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Assessment of the Economics and Resource-Use Efficiency of Rice Production in Ogun State, Nigeria

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Abstract

Nigeria is a major importer of rice in the world with over 756 million USD annual expenditure on rice importation. This is probably due to insufficient domestic production occasioned by inefficient utilization of resources and other farm inputs. This study is therefore designed to estimate the costs and returns to rice production; and analyze resource use efficiency in rice production in Ogun State, Nigeria. A three-stage sampling technique was used to select a total of 120 rice farmers. Gross margin and regression analyses were used to analyse the data for the study. The study revealed that an average small scale rice farmer realizes a gross margin of N 90, 634.35 per hectare. While farm size, labour and crop production systems account for 80.5% (coefficient of multiple determination, R^2) of the changes in rice production, the study revealed that farm size, labour and seeds were grossly underutilized in rice production. The study therefore recommends the need for policy that would enhance increase in the allocation of land, seeds and labour in the production of rice.

Key words

Resources, Rice Production, Regression, Gross Margin, Ogun State.

Introduction

Background to the Study

Farming is arguably mankind's most important activity. Management of farms has therefore always been critically important for the production of food, fibre and fuel (Kemp, 2004). Agriculture is an important sector of the Nigerian economy. In spite of the various efforts by the government to break the cycle of low production and productivity which have characterized the sector and limited its ability to perform its traditional role in economic development, the sector is still dominated by small scale farmers (Ezeh et.al., 2012; Ajibefun and Aderinola, 2004). The small-scale agricultural entrepreneurs exist at the margins of modern economy. They are neither fully integrated into that economy nor wholly insulated from its pressure. It is therefore not surprising that many agricultural policies and programmes since Nigeria's independence in 1960 have been directed toward these small-scale farmers (Ayinde et. al., 2012). Small scale farmers have important role to play in the development of the agricultural sector of the Nigerian economy (Ojo et. al., 2012).

Agricultural growth in Nigeria is increasingly recognized as central to sustained improvement in economic development. Yet, its contribution to the Gross Domestic Product (GDP) has suffered setback as portrayed in the report of Amaza and Maurice (2005) which states that contribution of agriculture to the GDP between 1960-1964 declined from 56 to 47 percent in 1965-1969 and further declined to 35 percent between 2002-2004. Being a major agricultural commodity, decline in the contribution of agriculture to the economy to about 30 percent potentially has great implication for access to rice as a staple food item (Adeoye, 2003).

Rice is an important basic food commodity for certain populations in Sub-Saharan Africa, particularly West Africa. Since 1973, regional demand for rice has grown at an annual rate of 6%, driven by a combination of population growth and change in taste traditional coarse grains (Ismail et. al., 2012).

The consumption of traditional cereals, mainly sorghum and millet, has fallen by 12 kg per capita, and their share in cereals used as food decreased from 61% in the early 1970s to 49% in the early 90s. In contrast, the share of rice in cereals consumption has grown from 15% to 26% over the same period. The demand for rice has been increasing at a much faster rate in Nigeria than in other West African countries since the mid 1970s. For example, during the 1960's, Nigeria had the lowest per-capita annual consumption of rice in the sub-region (average of 3 kg). Since then, Nigerian per-capita consumption levels have grown significantly at 7.3% per annum. Consequently, per-capita consumption during the 1980's averaged 18 kg and reached 22 kg in 1995-1999. The increased average growth rate in Nigerian per capita rice consumption is likely to continue for some time (Akpokodje et. al. 2001). Rice, cultivated in a wide range of environments, from tropical to temperate climates as a major crop for more than 7000 years currently sustains more than half the world population (Ismail et.al., 2012; Izawa and Shimamoto, 1996).

Though rice contributes a significant proportion of the food requirements of the population, production capacity is far below the national requirements for rice (Wudiri and Fatoba, 1992; and Ladebo, 1999). Nigeria is currently the largest rice importer in the world. Hitherto, Indonesia had until 2004 been the world's largest importer of rice. Today Indonesia has with a sense of patriotism surpassed all odds to become self sufficient in the commodity. Annual demand for rice in Nigeria is estimated at 5 million tons, while domestic production is 3million, resulting in a deficit of 2 million tons (Ezedinma, 2002). Between 1990 and 2002, Nigeria imported 5,132,616 tons of rice valued at US$1.883553 billion. In 2002 alone, the country imported 1.882 million tons of rice (FAO 2002). This was estimated at about $756 million (Bello, 2003).

