Resource-Use Efficiency among Rice Farmers in Derived Savanna Zone of Oyo State, Nigeria

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ABSTRACT This study investigated the resource use efficiency among rice farmers in derived savanna zone of Oyo State, Nigeria. Multi-stage sampling technique was used to select 150 rice farmers as the sample for the study. Data were collected through structured interview schedule and personal interview. The findings revealed that majority of the rice farmers are middle aged, married males with no formal education. The stochastic frontier production using the Maximum Likelihood Estimation (MLE) procedure was employed in inferential statistical analysis. The Maximum Likelihood Estimation (MLE) results revealed that land, family labor, hired labor and fertilizer are the major factors that influence the output of rice. The effect of land on output is positive and the coefficient found to be statistically significant at1% level. The coefficient of family labor is found to be negative but significant at 1% level. Hired labor and fertilizer have positive effects on output and their coefficients are statistically significant at 5% level. The analysis also indicated that farmer's specific factors such as farming experience, years of formal education, meetings with extension agent per year, crop diversification and animal/mechanical traction have significant influence on level of technical efficiency in rice production.

1. INTRODUCTION

Rice is a very important staple food in the diet of the estimated 120 million Nigerians. It is consumed in various forms but the most popular is as grains. Rice can be cultivated in all the ecological zones of Nigeria, although with varying prospects from one location to the other. The value of Nigeria's rice industry is estimated to be about US $ 5.86 billion (as at 2002) made up of US $ 2.2 billion of imports and US $ 3.66 billions of domestic production. The value of the industry is expected to rise to about US $ 7.98 billions by 2006 at the current growth rate of 10% per annum. Nigeria is West Africa's largest producer of rice, producing an average of 3.2 million tons of paddy rice (2 million tons of milled rice) for the past 7 years. However, domestic supply has not kept pace with demand as imports have steadily increased faster than domestic supply by accounting for close to 60% of total supply (Daramola 2005).

Average yield of upland and low land rain fed rice in Nigeria is 1.8 ton/ha, while that of the irrigation system is 3.0ton/ha (PCU 2002). This is a far cry from the 3.0 ton/ha of upland and lowland systems and 7.0ton/ha of the irrigation system obtainable in places like Cote d'voire and Senegal (WARDA and NISER 2001).

One of the measures taken to address the problem of low supply is the call for rapid expansion of cereal production especially rice, in order to find a real basis for improvement in nutrition, especially among the people of Southern Nigeria who depended mainly on relatively inferior starch staple foods like Cassava, Yam, Cocoyam and Plantain. The Presidential initiative of the immediate past administration on rice is new production strategy for sustained increase in rice production for national self-sufficiency, food security and export promotion. This initiative has as its objective, the need to address the widening demand/supply gap and attain self-sufficiency in rice production by 2005 and have surplus for export by 2007.

The present federal government of Nigeria in her seven point agenda emphasized the rapid expansion in domestic production of rice in order to reduce annual importation of rice whose bills amounted to billions of naira and the bills can no longer be sustained by the national economy (CBN 2008). However, there is still persistent low yield and output of rice inspite of the government's efforts in ensuring availability of improved material inputs, modern technologies of rice farming and other production resources.

Efficiency of resource use, which can be defined as the ability to derive maximum output per unit of resource, is the key to effectively addressing the challenges of achieving food security. Raising productivity in agriculture will cer-

tainly lead to availability of food and reduce the real price of food. Increased food production will have to come from increased yield. Production of rice in Nigeria is mainly in the hands of small scale farmers who are still using unimproved farming techniques. Actual yields of rice differ significantly from potential yields, and this has been attributed to low resource productivity (Federal Ministry of Agriculture 1995). It is, therefore, necessary to examine resource use efficiency among rice farmers.

This study examined the resource use efficiency among rice farmers in the derived savanna zone of Oyo state, Nigeria. The objectives of the study are:

(a) Identify socio-economic characteristics of rice farmers in the study area.
(b) Identify, quantify and estimate the factors affecting resource- use efficiency among rice farmers in the study area.
(c) Determine inputs demand function.
(d) Determine the technical, price and economic efficiency of rice farmers in the study area.

2. MATERIALS AND METHOD

The study on resource use efficiency among rice farmers in the derived savanna zone of Oyo state was carried out using a combination of structured interview schedule and personal interaction with the rice farmers. A test survey was conducted to pretest the instrument. The final survey was carried out in May and June 2009. Multi-stage sampling technique was used to select 150 rice farmers to form the sample for the study. Six (6) local government areas namely Ogbomoso North, Ogomoso South, Orire, Surulere, Ogooluwa and Ejigbo were covered in the study. The socio-economic characteristics of the rice farmers examined in the study are age, gender, farming experience, marital status and years of formal education. The parameters considered in the study are production factors such as farm size, type of labor used, farm inputs, and price index. The efficiency factors included farming experience, years of formal education, farm mechanization, contact with extension agents and crop diversification. Farell (1957) distinguished three types of efficiency as technical efficiency, price or allocative efficiency and economic efficiency which is the combination of the first two. Technical efficiency is an engineering concept referring to the input-output relationship. A firm is said to be efficient if it is operating on the production frontier (Ali and Byerlee 1991). The stochastic efficiency frontier independently proposed by Aigner et al. (1977) and Meeusen and Van de Brock (1977) was used for data analysis. The empirical production model that was applied in the analysis of economic efficiency in rice production is specified as follows;

