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Farm size and resource use efficiency of selected farms in Kwara State of Nigeria

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ABSTRACT: This paper examines resource use efficiency on small and large farms in Kwara State of Nigeria. Primary data were collected from 120 farmers who were selected using multistage random sampling method. The data were analyzed using descriptive and regression techniques. Results of the analysis revealed that farm size and fertilizer play major role in explaining variations in farm output. The marginal value product (MVP) of land, labour, purchased inputs, durable capital and fertilizer were positive and higher on large farms than on small farms. The MVP of labour and purchased inputs was negative on small farms. Durable capital was efficiently used on small farms but the use of the other resources was not efficient. The use of labour, durable capital, fertilizer and purchased inputs were not efficient on large farms. Increasing rate of returns was observed on both the small and large farms. Increasing the level of farm size and fertilizer use and decreasing the level of labour and purchased input would increase output on both small and large farms. Policy efforts should concentrate on making fertilizer available and affordable to farmers and expanding farmer's resource base to increase farm size and productivity.

Key words: Farm size, Resource-use efficiency.

Introduction

Agricultural development has suffered major set backs since the 1970s in Nigeria due to increased attention being paid to crude oil production at the expense of agricultural production. This neglect has manifested in reduction in the percentage contribution of agriculture to total gross domestic product. However, Government policies since the coming of the present civilian government in 1999 have stimulated some interest in agriculture and investment in agricultural enterprises. Some of the incentives provided by government in this regard include; concessionary interest rate on loans, subsidies on agricultural equipment up to 25%, zero or minimal import duty for importation of processing equipment, adequate remuneration for agricultural produce through guaranteed minimum prices, adequate funding of research into new and disease resistant varieties and tax holiday for new investors (Bello, 2003).

For these incentives to be transformed into increased agricultural production, there must be deliberate efforts to make an efficient use of available resources. This is because inefficient use of available resources have been identified as one of the major hinderances to increased agricultural production in Nigeria (Okuneye, 1985). To achieve increased agricultural production therefore, knowledge of resource use

efficiency is necessary in order to know resources whose quantity or rate of use should be increased or decreased to achieve increased farm production. Oladunni (1996), submitted that efficiency of resource use by farmers in most developing countries, Nigeria inclusive, is an important issue since agriculture is the largest employer of labour and also because of the need to produce enough food to feed the ever-increasing population.

Resource use efficiency analyses are usually based on the entire sample farms under the implicit assumption that all farms under study are similar with respect to such factors as resource endowment and farmer's managerial ability (Adeniyi, 1988). This assumption may not necessarily hold for different farm sizes, since differences in production efficiency often arise due to difference in factor endowment and in farmer's managerial ability and these explain why it is necessary to group farms into different sizes in resource use efficiency studies. An examination of resource efficiency on different farm sizes will indicate, for example, whether or not resource adjustment is necessary for the purpose of increasing output per unit of input. If resources are inefficiently allocated on both small and large farms, a reallocation of resource will increase output, on the other hand, if resources are efficiently allocated, the output can be increased not by resources adjustment but by other measures such as adoption of modern input and improved production techniques.

The objective of this study is to compare, within the limitations of data and methods, resource-use efficiency between small and large farms in Kwara State of Nigeria. A study of this nature is important, as it is likely to give the direction of adjustment in resource use and allocation in order to increase agricultural productivity.

Methodology

The Study Area

This study was conducted in Kwara State of Nigeria. A humid climate prevails over the state and it has two distinct seasons (the wet and dry seasons). The mean annual rainfall ranges between 1000mm and 1200mm. The mean annual temperature range between 25°C to 35°C in the state. The state is blessed with a vast area of fertile land suitable for production of arable crop such as yam, cassava, rice, maize, sorghum, cowpeas, groundnut, melon, okro, pepper and some perennial crop such as cashew (Ogunfowora *et al*., 1975). The soil type includes very deep loamy soil with well-leached topsoil that supports the growth of these crops. Agricultural production is largely traditional and small scale relying on manual labour equipped with hoes and cutlasses. Farm operations are performed largely by family labour but hired and pooled labour are also used during the peak period of the farming season.

