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Full Length Research Article

Resource use Efficiency in Sweet Potato Production in Odeda Local Government Area, Ogun State, Nigeria

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ABSTRACT: This study estimated the resource use efficiency in sweet potato production in Odeda Local Government Area, Ogun State. The study was based on primary data collected from 82 sweet potato farmers through multistage sampling procedure; analyzed using descriptive statistics and multiple regression analysis. The result reveal that 90.2% male, with 21.7 years of sweet potato farming experience, 87.8% were married, 64.6% have a household size of 8 persons on average, 81.7% have no formal education, 96.4% acquired land through leasehold. Only 13.4% are members of farmers' cooperative society. Multiple regression analysis show that the quantity of fertilizer used and the age of farmers were significantly related to quantity of output produced at ($p<0.01$) and ($p<0.1$) respectively. The coefficient of elasticity of Cobb Douglas function was 0.91. The efficiency estimates reveal that fertilizer was over utilized and should be reduced to ensure optimum production while vines, labour and farm size were sparingly used and these should be increased to ensure optimum production. Conclusively, sweet potato farmers in the study area were technically inefficient. It is recommended that farmers should utilize inputs, most especially fertilizer at optimum rate to bring about an increase in quantity of sweet potato produced.

Keywords: Sweet potato, Farmers, Resource use efficiency, Production, Utilization

INTRODUCTION

Sweet Potato (*Ipomea batatas L*), belongs to the family of *Convolvulaceae* and it is originated from South America where it was introduced to Europe between 1565 and 1573AD (Adekoya *et al*, 2010). It is one of the world's most important food crops due to its high yield and nutritive value (Raemaekers, 2001). It is a short duration (3 - 4 months) crop that could be cultivated more than once in the year (Nwauzor *et al*, 2005; Adekoya *et al,* 2010). It is extensively cultivated in the tropical zones (e.g. North-central and Southwest) in Nigeria. The crop requires low inputs, less management and does well on marginal soils, thereby giving a reasonable yield than most other root crops (Raemaekers, 2001). However, according to FAO, (2008) and Adekoya *et al.,* (2010), Nigeria is the largest producer of sweet potato in Africa.

The importance of sweet potato is increasing in Nigeria's farming and food systems because its production has recorded good profit margin and is suitable for income generation. It has the potential for food security as well as serving as a cash crop (Adekoya *et al,* 2010). It has edible tubers which can be eaten boiled, fried, or baked. The tubers can be consumed by man, the leaves and stems can provide important fodder sources for domesticated animals. Spent fields of sweet potato have been widely noted as supplementary pig forage (Yen, 1991). The leaves are also consumed as vegetables because its leaf contains (on dry matter basis) about 8% starch, 4% sugar, 27% protein and 10% ash (Adekoya *et al,* 2010). The leaves are much richer (than the root) in protein, minerals and vitamins and therefore are more nutritious (Adewunmi and Adebayo, 2008).

Sweet potato has also been used in Africa to fight vitamin A deficiency that result in blindness and even death of about 25,000 - 500,000 African children per year (CIP, 2009). The leaves contain vitamin A with sufficient quantities of *beta-carotene***.** Vitamin A deficiency is a particular problem with children under five and for pregnant and lactating women.

In view of the above points, any boost in (market) supply of sweet potato through improved production as well as consequent utilization in Nigeria because of its potentials will not only assist in achieving Nigerians' household food security but also health security from proper nutrition (Odebode *et al*, 2008).

Improved varieties were developed by National Root Crops Research Institute (NRCRI) Umudike; and International Institute for Tropical Agriculture (IITA),

Ibadan. In spite of these improved varieties that were developed with desirable traits such as high yielding potential, most rural farmers in Nigeria are conservative and still cultivate the local varieties (Woolfe, 1992; Ogbonna *et al,* 2009).

Resources can be organised into a farm-firm or producing unit whose ultimate objectives may be profit maximization, output maximization, cost minimization or utility maximization or a combination of the four. In production process, the manager, entrepreneur or the firm as the case may be is concerned with efficiency in the use of inputs to achieve his aim i.e. the technological versus economic efficiency. Economic efficiency occurs when the cost of producing a given output is as low as possible. The theory of production presents the theoretical and empirical framework that facilitates a proper selection among alternatives so that anyone or a combination of the farmer's objectives can be attained.