Rice producing farmers are mostly small scale farmers with limited capital resources (Babafade, 2003). Based on this situation, there is limited capacity in terms of farm inputs that is directed towards the production of rice. In spite of this, there is high level of waste that accompanies resource utilization. Given the trend of the population increase in the country, there is likelihood of an increase in the dependence on importation of rice to meet demand if domestic production is not increased. This study is therefore designed to provide answers to the following research questions:

1. How profitable is the rice production enterprise in the study area?
2. What are the factors affecting rice production?
3. What is the level of resource-use efficiency in rice production in the study area?

Objectives of the Study

The main objective of this study is to carry out an assessment of the economic analysis of rice production in Ogun state, Nigeria. The specific objectives are to:

1. determine the socio economic characteristics of the rice farmers in the study area;
2. calculate the cost and returns of the rice production enterprise in the study area; and
3. examine the resource use of the rice production enterprise.

Material and methods

Study Area

This study was carried out in Ogun State which covers a total land area of 16,762km2 and population of about 3,728,098 (Nigerian Tribune, 2007). The State has Lagos, Oyo, Osun, Ondo and Benin States along its borders. The rainy season falls between April and October while the dry season falls between November and March. There are four agro-ecological zones in the state out of which two, namely, Ikene and Abeokuta zones are very prominent for rice production.

Sampling Technique

Data for this study were collected through a three-stage random sampling technique. The first stage was the purposive sampling of Ikene and the Abeokuta zones that are predominantly known for rice production in the state. The second stage involved the random selection of ten (10) villages within each of the two zones. The third stage involved a random selection of twelve (12) rice farmers drawn from the list of all rice farmers in each of the selected villages.

Method of Data Collection

The data employed for this study were collected through the use of well structured questionnaire. Data collected included socio-economic characteristics of the rice farmers such as sex, education, years of experience. Data on the output of rice were also collected. The data collected were

based on the 2006/2007 planting season.

Method of Data Analysis

Descriptive statistics such as mean, frequency and percentages were used to analyse the socio-economic characteristics of the respondents. Other analytical tools, namely, Gross Margin analysis and Ordinary Least Square regression were used to analyse the profitability and the level of resource-use efficiency of rice production respectively. Data used for the study were tested for normality by comparing the p-value of the Shapiro-Wilk Test with 0.05. If it is greater the 0.05 then the data is normal. If it is below 0.05 then the data significantly deviate from a normal distribution (Laerd Statistics, 2012). Furthermore, tests for the presence of heteroscedacity and autocorrelation were carried out using Levene's test and Durbin-Watson statistics respectively. The decision criteria for Durbin-Watson test is to reject null hypothesis (H_0) that there is no positive autocorrelation, if $0 < d < d_L$; no decision is taken in respect of H0 that there is no positive autocorrelation, if $d_L \leq d \leq d_U$; reject H_0 that there is no negative correlation if $4\text{-}d_L<d<4$; no decision taken on H_0 that there is no negative correlation if $4 - d_U \leq d \leq 4 - d_L$; and accept the H_0 that there is no autocorrelation either positive or negative if $d_U < d < 4 - d_U$ (Gujarati, 20003). The tabulated Durbin – Watson values are $d_L = 1.571$ and $d_U = 1.780$.

Gross Margin Analysis

This was used to capture the profitability of the rice production enterprise. This model was specified as follows:

$$GM = TR - TVC$$

Where:

GM = average gross margin (N/ha)

TR = average total revenue (N/ha)

TVC = average total variable cost (N/ha)

Regression Analysis

Economic model commonly used to determine the relationship between the various factors and the output in agriculture is production function model. The production function of any farmer is determined by resource availability of the farmer (Wongnaa and Ofori, 2012). As such, the general model of the Ordinary Least Square (OLS) regression model specified for this study is presented as follows:

$$Y = (X_1, X_2, X_3, X_4, d_1, u)$$

where:

Y = output of rice (kg);

X_1 = Farm size (ha);

X_2 = Labour input (man day);

X_3 = Quantity of chemical fertilizer (kg);

X_4 = Quantity of seeds (kg);

d_1 = production system (dummy variable. It takes the value of 1 for lowland rice production system; 0 for upland production system); and

u = error term.

