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Resource-Use Efficiency and Return to Scale in Smallholders Rubber Farming System in Edo State, Nigeria

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ABSTRACT The study examined the resource use efficiency and the farming system in Edo state of Nigeria. Data were collected from 50 randomly selected rubber smallholders in Ikpoba-Okha Local Government Area of Edo state using a multistage sampling procedure. The study reveals that there is under utilization of all the production inputs under consideration. In addition, land was a significant factor influencing output level of rubber in the area. The scale coefficient is 1.76 hence, increasing return to scale. Also, there are 13 farming systems operated by the rubber small holders in the study area. Incorporating policy measures of efficient use of production inputs and also to guard against all bids that may stands as obstacles towards efficient use of these production inputs were suggested.

INTRODUCTION

Agriculture occupies a prominent place in the economy of Nigeria. The sector accounts for about 35% of the Gross Domestic Product (GDP) and employs about two-third of the labour force (CBN 1994). In the period preceding the political independence of Nigeria in 1960, agriculture was the major foreign exchange earning sub-sector. However, the importance role agriculture has played in Nigeria's economic life has decline tremendously (Yusuf and Falusi 2000). The decline has for a long time been blamed on the neglect of the rural sector, comprising mainly of smallholdings farming families or households by successive administration in the country. Also, the age of the farmer, farm size and the farmland tenancy have had their own share of the blame. (Abolagba et al. 2004).

Intercropping food crop with natural rubber play an important role in farming system as it serves as individual rubber farmers' contributions towards national food security. Ruthenberg (1980) described intercropping as the growing of two or more crops simultaneously on the same piece of land with distinct row arrangement. Okigbo and Greenland (1976) reported that intercropping is the predominant practice for both staples and cash crops; the number of crops involved in the mixtures may exceed 50 species since several strains of crop may be grown in a field. According to Beets (1982), intercropping as been associated with advantages like better utilization of environmental factors, greater yield stability, soil protection and socio-economic advantage like higher yields, greater gross returns per unit area and insurance against mono-crop failures.

One way of increasing production by the small farmers is to efficiently use all the resources available in the production process. Olayide (1980) indicated that the most productive and efficiently used inputs are labour, seeds and farm equipment. Land as a resources is efficiently used through shifting cultivation practices and other cropping systems (Okigbo 1978), but the full potentials of land, capital and labour resources are yet to be efficiently husbanded for optimum production.

There is need to develop a sound knowledge of the current situation as regard rubber smallholders who formed the bulk of rubber producers in Nigeria, and most especially as regards to the utilization of the available resources to them.

This study is therefore designed to determine the efficiency of resource-use, the returns-to-scale and to investigate the farming system among rubber smallholders in the study area.

LITERATURE REVIEW

Olukosi and Erhabor (1988) characterize resources into variable and fixed resources. Variable resources include labour, seeds and

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fertilizers, which are normally used up in one production process. Fixed resources are more durable resources, which contribute to the production process over several production periods. They include land, machinery, farm building etc. Baumol (1977) stated that production economics is concerned with optimisation and optimisation implies efficiency

Efficiency measurement is important because it leads to a substantial resource savings (Bravo-Ureta and Rieger 1991). Efficiency measurement is important for three main reasons: Firstly, it is a success indicator and performance measure by which production units are evaluated. Secondly, the exploring of hypothesis concerning the sources of efficiency differential can only be possible by measuring efficiency and separating its effects from the effects of the production environment. Thirdly, identification of sources of inefficiency is important to the institution of public and private policies designed to improve performance (Ogunjobi 1999).

One of the strategies for increasing agricultural production is a combination of measures designed to increase the level of farm resources as well as make efficient use of the resources already committed to the farm sector. Farrel (1957), observed that technical inefficiency arises when less than maximum output is obtained from a given bundle of factors while allocative inefficiency arises when factors are used in proportions, which do not lead to profit maximization. Efficient use and allocation of resources imply that a redistribution or re-allocation of resources achieves optimal level of production.