The main farming systems are shifting cultivation, crop rotation and mixed cropping. Livestock keeping is also very common. The non-farm occupations in the study area include cloth weaving, dyeing, petty trading, tailoring, blacksmithing, bricklaying, carpentry, hunting and shoe making.

Sampling Procedure

The multi-stage random sampling method was used in selecting respondents for this study. Six local government areas were randomly selected in Kwara State. The second stage involves the random selection of two villages from each of the six local government areas. The last stage of the sampling was the random selection of ten farmers from each of the twelve selected villages using Kwara State Agricultural Development Project Household listing as the sampling frame.

Method of data Collection

The data for this study were collected from 120 selected farmers by means of an enumerator-administered structured questionnaire. The data collected include among others, the socio-economic background of the respondents, types of crop grown, crop yield, farm size, the various input used and the prices of inputs and output in the study area for the 2000/2001 farming season.

Analytical techniques

The data collected were analyzed using frequency distribution and regression technique. In order to examine the efficiency of resource use on different farm size categories, farms were grouped into two size categories. The observed modal farm size for all the sampled farms in the study area was 1.57ha, farms with size above this modal farm size were grouped as large farms and those with size equal or less than the modal farm size were grouped as small farms (Adeniyi, 1988). This method of classification gave 68 small farms and 52 large farms.

Production Function Model

Production function has been the traditional tool for analyzing resource efficiency and returns to scale. The linear and Cobb-Douglas functions are particularly useful where interest revolves around the quantitative estimation of resource productivities at the means of input (Ogunfowora *et al*., 1975).The production function model employed in this study is stated as follows:

$$Y = (X_1, X_2, X_3, X_4, X_5, U) \quad (1)$$

Where:

Y = value of farm output in naira
X_1 = farm size in hectare
X_2 = labour input in man-hours
X_3 = value of durable capital in naira
X_4 = value of fertilizer in naira
X_5 = value of purchased inputs in naira*
U = error term.

*Purchased inputs referred to here are agrochemicals and seeds.

The farm size for any farmer is the addition of all the hectares cultivated to the various crops. Land quality and managerial ability of all sampled farmers were assumed to be equal in the study area. Labour input include family, hired and pooled labour all added together and measured in man-hours. Durable capital input was measured by the amount spent on farm tools and the cost of tractor hiring services in naira. Fertilizer input was measured by the total amount in naira spent on fertilizer. Purchased inputs such as agrochemicals and seeds were measured in quantities and these quantities were converted to their naira value based on the ruling prices in the competitive market. On *a priori* basis, it is expected that each of the independent variables in equation (1) will be positively related to the dependent variable (Y), i.e. $dy/dxi > 0$ for i = 1,2,3,4,5.

Linear and Cobb-Douglas functions were fitted to the data collected from the large and small farms using the ordinary least square (OLS) regression technique. The lead equations were selected for both farm classes based on the magnitude of the coefficient of multiple determinations (R^2), the significance of the t-values, and the appropriateness of the signs of the regression coefficients. The marginal value product (MVP) of each resource was calculated for each farm class, by using the regression coefficient of the lead equations. For a Cobb-Douglas function for example, the MvP_{xi} is the product of elasticity coefficient of the input (bi) and the value of the average physical product (Y/Xi) (Alimi, 2000). The ratio of MVP to MFC (marginal factor cost) of each resource was computed to measure resource use efficiency in the two farm sizes. The marginal factor cost of a resource was taken to be the market price when purchased from a competitive input market or one naira plus the going interest rate in case of capital inputs (Omotesho *et al*., 1993).

Economic theory states that a resource is efficiently utilized if the ratio of its MVP to MFC is one. A ratio less than unity shows over-utilization and proft would be increased by decreasing the quantity used of that resource. A ratio greater than unity indicates under-utilization and increasing the rate of use of that resource will increase profit (Kay, 1981). T-values were calculated to test the significant difference between MVP and MFC of each resource using the method suggested by Ladipo (1977).

Results and Discussion

The Cobb-Douglas function was chosen as the lead equation and was used in determining resource use efficiency in both small and large farm categories because it gave the best fit. The estimated regression coefficient and other related statistics are presented in Table 1.

Table 1: Regression co-efficient of small and large farms in Kwara State.

