading to reduction in profit inefficiency in the study area.

The formulated hypothesis was subjected to empirical validation.

Hypothesis

Ho_1: The test of the explanatory variables included in the inefficiency model do not significantly explain the profit efficiency of rice farmers.

Table 3 presents the result of maximum likelihood estimates from the inefficiency model for the stochastic frontier profit function for hypothesis. The hypothesis was stated in the null form that "explanatory variables included in the inefficiency model do not significantly explain the profit efficiency of rice farmers". The result of maximum likelihood estimates from the inefficiency model for the stochastic frontier profit function revealed that explanatory variables included in the inefficiency model significantly explain the profit efficiency of rice farmers with estimated coefficients. The null hypothesis was therefore rejected while the alternative hypothesis is accepted and the study concludes that explanatory variables included in the inefficiency model significantly explain the profit efficiency of rice farmers.

Profit Efficiency Level of Rice Farmers in the Study Area

The frequency distribution of profit efficiency of rice farmers is as presented in Table 4. Individual profit efficiency indices ranged between 22% and 93% in the study area with mean profit efficiency index of 0.78. This implies that an average rice farmer in the study was able to obtain 78% of the potential profit from given levels of inputs. The efficiency distribution shows that, over 89% of rice farmers in the study area attained profit efficiency of 61% and above, while few had below 50 % level of efficiency. indicating that on the relative term more than half of the farm under assumption of the perfect competition market used for the analysis were fairly efficient in allocating their cost structure in course of rice production. This high level of efficiency is an indication that only a small fraction of the profit can be attributed to wastage. The result also indicates that; the average rice farmer would require about 22% cost saving to become the most efficient rice farmer.

Table 4: Frequency Distribution of Profit Efficiency Indices of Rice Farmers

Efficiency class	Frequency	Percentage
≤0.50	20	9.17
0.51-0,60	3	1.38
0.61-0.70	13	5.85
0.71-0,80	41	18.81

0.81-0.90	125	57.34
0.91-1.0	16	7.34
Total	**218**	**100**
Mean	**0.78**	
Minimum	**0.22**	
Maximum	**0.93**	

Source: Computed from Field survey, 2016

4. CONCLUSION

The study revealed that the area has great potentials to increase rice production and farmer's income. This means that rice production is profitable in the study area. The returns on investment of ₦1.26 were realized from every ₦1.00 invested in rice production by the farmers in the study area. The gross ratio of 0.46 and the operating ratio of 0.44 are indicators that rice production was profitable in the study area.

The estimated parameters of the Trans-log profit frontier indicate that only few inputs have positive sign on the profitability of rice farming in North central, Nigeria except the unit cost of seed/kg unit cost of labour/man-day, unit cost of fertilizer/kg. The negative sign of prices of these inputs may be due to wrong or excessive application of such inputs by the farmers, thus leading to extra cost incurred on the part of the farmers. The study further revealed that rice farmers in the area are not all fully profit efficient and thus an average rice farmer in the study area could potentially increase their profit level if resources are more efficiently utilized. However, the study concluded that fertilizer, labour, agrochemical, farm size, age, household size, education, farming experience, awareness of climate change and access to climate information had significant effects on the profit efficiency of rice farmers in the study area. The policy implication of these findings is that inefficiency in rice production can be reduced significantly by improving the level of education among the farmers and awareness by extension agents. Most important are the extension services and the existing technological packages that need to be critically examined. Farmers in the study area should be encouraged by extension agents to form co-operative associations to enable them share their knowledge and experience to facilitate their access to information on production strategies and credit facilities that will enable them to expand their rice production

[This should briefly state the major findings of the study. If you are using copy-paste option then select 'match destination formatting' in paste option OR use 'paste special' option and select 'unformatted Unicode text' option]

CONSENT (WHERE EVER APPLICABLE)

No manuscripts will be peer-reviewed if a statement of patient consent is not presented during submission (wherever applicable).
This section is compulsory for medical journals. Other journals may require this section if found suitable. It should provide a statement to confirm that the patient has given their informed consent for the case report to be published. Journal editorial office may ask the copies of the consent documentation at any time.

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For manuscripts involving human experiments, Authors may use the following wordings for this section: "All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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DEFINITIONS, ACRONYMS, ABBREVIATIONS

Here is the Definitions section. This is an optional section.
Term: Definition for the term

APPENDIX