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Sustainable Resource Productivity in Small Scale Farming in Kwara State, Nigeria

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Abstract

Rising resource prices in recent years, combined with increasing global demand for resources due to a growing population and increasing wealth, have brought the issue of resource scarcity to the forefront of the political agenda. Low level of agricultural production in Nigeria is partly due to poor resource use by small scale farmers. Efficient and sustainable use of limited agricultural production resources is therefore necessary for sustained food security. This study has been able to produce some useful results based on responses from one hundred and ten farmers interviewed in three local government areas of Kwara state. The cost and returns analysis revealed that the average gross margin of ₦18,975.92/ha is obtained by the farmer. The production function that gave the best fit to the specified production model was Cobb-Douglas function. By comparing the Marginal Value Product (MVP) to the Unit Factor Cost (UFC) of the resources employed, it was established that land and capital resources were over utilized. The linear programming analysis also showed that the most profitable and sustainable crop combination in the area was maize and cassava, which had a gross margin of ₦108,920.80/ha.

Key words: Sustainable, Resource Productivity, Small Scale.

Introduction

The increasing population of African countries has necessitated increase in food production if food availability is to be ensured. However, increased food production cannot satisfy the increasing food demand (Booth and Coursey, 1992). The projected population of Nigeria in 2025 according to 2007 estimate is about 200 million. The agricultural sector is confronted with the major challenge of increasing production

to feed a growing and increasingly prosperous population in a situation of decreasing availability of natural resources. On the supply side there is a shortage of arable land, degradation of land, loss of agricultural land due to urbanization, irrigation problems, water shortages, disappearing genetic diversity, and climate change (Stienen *et al*, 2007). Today's conventional or industrial agriculture is considered unsustainable because it erodes natural resources faster than the environment can regenerate them (Tai, 2002). Therefore, it appears we are left with the only choice of substantially increasing sustainable agricultural productivity especially among small scale farmers who dominate the agricultural sector in developing countries (Dipeolu *et al*, 1999). Sustainable agricultural productivity therefore is referred to as the system of farming which involves making the most efficient use of existing farming resources while ensuring that the resources are preserved. It is a farming system that is both ecologically and economically viable. This paper examines sustainable resource use efficiency by small scale farmers in Nigeria.

Methodology

The area of study consists of three randomly selected local government areas of Kwara state, Nigeria. Three towns were selected from each of the local government areas based on their geographical location. The data were collected using structured questionnaire which was designed in such a manner as to achieve the objectives of the research. One hundred and ten farmers in Ekiti, Oke Ero and Irepodun local government areas of Kwara state were interviewed. The information sought includes demographic and socio-economic characteristics, quantity and source of input, cropping systems and corresponding outputs as well as resource conservation measures. Other secondary sources of data include journals, previous studies on resource management and other relevant texts.

The data collected were subjected to frequency and percentage analysis so that the socio-economic characteristics of the farmers could be clearly presented. Also subjected were cropping pattern, resource use, sources of inputs and other related data. Regression analysis was used to assess the resource-use efficiency. Production functions were also fitted to the data obtained and marginal value production of resources computed. The model employed in this study is stated below in its implicit form:

$$Y = f(X_1, X_2, X_3, U)$$

Where:

Y = the aggregate value of product (grain equivalent)

X_1 = Land (ha)

X_2 = Labour (man days)

X_3 = Operating capital (₦)

U = Error term

The land variable was measured in hectares. This variable may not be adjusted for the differences in soil fertility because there exist no acceptable criterion for standardizing it. Labour variable includes family, communal and hired labour, all measured in man-days. Operating expenses consist of expenses on fertilizer, chemical and seeds. Criteria for selecting the best fit for the regression include the coefficient of multiple determination R^2, the F- ratio, t- statistics and theoretical expectations based on the nature of the function being considered. The R^2 will show the level of variation of dependent variable that can be explained by the explanatory variables. A low R^2 therefore confirms a poor relationship between the explanatory variables and the dependent variable, while a high R^2 shows a significant relationship. The higher the R^2 the better. The F- ratio shows the overall significance of the equation and the significance of each explanatory variable is examined by the t- statistic given by:

$$\frac{b_1}{\text{Standard Error}}$$

Where b_1 = coefficient

The t- statistic is used to determine the significance of each variable and hence to see whether or not it could have been dropped from the equation. The appropriateness of signs with reference to a priori expectation also guides in the selection of lead equation.