Parameters	**Small farms (n=68)**	**Large farms (n = 52)**
X_1	2.11	3.72
	0.41	0.89
	(3.42)**	(2.60)**
X_2	-0.04	0.22
	(-1.01)	(2.44)**
X_3	0.12	0.26
	(0.08)	(0.77)
X_4	0.84	0.62
	(2.16)**	(4.02)**
X_5	-0.09	0.07
	(-0.48)	(0.51)
R^2	0.72	0.83
F-Value	13.2+	15.8+
Returns to scale	1.24	2.06

Source: Field survey, 2001.
Figures in parenthesis are t-values
**t-values significant at 5% level
+F-values significant at 1% level

From Table 1, the coefficient of multiple determinations (R^2) was 0.72 and 0.83 for the small and large farms respectively. The implication of this is that in the two farms classes, the independent variables explained on the average, over 70% of the variations in the value of farm output in the study area. In the small farms category, the coefficients of farm size and fertilizer were significant at 5% level. Also, farm size, fertilizer and durables capital were positively related to output. The coefficients of labour and purchased input were negatively related to output. This is not in conformity with *a priori* expectation. In the large farm categories, all the coefficients of the independent variables have positive signs indicating that increasing the quantity of each input individually or collectively will increase the value of farm output. This agrees with *a priori* expectation. The coefficient of land, labour and fertilizer were significant at 5% level but the coefficients of durable capital and purchased input were not significant even at 10% level.

The F-values for small and large farms were significant at 1% level indicating the significance of the overall regression equation and therefore the non-significance of some coefficients in the two farm classes could be accommodated within limits. The sum of elasticity for small and large farms was 1.24 and 2.06 respectively. This suggests increasing returns to scale on both small and large farms. The implication of this is that if all inputs (including farm size) are proportionately increased on both small and large farms,

total output will increase at an increasing rate, however, the large farms appear to have greater potential for increased output since the returns to scale was higher on large farms. Judging from the significance of the regression coefficients, farm size and fertilizer play significant roles in explaining the variations in farm output in the two farm classes.

Given the level of technology and prices of both inputs and output, the marginal value productivity is the yardstick for judging the efficiency of resource use (Ogunfowora *et al*., 1975). The marginal value product (MVP) of resources for small and large farms is presented in Table 2.

Table 2: marginal value product of resources for small and large farms in Kwara State.

Resources	**Small Farms**	**Large Farms**
Land	120.2	150.6
Labour	-0.62	1.47
Durable capital	1.38	2.91
Fertilizer	38.4	40.6
Purchased inputs	-0.86	0.54

Source: Field survey, 2001.

The MVP of land was 120.2 on small farms and 150.6 on large farms; this suggests that the productivity of land was higher on large farms than on small farms. The MVP of labour on small farms was -0.62 and 1.47 on large farms. This implies that more labour input per hectare was used on small farms than on large farms. The reason for this might be that small farms rely mostly on family labour, which is readily and cheaply available while large farms employ hired labour to which wage has to be paid at the market rate.

The MVP of durable capital and fertilizer were higher on large farms than on small farms indicating that these inputs were more productive on large farms than on small farms. The MVP of purchased input was -0.86 on small farms and 0.54 on large farms. This raises the question, why should small-scale farmers use purchased input up to the point at which the MVP becomes negative? The reason for this might be that the amount of agrochemicals and seed used per hectare by small farmers were higher than the recommended rate in the area and this led to excessive use of these inputs.

To examine resource use efficiency on the two farm categories, the ratio of MVP to MFC and the t-ratios were computed and presented in Table 3. The MFC of an input (MFCxi) is the addition to cost as a result of using additional unit of the input (xi), which for a firm operating in a purely competitive industry is the market unit price (Alimi, 2000). The farmers in the study area were assumed to operate in a purely competitive input market, thus the market unit price of input was used as the marginal factor cost. The MFC of land could however, not be compared with the MVP because agricultural land was neither bought nor rented in the study area. Permission for the use of land is usually given automatically as long as the owner is not cultivating the land. The MFC of labour was ₦50, which was the average wage rate of labour per hour. The MFC of durable capital and purchased input was taken to be one plus the interest rate of 30%, which gave 1.30. The MFC of fertilizer was ₦30 representing the cost per kilogram of fertilizer in the competitive market.