The apriori expectation is that all the independent variables have positive relationships with the rice output.

The following functional forms of the production functions were fitted to the data:

1. Linear Function:
   $Y = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + z_1d_1 + u$
2. Semi Log:
   $Y = a_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + z_1d_1 + u$
3. Exponential:
   $\log Y = a_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + z_1d_1 + u$
4. Cobb Douglas:
   $\log Y = a_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + z_1d_1 + u$

The lead functional form for this study was determined using the four criteria: conformity with apriori expectation; highest R^2 value; highest number of significant variables; and highest F-value (Olayide and Heady, 1982).

One of the effective factors for improving the quantity and quality of agricultural products is optimal application resources (Behrouzi, et.al., 2012). The production function with best fit was thereafter used to compute the resource-use efficiency as follows:

Resource Use Efficiency (RUE) of each input = Marginal Value of Product (MVP) /Unit Factor Cost (UFC).

$$MVPx_i = MPPx_i \,.\, Py$$

where:

$MVPx_i$ = marginal value product of xi inputs;
$MPPx_i$ = marginal physical product of xi inputs;
Py = average unit factor cost or unit price

To ensure maximum profit and efficiency of resources, a farmer must utilize resources at the level where their marginal value product

(MVP) is equal to their marginal factor cost (MFC) under perfect competition (Kabir Miah et al, 2006; Tambo and Gbemu, 2010). In line with Goni et al. (2007) and Fasasi (2006), the efficiency of a resource was determined by assessing the ratio of MVP of inputs (based on the estimated regression coefficients) and the MFC.

Results and discussion

Socio-Economic Characteristics of Respondents

This section presents the socioeconomic characteristics of rice farmers such as sex, age, marital status, household size, level of education, farming experience, farm size and place of farming as a source of occupation of the respondents. The distribution of the respondents according to their socioeconomic characteristics is as presented in Table 1.

Variables	Frequency	Percentage
i. Sex:		
Male	98	81.7
Female	22	18.3
ii. Age(years):		
<30	2	1.67
31-40	13	10.83
41-50	46	38.33
51-60	45	37.5
>60	14	11.67
iii. Marital status:		
Single	2	1.67
Married	118	98.3
iv. Household size:		
<5	10	8.33
6-10	75	62.5
11-15	30	25
>16	5	4.17
v. Education level:		
No formal education	46	38.33
Adult education	11	9.167
Primary education	36	30
Secondary education	18	15
Post secondary	9	7.5
vi. Farming Occupation		
Major occupation	79	65.83
Minor occupation	41	34.167
vii. Farming experience(years);		
<10	25	20.83
10-20	36	30
21-30	40	33.33
>30	19	15.83
viii. Farm size (ha);		
< 1	11	9.167
1-2	52	43.33
3-4	45	37.5
5-10	12	10

Source: Field Survey, 2007

Table 1: Socioeconomic Characteristics of Rice Farmers.

Analysis of the socioeconomic characteristics of the rice producers as shown in Table 1 indicates that rice production is a male dominated enterprise. The modal age group of the farmers falls between ages 41-50. The mean age of these farmers is 43years with the youngest being 25 years of age and the eldest 75 years old. The results show that majority of the farmers (87.5%) are above 40 years of age. The study further shows that most of rice farmers have large family size; about 62.50% have between 6-10 household members. Overall, 91.67% have family size greater than six members. With regards to education, the study shows that 61.67% of the respondents have some forms of formal education. While the majority of the respondents have farming as their major occupation, 60.00% of the farmers have more than 10 years farming experience. Considering the fact that 90.10% of the farmers cultivated less than 4 hectares of land to rice, rice production in the study area could be seen as being carried out at small scale level.