$$\text{Ln } Y_{ij} = \hat{a}_0 + \hat{a}_1 \ln X_{1ij} + \hat{a}_2 X_{2ij} + \hat{a}_3 X_{3ij} + \hat{a}_4 X_{4ij} + \hat{a} X_{5ij} + \hat{a}_6 D_{1ij} + \hat{a}_7 \ln X_{6ij} + \hat{a}_8 \ln X_{7ij} + \hat{a}_9 \ln X_{8ij} + \hat{a}_{10} \ln X_{9ij} + U_i$$

Where $_{ij}$ refers to the ith observation of the jth farmer.

Ln = logarithm to base e
Y = the farm gross margin in Naira
X_1 = total farm area under cultivation (in hectares)
X_2 = family labor used in production (in Man days)
X_3 = hired labor used in production
X_4 = expenses on mechanical traction (valued in Naira)
X_5 = material inputs of seed and pesticides (valued in Naira)
D_1 = dummy variable scored 1if organic fertilizer was applied in rice production and 0 otherwise.
X_6 = the quantity of chemical fertilizer (in kg)
X_7 = fixed cost incurred in rice production (valued in Naira)
X_8 = depreciation costs fixed inputs used in rice production
X_9 = price index of output using moving average (valued in Naira)
U_i = random error term.

It is assumed that the economic efficiency effects are independently distributed and v_{ij} and variance σ^2 arises by truncation (at 0) of the normal distribution with mean v_{ij} and variance σ^2, where v_{ij} is defined by

$$V_{ij} = d_0 + d_1 \ln Z_{1ij} + d_2 \ln D_{2ij} + d_3 \ln Z_{2ij} + d_4 \ln Z_{3ij} + d_5 \ln D_{3ij} + U_i$$

Where,

V_{ij} = the economic efficiency of of the ith farmer
Z_1 = years of farming experience
D_2 = dummy variable for education, where 1 denotes educated and zero otherwise.
Z_2 = number of meetings with the extension agents per cropping season.
D_3 = dummy variable, where 1 denotes farmer who own animal traction and 0 otherwise.

The B and d coefficients are parameters which

were estimated by the method of Maximum Likelihood Estimates (MLE).

3. RESULTS AND DISCUSSION

The results of descriptive statistics show that majority of the rice farmers are middle- aged, married males with no formal education. Most peasant farmers in Nigeria are middle-aged, married and non-literate males with low level of formal training (Burfisher and Horenstein 1985). The results of the inferential statistics are presented below.

3.1 Results of Stochastic Frontier Model to Production Parameters

From table 1, the estimated coefficient for land is positive, which conforms to apriori expectation and significant at 1% level. The magnitude of coefficient of land which is 1.23 indicates that gross margin in rice production is elastic to changes in the level of cultivated land area. This implies that land is a significant factor associated with changes in rice output.

Table 1: Parameter estimates (Production factors)

Variables	Parameters	Coefficients	Standard Error	t-value
Constant	$\hat{a}_0$	9.18	1.03	8.91***
Farm size (x_1)	$\hat{a}_1$	1.23	0.41	3.0 ***
Family labour (x_2)	$\hat{a}_2$	-0.48	0.14	3.43***
Hired labour (x_3)	$\hat{a}_3$	0.21	0.08	2.63**
Animal traction (x_4)	$\hat{a}_4$	-0.01	0.10	1.00
Material inputs (x_5)	$\hat{a}_5$	0.03	0.17	0.18
Organic fertilizer (D_1)	$\hat{a}_6$	0.65	0.22	2.95**
Chemical fertilizer (x_6)	$\hat{a}_7$	0.66	0.22	3.00**
Fixed cost (x_7)	$\hat{a}_8$	0.56	0.24	2.33**
Depreciation cost (x_8)	$\hat{a}_9$	-0.48	0.32	1.50**
Price index (x_9)	$\hat{a}_{10}$	0.41	0.38	1.08
Diagnostic Statistics				
Likelihood ratio = 46.68				
Sigma square ($\hat{o}^2$)		28.60	15.61	1.83**
Gamma ($\hat{a}$)		0.98	0.08	122.5 ***

Source: Data Analysis 2009.
   *** implies significant at 0.01 level
   ** implies significant at 0.05 level
   * implies significant at 0.10 level

The elasticity of output with respect to family labor is negative at -0.48 and it is statistically significant at 1% level. This implies that family labor is a significant but negative factor that influences changes in output of rice. The gross margin from rice production is expected to in-

crease with a decrease in family labor input and vice versa.