Table 3: Ratio of MVP to MFC of resources for small and large farms.

Resources	Small farms		Large Farms	
	MVP/MFC	t-values	MVP/MFC	t-values
Labour	-0.01	-3.01**	0.03	4.36**
Durable capital	1.06	2.48**	2.23	1.11
Fertilizer	1.28	2.66**	1.35	3.90**
Purchased inputs	-0.66	-2.81**	0.41	6.28**

Source: Survey data.
**t-values significant at 5%level.

The marginal analysis presented in Table 3 shows that in the small farms, there were over-utilization of labour and purchased input and reducing the quantity use of these inputs could increase farm profit. There was under-utilization of fertilizer and efficient utilization of durable capital input. The t-ratios were significant in all cases at 5% level showing that there were significant differences between the MVP and the MFC.

In the large farm category, there was over-utilization of labour and purchased input. This might be as a result of cheap source of labour and the use of purchased inputs above the recommended rate. Durable capital and fertilizer were under-utilized and using more of these inputs could increase farm output. The t-ratios for labour, fertilizer and purchased inputs were significant while the t-ratio for durable capital was not significant at 5% level in the large farms. It should be pointed out that in the large farms, the MVP of neither labour nor purchased inputs was negative (as it was the case in the small farms), indicating that the farmers in this class still use these inputs within economically rational region, though they were not optimally utilized.

Summary, Conclusion and Recommendations

The analysis of farm size and resource use efficiency presented in this micro study revealed that the productivity of land, labour, durable capital, fertilizer and purchased inputs were higher on large farms than on small farms. This is without prejudice to the submission of Okuneye (1985), that the level of available resource and the amount of information available to the farmers usually affect resource productivity and resource use efficiency. This study also revealed that farm size and fertilizer were the most significant determinant of farm output on both small and large farms. Labour input significantly affect farm output only in the large farm. Marginal analysis indicated that on both small and large farms, labour input and purchased inputs were over-utilized while fertilizer was under-utilized. Durable capital was efficiently allocated on small farms but was under-utilized on large farms. The returns to scale indicated increasing return to scale on both small and large farms.

To achieve efficient use of resource that will lead to increase productivity therefore, farmers should reduce the use of labour and purchased inputs per hectare but they should increase the use of durable capital and fertilizer. Also, there should be effective dissemination of information to farmers on proper labour utilization and appropriate rate of application of purchased inputs. Finally, it is recommended that there should be an expansion of the farmers' resource base, particularly in the area of fertilizer supply and tractor hiring services.

References

Adeniyi, J.P. (1988). Farm size and resources use efficiency in small scale agricultural production. The case of rice farms in Kwara State of Nigeria. Nigerian Agricultural Journal, 23(2): 43-50.

Alimi, T. (2000). Resource use efficiency in food crop production in Oyo State of Nigeria. Journal of Agriculture and Environment, 1(1): 1-7.

Bello, A. (2003). "Federal Government Releases ₦310 million to combat cassava mosaic". The Punch Newspaper, November 18, 2003, pp. 19.

Kay, R.D. (1981). Farm management Planning, Control and Implementation. McGraw-Hill Books Company, New York, pp. 34.

Ladipo, O.O. (1977). The variance of marginal value productivity estimates using Cobb-Douglas function. Journal of Rural Economics and Development, 11(1): 57-68.

Ogunfowora, O.; Essang, S.M. and Olayide, S.O. (1975). Resource productivity in traditional agriculture: A case study of four agricultural division of Kwara State of Nigeria. Journal of Rural Economics and development, 9(11): 119 – 131.

Okuneye, P.A. (1985). Resource productivity on co-operative farms in Nigeria: A linear programming appraisal. Journal of rural co-operation. 13(2): 119 – 133.

Oladunni, O.A. (1996). Technical efficiency differentials in agricultural production: Implication for agricultural development in Nigeria. The Nigeria Journal of Agricultural and Rural management, 1(1): 51-59.

Omotesho, O.A.; Olufe, J. and Oladeji, S.O. (1993). Resource productivity in food crop production in some selected village in Oyi Local Government Area of Kwara State, Nigeria. Ife Journal of Agriculture, vol. 14; 90 – 97.