Agricultural productivity is the measure of efficiency with which an agricultural production system employs land, labour, capital and other resources. Efficiency can be considered in terms of the optimal combination of inputs to achieve a given level of output (an input orientation) or the optimal output that could be produced given a set of inputs (an output orientation). Production function analysis as a tool is used to estimate efficiency of resources used in crop production systems and determine the optimal resource use in resource allocation. According to Farrell (1957), the elasticity of production which is the percentage change in output as a ratio of percentage change in input is used to calculate the rate of return to scale which is a measure of a firm's success in producing maximum output from a set of inputs. The elasticity of various inputs can be determined by: E_p = MPP/APP; where: MPP = marginal physical product; APP = average physical product (Output/Input). Farrell specified two types of efficiency: technical efficiency and allocative efficiency. He defined technical efficiency as the ability to extract the maximum output from a given level of input that is, the ability to produce a given level of output with a minimum quantity of inputs under certain technology. Allocative efficiency refers to the ability to choose optimum input levels for given factor prices. It is the farmers' ability to achieve the optimal mix, having the right and efficient combination of inputs that gives optimal output (Farrell, 1957).

Technical efficiency for a firm that operates below the frontier output i.e. technically inefficient firm, may be improved or achieved in three ways: (1) improved production techniques, (2) improvement in production technology and (3) improvement in both. The measurement of firm specific technical efficiency is based upon deviations of observed output from the best production or efficient production frontier. If a firm's actual production point lies on the frontier, then it is perfectly efficient; if it lies below the frontier, then it is technically inefficient with the ratio of the actual to potential production defining the level of technical efficiency of the individual firm (Greene, 1993; Idiong, 2007). Technically efficient is just one component of overall economic efficiency. However, in order to be economically efficient, a firm must first be technically efficient. Thus, the economic or total efficiency of a firm is the product of technical and allocative efficiencies. An economically efficient input-output combination would be on both the frontier function and the expansion path.
Sweet potato is facing a lot of production and post-harvest challenges (Odedode *et al*., 2008). For instance, sweet potato weevil (*Cylas spp*) often affects crops planted between October and December especially during the dry season. Grasshoppers and rats are also common pests that attack sweet potato when it is planted late leading to a reduction in the profit margin if proper care is not taken (Ojeniyi *et al*., 2003). Transportation is demanding because of its bulkiness leading to high cost of transportation and labour used in transportation. Most of the farmers employ labour at exorbitant rate even in the rural areas simply because the few labourers that are available are expensive to hire (Ojeniyi *et al*, 2003). Sweet potato farmers are also faced with the problems of allocating the available resources and the efficient use of these resources which can lead to under-utilization or over-utilization of inputs or resources if they are not efficiently used. These factors and others can reduce efficiency. It is not clear who current producers of sweet potato are; what factors influence sweet potato production; or what the resource use efficiency of sweet potato production is in the study area.

Therefore, this study determined the resource use efficiency of sweet potato farmers and factors affecting its production in order to address food production problem in Ogun State, Nigeria. The objectives were to: describe the socio-economic characteristics of sweet potato farmers in the study area; determine the factors influencing sweet potato production; and estimate the

resource use efficiency of sweet potato production in the study area.

METHODOLOGY

Study Area

This study was carried out in Odeda Local Government Area (LGA) of Ogun State in the western part of Nigeria. Odeda is one of the twenty LGAs in Ogun State. Its headquarter is at Odeda town located along Abeokuta-Ibadan high way; about 20 kilometres from the State capital (Abeokuta). The LGA lies within latitude 7°13" North and longitude of 3°31" East with a land mass of 1,560km^2 (or land area of 126,341ha) and a population of 109,449 people (NBS, 2009). It shares boundary with Ido LGA of Oyo State and Abeokuta-South LGA in Ogun State and has an average temperature of 30^{0}C but humidity could be as high as 95% and the raining season is from April to October while the dry season is between November and March (OGADEP, 2010).

The dominant tribal group in the area is the Yoruba with some Hausas and Igbo traders. In the LGA, there are 25 semi-urban settlements and 860 villages and hamlets (OGADEP, 2010). Some of the arable crops grown in the area are yam, sweet potato, maize, cassava, vegetables, and cowpea while cocoa is the major cash crop and the major livestock include goats, pigs, poultry, sheep and cattle (NBS, 2009).

Sampling Techniques and Procedure

A multistage sampling technique was used to select eighty-two (82) sweet potato farmers in the study area. The first stage involved the purposive selection of Abeokuta agricultural zone due to the extensive cultivation of arable crops particularly sweet potato and the presence of numerous farm settlements in the zone according to Ogun State Agricultural Development Programme (OGADEP). The second stage also involved the purposive selection of Orile-Ilugun out of the six blocks under this zone because this block is known for sweet potato production according to OGADEP. The third stage involved the selection of three cells (Orile-Ilugun, Kila and Osiele) out of the eight cells under this block which was also selected purposively because these three cells have the largest number of sweet potato farmers according to OGADEP. The fourth stage involved a simple random sampling of 90 sweet potato farmers from 150 members of farmers' organizations in the selected cells who were then interviewed with the aid of the pre-tested questionnaire. However, data from 82 sweet potato farmers were analysed while 8 others were discarded for incompleteness and non-response from the selected farmers. This represents 60% of the total data sampled.