Costs and Returns to Rice Production

An assessment of the profitability of rice production in the study area presented in this section was based on analysis of the average costs and returns to production. The result of the analysis is as presented in Table 2. It should be noted that the figures are based on the average estimated figures per hectare per rice producer within a cropping season.

The result of the gross margin analysis presented in Table 2 shows that rice production enterprise is profitable. It is seen that cost incurred on labour was highest during rice production. This is in accordance with Olayide and Heady (1982) that labour accounts for the highest cost in agricultural production in small scale farming. Further analysis of the costs and returns shows that rice production has a net return to investment of about 81.64%.

Items		N/ha	
Average total revenue/ha			201,654.90
	Average fertilizer cost /ha	6,243.30	
	Average cost of seeds/ha	5,339.90	
	Average cost of labour/ha	20,291.20	
Average total variable costs/ha			111,020.50
Average gross margin/ha			90,635.35

Source: Data Analysis, 2007

Table 2: Estimated Gross Margin of Rice Producers in Ogun State.

Determinants of Rice Production

Data used for the OLS regression analysis were subjected to normality test using the Shapiro-Wilk test and test of homogeneity of variance using Levene's test. The results of the normality tests are as presented in Tables 3.

Variables	Statistics	df	p-value
Output (Y)	0.698	120	0.821
Farm size X_1	0.951	120	0.814
Labour input X_2	0.917	120	0.802
Agrochemicals X_3	0.834	120	0.785
Quantity of seeds X_4	0.405	120	0.673

Source: Data Analysis, 2007

Table 3: Test of Normality using Shapiro-Wilk Test.

The results of Shapiro-Wilk test in Table 3 show that the variables are not significant. Therefore, the null hypothesis that the variables have normal distribution is accepted. To test for the presence of homogeneity of variance (absence of heteroscedacity), this study used the Levene's test as presented in Table 4.

Variables	levene Statistics	df_1	df_2	p-value
Output (Y)	1.097	5	114	0.366
farm Size X_1	1.547	5	114	0.181
Labour input X_2	2.056	5	114	0.763
Fertilizer X_3	1.803	5	114	0.137
Quantity of Seeds X_4	1.976	5	114	0.125

Source: Data Analysis, 2007

Table 4: Test of Homogeneity of Variances.

The results of Levene's test of homogeneity of variance in Table 4 show that the two groups of the respondents based on production systems, namely, upland and lowland rice production have variables that have equal variance. In order to determine the factors affecting rice production among small scale farmers in the study area, four functional forms of the Ordinary Least Square (OLS) regression model were estimated for this study. The results of the OLS regression model are as presented in Table 5.

Equations	Constant	X_1	X_2	X_3	X_4	d_1	R^2	F- value	Dubin-Watson
Linear	191.86 (119.767) 1.602	961.75** (214.77) 4.49	3.25** (0.706) 4.606	-2.07E+04 (0.04) -0.047	41.62 (3.93) 0.413	-1702.49** (464.43) -3.67	0.936	334.77	1.906
Semi-Log	-15136.12 (4026.9) -3.763	1284.58 (1678.37) 0.765	3344.660** (1103.16) 3.03	892.98* (657.59) -2.35*	3371.56* (1580.95) 2.133	-222.05 (946.52) 1.36	0.732	62.25	1.924
Exponential	3.178 (0.023) 138.12	8.56E-02* (0.041) 2.074	3.99E04** (1.357E04) 2.94	-7.12E-05 (8.37E-05) -0.851	-2.27E+05 (7.57E+06) -0.03	-0.121 (0.089) -1.36	0.746	66.89	2.083
Cobb Douglas	2.175 (0.33) 6.59	0.386** (0.138) 2.8	0.349** (0.09) 3.86	3.37E-02 (0.054) 0.625	0.113 (0.13) 0.873	-0.196* (0.078) -2.52	0.805	94.22	1.913

Note: **p<0.01 and *p<0.05, figures in parenthesis are the standard errors. Figures below the standard errors are the t-ratios.

Source: Data Analysis, 2007

Table 5: Determinants of rice production.