The production elasticity with respect to hire labor is positive as expected and it is statistically significant at 5% level. The magnitude of coefficient of hired labor (0.21) indicates that gross margin in rice production is inelastic to changes in amount of hired labor used. The coefficients of hired labour suggest that a 1% increase in hired labor would cause an increase of 0.21% in gross margin and vice versa.

The production elasticity with respect to animal traction is positive as expected, but not statistically significant, even at 10% level. This suggests that the use of animal traction is not a significant factor in rice production in the study area. The coefficient of the variable associated with material inputs is positive and this conforms to apriori expectation, but it is not statistically significantly even at 10% level. The statistical insignificance of the coefficient is as a result of observed fact that there is little variation in the level of expenditure on material inputs used among the sampled rice farmers.

The organic fertilizer variable was specified as an intercept dummy. The coefficient of dummy variable is positive as expected and statistically significant at 5% level. This suggests that organic fertilizer is a significant factor in rice production.

The production elasticity with respect to inorganic or chemical fertilizer is positive as expected and statistically significant at 5% level. The magnitude of the coefficient of chemical fertilizer which is 0.66 indicates that farm gross margin in rice production is inelastic to changes in the level of chemical fertilizer used. The significance of fertilizer variable derives from the fact that fertilizer is a major land augmenting input in the sense that it improves the productivity of existing land by increasing crop yield per hectare.

The magnitude of coefficient of fixed cost in rice production is 0.56 and is significant at 5% level. This implies that fixed cost is a significant factor in rice production. The coefficient of depreciation cost which is -0.48 is negative as expected and is significant at level.

This indicates that depreciation cost is a negative but significant factor that influences gross margin in rice production. The price index coefficient is positive and significant at 1% level. This is expected because an increase in price of out-

put in a production year will stimulate cultivation of more hectares of rice the following cropping season.

3.2 Results of Stochastic Frontier Model of Efficiency Parameters

The efficiency factors (Table 2) are specified as those relating to farmer's specific socio- economic characteristics. These include farmer's years of farming experience, years of formal education, the number of extension contacts they had in a cropping year, their degree of crop diversification and whether they owned or hired animal traction.

Table 2: Parameter estimates (Efficiency factors)

Variables	Parameters	Coefficients	Standard Error	t-value
Constant	d_0	12.26	9.35	1.31
Farming experience(Z_1)	d_1	6.12	4.16	1.47
Education (D_2)	d_2	0.31	0.19	1.63**
Extension (Z_3)	d_3	-20.50	12.25	1.67*
Crop diversification (Z_3)	d_4	3.31	1.75	1.90
Animal traction (D_3)	d_5	5.31	3.73	1.42

Source: Data Analysis 2009
         ** implies significant at 0.05 level
          * implies significant at 0.01 level

The coefficients of farming experience is estimated to be positive and statistically not significant even at 10% level. The coefficient of education variable is statistically significant at 5% and positive as expected. The implication is that farmers with higher numbers of years of formal education tend to be more efficient in rice production because of their ability to acquire technical knowledge which makes them to move closer to the frontier output. It is very plausible that the farmers with education responds rapidly to the use of improved technology such as application of fertilizers, use of pesticides and so on thus producing closer to the frontier. This finding is in line with that of Weir and Knight (2000), that technical and economic efficiency of farmers is enhanced through acquisition of formal education.

The coefficient of the extension variable as an efficiency factor is estimated to be positive and statistically significant at 10% level. This indicates that increased extension services to the farmer tend to increase technical efficiency in rice production. This conforms to finding of Ajibefun et al. (2002) that efficiency of farmers increases with adoption of improved technology through informal training.

The crop diversification variable in the model is negative and statistically significant at 10% level. As diversification decreases and rice is solely grown, efficiency increases. The implication is that the greater diversification is associated with lower relative efficiency, while greater specialization in crop production is associated with higher relative efficiency. This corroborates with Yolotopus and Lau (1973), that relative efficiency of farmer increases with specialization in crop production.

4. CONCLUSION

Majority of the rice farmers still employ low level of modern technology in rice cultivation. Also, most of the rice farmers are middle-aged, non-literate males; this had greatly contributed to inefficiency in rice production among the rice farmers.

5. RECOMMENDATIONS

Based on the major findings of the study, the following recommendations are made for effective resource and increased local production of rice in Nigeria.

More agricultural extension effort should be devoted to the dissemination of innovations in rice cultivation to the farmers, no doubt there is regular contact with the rice farmers, but, the extension education focuses more on other crops such as maize, cassava, cowpea and soya bean.

Appropriate technology should be developed from the point of view of users. This will go a long way to improve the level of resource use efficiency among the rice farmers.

Rice farmers should organize themselves into cooperatives and this will enable them to purchase modern farm inputs and hire additional labor.

Government should organize formal education imparting programmes for the farmers, this will go a long way in improving their technical knowledge and hence their efficiency.

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