Method of Data Collection

Primary data were used for the study. These were obtained through administration of questionnaire to sweet potato farmers in the study area. The questionnaire contained pertinent questions that border on production, farming practices, outputs and inputs as well as some socio-economic characteristics of the sweet potato producers.

Analytical Techniques

The following analytical tools were employed in the analysis.

(i) ***Descriptive statistics:*** the use of frequency distributions, percentages and mean distributions were adopted to describe the socio-economic characteristics of sweet potato farmers.

(ii) ***Multiple Regression Analysis:*** this was used to determine the factors influencing sweet potato production in the study area.

The implicit form of the multiple regression model is

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, \mu) \quad \text{(i)}$$

where:

Y = Sweet potato output (kg)
X_1 = Age of the respondents (years)
X_2 = Gender of the respondents (male = 1 and female = 2)
X_3 = Farm size (hectares)
X_4 = Labour (man day)
X_5 = Quantity of planting materials (strands)
X_6 = Quantity of fertilizer used (kg)
μ = Error term

The explicit form of the multiple regression model is:

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + \mu \quad \text{(ii)}$$

where:

b_0 = Constant
$b_1, b_2, b_3, b_4, b_5, b_6$ = Regression Coefficients
X's are as specified above
μ = Error term

(iii) ***Resource Use Efficiency (r):*** this was used to estimate the resource use efficiency of sweet potato production in the study area. This was obtained from estimated equation(s) by comparing the marginal value

product (MVP) of a particular variable input with the marginal factor cost (MFC) of one unit of a particular resource input employed in production (Iheanacho *et al,* 2000). The marginal value product (MVP) of any resource is the product of the marginal physical product (MPP) and the unit price of output (P_y); while the marginal factor cost (MFC) is the opportunity cost of the input used i.e. the unit price of input (P_x) (Iheanacho *et al,* 2000). Efficiency of a resource use can be determined by the ratio of the marginal value product (MVP) to the marginal factor cost (MFC). This efficiency ratio (r) was used to estimate the relative efficiency of resource use.

Mathematically:

$r = MVP/MFC$……(iii)

$MVP = MPP*P_y$……(iv)

$MFC = P_x$……(v)

The marginal value product (MVP) for X_i is equal to coefficient of the variables multiplied by price of the output (P_y). Mathematically for:

Double log equation: $MVPx_i = P_y b_i y/x_i$……(vi)

$MPPx_i*P_y = P_y b_i y/x_i$……(vii)

$MPPx_i = b_i y/x_i$……(viii)

Exponential equation: $MVPx_i = P_y b_i y$…… (ix)

$MPPx_i*P_y = P_y b_i y$……(x)

$MPPx_i = b_i y$……(xi)

Quadratic equation: $MVPx_i = P_y (b_i - 2b_i x_i)$……(xii)

$MPPx_i*P_y = P_y (b_i - 2b_i x_i)$……(xiii)

$MPPx_i = b_i - 2b_i x_i$……(xiv)

where:

$xi = x_1$..... x_4,

y = geometric mean of Y

x = geometric mean of X_1..... X_4

bi = regression coefficients

RESULTS AND DISCUSSION

Socio-economic Characteristics of Sweet Potato Farmers

The study reveals that 36.5% of the sweet potato farmers were within the age range of 31 to 40 years (Table 1). This age range falls within active economic age group and the mean age of 35 years implies that majority of the sweet potato farmers were middle aged. Also, majority (90.2%) of the respondents were male while 9.8% were female. This implies that sweet potato production is male dominated in the study area and this may be because of the tedious activities involved in sweet potato production and also because majority of the women find attraction in combining home keeping with their farming activities. The study also revealed that majority (87.8%) of the respondents were married with a mean household size of 8 persons; since they believe that getting married and having children is an alternative source of labour to the usage of hired farmlands. This implied that more labour will be employed in sweet potato production.

The study also reveal that majority (54.9%) of the farmers had an average of about 22 years experience in sweet potato farming.

The farmers possess a substantial wealth of experience which could improve sweet potato production in the study area. Table 2 shows that 36.5% of the sweet potato farmers belonged to Idunu Farmers' group, while 59.8% do not belong to any farmers' group. This indicated that the respondents were not actively involved in cooperative societies in the study area. This may be due to high membership charges thus having implication on the revenue accruable to the farmers. Majority of the farmers (96.4%) acquired land through leasehold and 97.5% had their source of fund from own savings.