As shown in Table 5, all the models tested as a whole are significantly different from zero based on F value. 99% confidence interval ($p<0.01$) was obtained and this implies that the models explain the dependent variables at 99% confidence. This implies that the four functional forms are good fit for the model. The coefficient of determination (R^2) of the various regression models ranges from 73.2 to 93.6. These measure the proportion of the variations in the dependent variables (rice output) that was explained by the variations in the independent variables. The results imply that the independent variables account for between 73.2% and 93.6% of the variation in the values of the rice produced. The reliability of the individual coefficient using the T-ratio provides the information of the effect of individual independent variable on the dependent variable (rice output).

Based on the highest R^2, highest number of significant variables, highest F-values and conformity to positive apriori sign of the regression coefficient, Cobb Douglas function was chosen as the lead equation. This is in line with the finding of Eze et al, (2010) and Goni et al, (2007) where double-log gives the best fit among other production functions specified. This is expressed in explicit form as follows:

$$\log Y = 2.175 + 0.38\log X_1^* + 0.349\log X_2^* - 0.03372\log X_3 + 0.113\log X_4 - 0.196X_5^*$$

The Durbin-Watson statistics for the Cobb-Douglas functional form is 1.913. This shows that there is no presence of autocorrelation in the model. With R2 of 0.805, 80.5% of the variation in output can be explained by the explanatory variables while only 19.5% of the variation is due to other factors not specified in the model. Based on the reliability of the estimates of the individual coefficient of the independent variables, this study reveals that farm size and labour input have positive relationships with rice output. These two inputs were also significantly different from zero. This is in line with the findings of Arifalo and Ayilaran (2011) as well as Opaluwa et. al. (2011). They asserted that land and labour inputs are significant variables in production of crops. The production system adopted by the rice farmers also had significant but negative effect on rice production. This implies that upland rice production lead to higher rice production that lowland rice production. Contrary to expectation, this study shows that upland rice production have the potential for increased rice output than lowland rice production. This might however be due probably to better management among upland rice farmers.

Further analysis of the Cobb-Douglas lead equation shows that one percent increase in farmland employed by the farmers, holding other inputs constant will result into about a 0.38 percent increase in rice output. This also applies to labour input which will result into about 0.349 percent increase in output when labour input is increased by one percent while holding other inputs constant. Other variables such as chemical fertilizer input, and seeds were not significantly different from zero. Efforts at increasing production should therefore be directed toward the identified variables that have significant effects on production. This could also be achieved by carryout detailed analysis of the efficiency of the use of the identified factors of production as presented in Table 6.

Resources	MVP (N)	UFC (N)	MVP÷UFC
Farm size	18,943.20	3,000	26.31
Labour	698.8	500	1.39
Chemical inputs	0.62	1.25	0.49
Seed	424.3	100	4.24

Source: Data Analysis, 2007

Table 6: Efficiency of Resource - Use.

Table 6 shows the Unit Factor Cost (UFC) of each of the input used for the analysis as the prevailing average price of each input as at the time the data were collected. The results show that farm size and labour inputs were grossly underutilized. This is on the basis of disparity between the marginal value of product (MVP) and the unit factor cost (UFC) which makes the ratio to be greater than unity. The farmers can therefore increase their allocation of these two production factors until the ratio of the MVP to UFC is unity.

Conclusion

Rice is a very important crop in Nigeria. The study shows that small scale rice production has a gross margin N90,643.35 per hectare. Investment in rice production in Ogun State, Nigeria is therefore a worthwhile and profitable venture. In spite of their positive and significant effect on rice production in the study area, land and labour inputs were grossly underutilized. In order to increase the level of rice production among small scale farmers in the study area, this study makes

the following recommendations:

1. Farmers should increase their level of utilization of land and labour in production of rice. This may require that right policy be put in place to encourage better access to farm land and higher returns to rice output so that farmers would be able to pay for hired labour;
2. Small and medium scale investors should be enlightened on the high level of profitability in rice production; and
3. Cooperatives could be organized among rice producers for easier access to the use of machinery that will reduce the drudgery of the labour intensive farm practices adopted by the farmers.

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