Economic efficiency combines both technical and allocative efficiency. It occurs when a firm chooses resources and enterprises in such a way as to attain economic optimum (Heady 1960; Ellis 1988; Russell and Young 1983; Adesina and Djato 1997). The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or certain level of output at least cost.

MATERIALS AND METHOD

Primary data used were generated through oral interviews and 50 sets of structured questionnaires. Information was sought on age, household size, farming experience, farm size of the rubber farmers, farm capital outlay, farm borrowing, farm input use and output.

Multistage sampling procedure was employed. First, Edo state was selected based on a priori knowledge that it is a rubber producing state. Second, Ikpoba – Okha Local Government Area (LGA) was also purposively selected because Rubber Research Institute of Nigeria (RRIN) is located in the area and because there are considerable numbers of rubber farmers in the area. Third, from the local government, ten communities namely; Obaretin,Iyanomo, Uhie, Okha, Ologbo, Obayator 1, Obayator 2, Ogbekpen, Obagie, and Agbonwonba were selected. In all a random selection of 50 farmers were selected.

Both descriptive and quantitative analyses were used in the study. The descriptive analysis was used to analyse the socio demographic characteristics of rubber farming households and the farming system in the study area. Quantitative analytical tool in form of unrestricted Cobb-Douglas production function was used to determine the extent to which the inputs used explained the variability of rubber output. The Cobb-Douglas production function is expressed as follows:

$Q = AX_i^{bI}$ (where i ranges from 1 to 4) .. Equation 1

The specification is log linearised to obtain an estimating equation as:

$Ln\ Qi = LnA + b_1LnX_{1i} + b_2LnX_{2i} + b_3LnX_{3i} + b_4LnX_{4i} + LnU_i$ ... Equation 2

Where,

Qi is the output of the i^{th} rubber-based farms (kg)

X_{1i} is the farm size of the i^{th} rubber-based farm in hectares

X_{2i} is the amount of hired labour employed on the i^{th} farm in man-days

X_{3i} is the amount of family labour used on the i^{th} farm in man-days

X_{3i} is the amount of capital used on the i^{th} farm in Naira

A is the intercept term which represents the average physical product (A measure of the efficiency of technology adopted by the i^{th} farmer);

b_1, b_2, …. b_4 are the slope terms representing the elasticity's of production for the different inputs used by the i^{th} farm;

Ui is the error term.

The efficiency of resource use was obtained from the estimated equation by comparing the Marginal Value Product (MVP) of a particular input with the Marginal Factor Cost (MFC) of that input. The MVP of an input was obtained by

$MVP_{xi} = MPP_{xi} * P$

Where $MPP_{xi\ is}$ the Marginal Physical Product

of x_i and P is the unit price of the output (q). The MFC For an input is defined as:

$MFC_{xi} = MPP_{xi} * r_{xi}$

Where r_{xi} is the unit price of input x_i

The regression coefficients, which are equal to the elasticity coefficients in Cobb-Douglas production function was used to measure the return-to-scale in rubber production. When $b_1 + b_2 + \text{———} + b_5$ equal one, there is constant return to scale, above one indicate increasing return to scale, and less than one indicate decreasing return to scale.

As regards the resource use efficiency, whenever

$MVP_{xi} > MFC_{xi}$ there is under utilization of resource x_i

$MVP_{xi} < MFC_{xi}$ there is over utilization of resource x_i

$MVP_{xi} = MFC_{xi}$ there is optimum utilization of resource x_i

RESULTS AND DISCUSSIONS

The summary statistics of a typical rubber-based farming household in Edo state is presented in Table 1. The table showed that a typical rubber-based farming household have about seven members. Besides, an average age of (sole and mixed crop) rubber farmers was about 52 years with 32 years of experience in rubber production. 30 percent of the farmers had informal education. 14 percent solely deals with rubber production while 86 percent intercrops rubber with the following food crops: pineapple, yam, cassava, maize, vegetables, cocoyam and plantain. This is line with the work of Jayasena and Herath (1986); Stirling et al. (1998) which stated that rubber smallholders with immature rubber stands intercropped with food crops in order not to face a gap in income of 5-7 years during which the immature rubber cannot be tapped for latex.