The principle of linear programming is also employed in order to derive feasible and/or profitable combination of crop production in the study area based on the assumption that the production objective of farmers is to maximize the gross margin. Thus the general objective function can be represented as follows:

Max. $Z = C_jX_j$

Subject to: $aijXj \leq \beta_I$ and

$X_j \geq 0$ for all j Where:

Z = objective function (profit)

C_j = the contribution per unit of activity

X_j = the level of activity in the optimal plan

a_{ij} = technical coefficients

β_I = the available resource constraints

i = number of constraints

j = number of activities.

Results and Discussions

The socio-economic characteristics of the farmers are presented in table 1. Most of the farmers (about 93 %) were men and they had been farming for an average of 28 years. Their ages range between 21 and 60 with the mean age of 47 years. About 30 % of them has no formal education while about one-third (40 %) of the farmers had primary education. More than three-quarters (54.94 %) of the respondents obtained operating capital through their personal savings while about 40 % obtained theirs from cooperatives. Also about 90 % of them obtained their chemicals from Kwara State Agricultural Development Programme (KWADP) office, while 60 % obtained their planting materials from KWADP. About 27 % got their planting materials from both KWADP and Ministry of Agriculture and Natural Resources (M.A.N.R). About 85 % of the farmers inherited their farmlands while only about 14 % borrowed theirs. 30 % of the farmers used their family as source of labour while about 38 % used both family and hired labour. The average family size for all the respondents is 12 and about 70 % practiced intercropping. About 94 % of the farmers practiced farming on a full time basis while about 6 % took to trading as alternative occupation.

Regression results

Multiple regression analysis was used so as to obtain as estimate of the coefficient and to determine the signs of factors that determine gross farm income. Cobb-Douglas production function was chosen based on its highest value of R^2, significance of regression coefficient and the signs of the coefficients.

The result of the best fit functional form is presented in the equation below:

$$Y = 3.229 + 0.221X_1^* - 0.346X_2 + 0.180X_3^*$$
$$(2.597) \quad (4.178) \quad (0.270)$$

$R^2 = 0.62$, F = 161.71

* Significant at 5 %

The values in parenthesis are t- statistics of the respective coefficients.

The regression results show that about 60 percent of the total variation in the output is explained by the

included independent variables in the model. The variable X_1 (land in hectare) has a positive coefficient meaning that it contributes positively to gross farm income. It is a significant independent variable; hence, a change in the number of hectares of land used for cultivation will lead to a change in the income of the farmer.

The coefficient of labour in man-days is negative and this implies that the amount of labour utilized is indirectly related to the gross farm income. The operating capital (X_3) in naira is also significant and its positive coefficient indicates that increase in the variable might lead to an increase in farmers' gross income.

Three enterprises prevail most in the study area. Enterprise X_1 consists of maize intercropped with cassava. The average labour utilized on maize/cassava enterprise is 142.66 man-days/ha. This value accounts for about 56 percent of the average total labour available per respondent. The average land area utilized for enterprise X_1 is about 0.5 ha (about 8.7 % of the total land that is available for cultivation). Operating capital utilized on enterprise X_1 is ₦31,932.94/ha. Enterprise X_2 consists of guinea corn and yam. This combination required average labour of 99.33 man-days/ha (about 80 percent of the total labour available to each farmer). It also required an average land area of 0.43 ha, accounting for about 7.47 % of the average land area available for cultivation. Operating capital requirement of enterprise X_2 is about ₦21,862.52/ha. Enterprise X_3 is made up of guinea corn and cassava. This requires an average of 125.10 man-days/ha of labour, about 70.14 percent of the total average labour available. Average land used fir enterprise X_3 is 0.43 ha, about 7.47 % of the average land available for cultivation. The amount of operating capital required on enterprise X_3 is ₦ 18,947.88/ha.