Production Estimates of Sweet Potato Cultivation in Odeda LGA

Table 3 presents the efficiency of the inputs used and the factors influencing sweet potato production in the study area. It shows that all the inputs were positively related to the output of sweet potato produced. The quantity of fertilizer was positive and significant at 1% ($p<0.01$). This implied that increase in the use of fertilizer will increase sweet potato output by 0.80kg. The age of farmers was also was positive and significantly affected the output of sweet potato produced at 10% ($p<0.1$) and this implied that increase in age of the farmers will increase sweet potato output by 0.079kg. The elasticity of production which is the sum of the coefficients of the Cobb-Douglas production function was 0.91, and this implied a decreasing return to scale; that is, the farmers were operating in the third stage of production. It is the characteristics of the stages when optimum efficiency of production or resources use is being approached, as well as the situation where there exists a misallocation of or over-utilization of inputs beyond the points of technical efficiency.

Resource Use Efficiency of Sweet Potato Production in the Study Area

Table 4 reveals that the partial elasticity (Ep) which is the summation of all the ratios of MPP values to APP

values was 0.81. This suggests that the farmers were producing in the third stage of production since the value of the partial elasticity (Ep) was less than one.

Table 1: Distribution of Sweet Potato Farmers by Personal Characteristics

Characteristics	*Frequency*	*Percentage*	*Mean*
Age (years)			
≤ 20	3	3.7	
21- 30	19	23.2	
31- 40	30	36.5	
41- 50	19	23.2	
≥ 51	11	13.4	
Total	82	100.0	35.00
Gender			
Male	74	90.2	
Female	8	9.8	
Total	82	100.0	
Marital Status			
Single	10	12.2	
Married	72	87.8	
Total	82	100.0	
Household Size (No)			
≤ 4 persons	16	19.5	
5 - 8 persons	53	64.6	
9 - 12 persons	13	15.9	
Total	82	100.0	8.00
Level of Education			
No Formal Education	67	81.7	
Primary Education	10	12.2	
Secondary Education	2	2.4	
Technical Education	3	3.7	
Total	82	100.0	
Religion			
Christianity	51	62.2	
Islam	21	25.6	
Traditional	10	12.2	
Total	82	100.0	
Sweet Potato Farming Experience (Years)			
≤ 10	10	12.2	
11 – 19	27	32.9	
≥ 20	45	54.9	
Total	82	100.0	21.68
Secondary Occupation			
Yes	24	29.3	
No	58	70.7	
Total	82	100.0	

Source: Field Survey, 2013

Table 2: Distribution of Sweet Potato Farmers by Farm Related Variables

Characteristics	*Frequency*	*Percentage*
Farmers' Group		
Potatoes Farmers' Club	3	3.7
Agbeloba	19	23.2
Idunu Farmers	30	36.5
Potatoes Cooperative Society	19	23.2
Total	82	100.0
Land Acquisition		
Lease	79	96.4
Communal land	1	1.2
Purchase	2	2.4
Total	82	100.0
Source of Fund		
Own Savings	80	97.5
Cooperatives	2	2.5
Total	82	100.0

Source: Field Survey, 2013

Table 3: Production Function Estimation of Sweet Potato Farmers in Odeda LGA

Variables	*Coefficient*	*Standard error*	*T-value*
Constant	1.242***	0.299	4.147
Age	0.079*	0.050	1.685
Gender	0.003	0.068	0.050
Farm size (Land)	0.005	0.019	0.275
Labour	0.007	0.013	0.578
Vines	0.018	0.026	0.685
Fertilizer	0.803***	0.044	18.131
R^2	0.873	-	-
$\bar{R}^2$	0.860	-	-
F-value	67.385***	-	-

NB: ****Significant at 1 percent, *Significant at 10 percent*
Source: Computed from Field Survey.

Table 4: The Average Unit and Average Price of the coefficient

Inputs	*Average Inputs*	*Unit Price (NGN)*	*(US$)*	*MPP*	*APP*	*Partial MPP/APP*	*Elasticity*
Farm Land	0.2 hectare	6,700.00	43.23	10.40	2,080.00	0.005	
Labour	6 man days	700.00	6.45	0.48	69.33	0.007	
Vines	300 strands	5.00	0.03	0.02	1.39	0.014	
Fertilizer	655kg	5,000.00	32.36	0.50	0.64	0.781	
Output	*416kg*	*1,500.00*	*9.68*	-	-	-	

*₦ = Naira, Nigerian currency; $ = Dollar, US currency; US$1 = NG₦155.
Source: Field Survey, 2013

CONCLUSION AND RECOMMENDATION

The study reveals that sweet potato farming is a profitable agricultural business in the study area whose output was significantly dependent on fertilizer used. The resource use efficiency ratio shows that farmers over-utilize fertilizer during the production of sweet potato and that farmers were technically inefficient in the use of the resource (fertilizer). The study recommends that policies should be devised and implemented by the Government (Ogun State) to encourage the farmers to utilize fertilizer at an optimum rate since the quantity of fertilizer used brought about an increase in the sweet potato produced and training in their cultivation could improve sweet potato production efficiency.

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