Table 1: Summary of a rubber-based farming households in Edo State

Indicator	*Average*	*Coefficient of variation*
Age of farmers	52.45	0.81
Household size	6.74	0.61
Farming experience (Years)	31.62	0.74
Informal education (percentage)	30.00	0.69
Farm size (hectares)	5.67	0. 29
Sole cropping (percentage)	14.00	0.58
Gross margin (Naira per hectare)	40,764.46	0. 42
Net farm income (Naira per year)	96,426.24	0. 23
Net gift from relation (Naira per year)	1,345.63	0.26
Non-farm income (Naira per year)	42,450.00	0.27

The thirteen farming systems operated by the rubber smallholders in the study area were: Rubber (Rb), Rubber/ Pineapple (Rb/Pa), Rubber/ Yam (Rb/Ym), Rubber/Cassava (Rb/Cv), Rubber/ Maize (Rb/Mz), Rubber/Vegetables (Rb/Vg), Rubber/Cocoyam (Rb/Cy), Rubber/Plantain(Rb/ Pt), Rubber/Pineapple/Maize (Rb/Pa/Mz), Rubber/ Pineapple/Vegetables (Rb/Pa/Vg), Rubber/Yam/ Vegetables (Rb/Ym/Vg), Rubber/Coco yam/ Vegetables (Rb/Cy/Vg), Rubber/Pineapple/ Plantain (Rb/Pa/Pt).

The average farmland cultivated was about 6 hectares with the farm size being in the range, 4 to 5 hectares. The gross margin per hectare was N40, 764.64 while the net farm income and non-farm income within the household were N96, 426.24 and N42, 450 respectively. The estimated form of the unrestricted Cobb-Douglas production function is given in Table 2.

Table 2: Estimated Cobb-Douglas production function for rubber smallholders in Edo state, Nigeria.

Variable	*Coefficients*	*t-ratios*
Intercept	1.217	2.74
ln Land (x_1)	0.421	4.25*
ln Hired labour (x_2)	0.065	0.74
ln Family labour (x_3)	0.134	1.28
ln Capital (x_4)	0.809	1.36

$R^2 = 0.65$, Adj. $R^2 = 0.63$, $F = 14.94$,
*significant at 1 percent.

The R^2 of 0.63 is high, thus this explained 63% of the variations in the value of rubber output in the study area. Moreover, land variable was significant at 1% and this explained that land availability determined the value of rubber output in the study area. The elasticities of production is 1.76 which was above unity; thus confirming increasing return-to-scale and suggesting the need for expansion of rubber production in the study area. That is if all inputs can be increased by 100 percent, the output of rubber will rise by 176 percent. However, the result of the scale coefficient masked the resource use efficiency of

Table 3: Marginal Value Product (MVP) and Marginal Factor Cost (MFC) of production inputs in rubber production in Edo State, Nigeria

Input	*MVP*	*MFC*	*Efficiency ratio*
Land	166.27	145.20	1.14
Hired labour	49.43	36.20	1.36
Family labour	38.18	18.28	2.08
Capital	138.17	110.79	1.24

each input in the production of rubber in the study area. Table 3, shows the MVP and MFC of the individual input used.

From Table 3, it is observed that all the production inputs were under-utilized, as the MVP was higher than the MFC. This means that increase use of this inputs will lead to further increase in output. Specifically for every amount spent on land, hired labour, family labour and capital the returns from rubber will increase by ₦ 1, ₦1, ₦2 and ₦1 respectively. Land in the study area is under – utilize because of the restrictive land tenure system operating in the study area or probably because some of the rubber farmers does not intercrop with food crop. Labour (family and hired) is very scarce in the area probably because people now prefer to train their children in school or on trade that will eventually pull them away from agriculture. As for capital, most of the rubber smallholders do not have enough capital to expand their production. This is in conformity with the study of Haruna et al. (2008) which stated that agricultural resources are under-utilize due to the cost of obtaining the resources.