The contribution per unit of activity (Cj) was ₦ 108,920.80/ha for maize and cassava enterprise, ₦ 93,938.81/ha for guinea corn and yam, and ₦ 32,182.20 /ha for guinea corn and cassava. The resource constraints were land, labour and operating capital. The final tableau in the linear programming result revealed that the most profitable crop combination in the study area was maize and cassava, which had a gross margin of ₦ 108,920.80/ha.

Summary and Conclusion

The study examined the socio-economic characteristics, resource use efficiency and the most profitable crop enterprises of small-scale farmers. It revealed that the small-scale farmer were earning average gross margin of ₦18,975.92/ hectare. The adjusted R^2 of 0.62 was obtained showing that about 62 % of the variability in the net income of the respondents is explained by the independent variables, which are land, operating capital and labour. It also revealed that inputs like land and operating capital were over utilized and that the total output might increase using less of labour input. The most profitable crop enterprise was maize and cassava which had a gross margin of ₦108,920.80/ha. The farmers also engage in soil conservation practices like drainage, crop rotation, manure application, incorporating organic matter back into the field and so on.

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Table 1: Socio-economic Characteristics of the Farmers

N0	Socio-economic characteristics	Responses
1.	Average age	47
2.	Usual educational level	Primary education
3.	Major occupation in addition to farming	Trading
4.	Usual source of credits	Personal savings and Cooperatives
5.	Usual source of planting materials	*KWADP
6.	Usual source of chemicals	KWADP and **MANR
7.	Usual mode of land acquisition	Inheritance
8.	Usual type of labour	Family and hired
9.	Proportion of farmers that are men	92.73 %
10.	Proportion of farmers that are women	7.27 %
11.	Average family size	12
12.	Average farm size	5.6 ha
13.	Average monthly income	₦ 3,854.88
14.	Major farming system	Inter-cropping

Source: Field Survey, 2008

***Kwara State Agricultural Development Programme**

** Ministry of Agriculture and Natural Resource

Table 2: Cost and Returns Analysis

N0	Item	Mean amount (₦/hectare)
1.	Average variable cost	9,188.54
2.	Gross revenue	28,164.46
3.	Gross revenue/respondent	256.04
4.	Gross margin	18,975.92

5. Gross margin/respondent 152.66

Source: Field Survey, 2008

Table 3: Estimate of MVP and UFC of Resources

FACTOR	MVP	UFC	EFFICIENCY RATIO
Land (₦/ha)	85.554	*1000	0.0855
Labour (₦/man/day)	-4.325	300	-0.014
Operating capital (₦)	0.0050	1.28	0.0039

Source: Field Survey, 2008

*1000: Opportunity cost of land; MVP = Marginal Value Product; UFC= Unit Factor Cost.

Table 4: Linear Programming Results

CONSTRAINTS

Crop Enterprises	Land / ha	Labour (man-days / ha)	Operating capital (₦)	Gross margin (₦/ha)
X_1	1	142.66	31,932.94	108,920.80
X_2	1	99.33	21,862.52	93,938.81
X_3	1	125.10	18,947.88	32,182.20

Source: Field Survey, 2008

Table 5: Resource Utilization by Respondents

A. Land use by respondents	Number of respondents	Percentage
Farm size (Ha)		
Less than 1	2	1.82
1 – 2	8	7.27
2.1 – 3	8	7.27
3.1 – 4	13	11.82
4.1 – 5	11	10.00
Above 5	68	61.82
B. Type of Labour Available		
Family	43	39.09
Hired	16	14.55
Communal	2	1.82
Family and hired	42	38.18
Family and communal	7	6.36
C. Sources of Planting Materials		
*KWADP	66	60.00
**MANR	3	2.73
MANR/KWADP	29	26.36
Private Stock	1	0.91
Local Markets	11	10.00
D. Sources of Credit		
Personal Savings	89	54.94
Relatives/friends	1	0.62
Cooperative Society	65	40.12
Money Lenders	1	0.62
***NACRDB	6	3.70

Source: field survey, 2008

*Kwara State Agricultural Development Programme

** Ministry of Agriculture and Natural Resources

***Nigeria Agricultural Credit and Rural Development Bank