CONCLUSION AND RECOMMENDATION

This study has explored the efficiency of resource-use and return-to-scale among rubber smallholders in Edo state. The result indicates that rubber production has an increasing return-to-scale. In addition, all the production inputs are under-utilized, meaning that opportunities still exists to increase output by increasing the level of these inputs. It was revealed from the production function analysis that farm size is a significant factor influencing output level of rubber, at 1 % level of probability.

Based on the findings from this study, it is recommended that rubber production should be based on the technique that will utilize more land, labour and capital. Also, any bids that may constrain the increased use of these resources should be guarded against.

REFRENCES

Abolagba E, Omokhafe K, Aigbekaen E. 2004. Age Distribution of Rubber Farmers, Farms, and Farm size of Smallholders in South-West Nigeria. *Journal of Sustainable Tropical Agricultural Research* 11: 118 -121.

Adesina AA, Djato KK 1997. Relative Efficiency of Women as Farm Managers. Profit Function Approach in Cote d voire. *Journal of Agricultural Economics*. 16: 47-53.

Baumol CF 1977. *Principles of Micro Economics*. 3rd Edition, Englewood Cliffs, NJ :Prentice Hall.

Beets, WC 1982. *Multiple Cropping and Tropical Farming Systems*. Baulder Colorado U.S.A.:West View Press Inc.

Bravo-Ureta BE, Rieger L 1991. Dairy Farm Efficiency measurement using Stochastic Frontier and Neoclassic Duality. *American Journal of Agricultural Economics*, 73: 421-428.

CBN 1994. Annual Report and Statement of Accounts. Central Bank of Nigeria 31st December 1994.

Ellis F 1988. *Peasant Economics of Farm Households and Agrarian Development.* Cambridge: Cambridge University Press.

Farrel JM 1957. The Measurement of Productive Efficiency. *Journal of Royal Statistic*, 120(3): 253-290.

Heady O 1960. *Economics of Agricultural Production and Resource Use.* Englewood Cliffs, NJ: Prentice Hall.

Jayasena WG, Herath HMG 1986. Innovation Receptivity and Adoption in Rubber Smallholdings of Sri Lanka. *SRRP Research Study* 71, ARTI, Sri Lanka, pp.79-88.

Ogunjobi OP 1999. *Efficiency of Smallholder Cocoa Farmers in Ondo State: A Stochastic Frontier Analysis*. M.Sc Thesis, Unpublished, Federal University of Technology, Akure

Okigbo BN, Greenland DJ 1976. Intercropping Systems in Tropical Africa. In: RI Panpendick, PA Sanchez, GB Tripplets (Eds.): *Multiple Cropping.* Madison, WA: American Society of Agriculture Publication No. 27.

Okigbo BN 1978. *Cropping Systems and Related Research in Africa.* AAASA. Anniversary Series.

Olaide, SO 1980. Characteristics, Problems and Significance of Farmers. In: SO Olaide, Eweka Bello (Eds.): *Nigeria Small Farmers. Problems and Prospects in Integrated Rural Development.* Published by centre for Agricultural, Rural and Development (CARO), University of Ibadan, Nigeria, pp. 1-15.

Olukosi JO, Erhabor PO 1980. *Introduction to Farm Management Economics: Principles and Applications.* Zaria: AGITAB Publishers.

Rusell NP, Young T 1983. Frontier Production Function and Measurement of Technical Efficiency. *Journal of Agricultural Economics*. 16: 47-53.

Ruthenberg H 1980. *Farming System in the Tropics*. Oxford: Oxford University Press

Yusuf SA, Falusi AO 2000. Trend Analysis of the Performance of Agriculture in Nigeria (1970-1998). *Nigeria Agricultural Development Studies*, 2: 1-19.