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Full-Length Research Paper

Analysis of Resource Use Efficiency Requirement of Plantain Farmers in Bayelsa State for Sustained Food Production

Wilcox, G. I.

Department of Agricultural Science, Ignatius Ajuru University of Education Port Harcourt, Rivers State, Nigeria.
Author email: willygcox68@gmail.com

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ABSTRACT: This study looked at the resource efficiency of plantain (Musa spp.) farmers in Bayelsa State, Nigeria. The study described the socio-economic characteristics of plantain farmers in detail, estimated the farmers' resource use efficiency, and calculated the returns to scale of plantain production. Two hundred (200) plantain farmers were chosen using multistage, purposive, and random sampling techniques. A structured questionnaire administered via personal interview was used to collect primary data. Descriptive statistics, the Cobb-Douglas production function, and the ratio of marginal value product of the inputs to their marginal factor costs were used to determine production elasticity and returns to scale. Resource utilisation efficiency was calculated from the marginal value product of the inputs' marginal factor costs. According to the study's findings, the majority (71.5%) of plantain farmers were females, 79% had some level of formal education, and 57.5% were between the ages of 14 and 37. The allocative efficiency result indicated farmers' inability to efficiently use and allocate plantain suckers, labour, and chemical inputs used in the enterprise, resulting in a decreasing return to scale.

Keywords: Resource, efficiency, plantain, sustainable, production, Bayelsa State

INTRODUCTION

The efficiency of farmers is key to realising sustainable food production as it reflects their ability to efficiently utilise the available scarce input resources for production to maximise their output and profit. This could also lead to further expansion of their enterprise, resulting in increased production and profit on a sustainable basis. Technical and Allocative efficiencies are two concepts used to estimate farmers' efficiency. While the technical concept considers the physical aspect of input used and physical outcome, the allocative idea views the monetary value (cost and profit). Technical efficiency here is the method that utilises the least quantity of resources for a given output, and it is the effectiveness with which farmers use a given set of inputs as producers to produce outputs. According to Sickles and Zelenyuk (2019), it is based on a firm's (farmer) ability to produce the highest number of units of a good while using the least number of resources possible. Allocative efficiency refers to a situation where the available resources are used to produce the greatest or optimal level of benefit. The additional cost of a product or service equals the additional benefit (Markovits, 2008). Allocative efficiency shows the ability of a farmer to use the production factors in optimal proportion given the respective prices of those production factors employed in the process of production and the production technology employed (Chirwa, 2007).

Staple food item such as plantain is major in Bayelsa State, South-South Nigeria. It is cultivated majorly by smallholder subsistence farmers characterised by smallholdings, using crude tools, and without the requisite funds to expand their enterprise even if they have the intention. Plantain is used to prepare a special dish called *kekefiya* in the language of the natives in the study area. Apart from this unique dish, it is also processed in the form of chips, and it is ground into powdered form to elongate its shelve life, thus adding value, eaten with palm oil after being boiled or even pounded and eaten with soup (especially for diabetic patients). Apart from the food aspect, plantain as an economic plant employs numerous smallholder farmers. Marketers in the State engaged in its cultivation and the sale of its different products, thus providing taxable income from the farmers and marketers and internally generating revenue for the State government through taxation.

Plantain is grown on any available space in the backyard of homes in small quantities, in small farms, and commercial quantities by a few commercial farmers. Plantain production in Bayelsa may be high, but, in comparison to its demand, it cannot meet market demand due to its demand for its varied use. Sustainable production would be vital to surmounting the gap. Sustainable production depends on the farmer's efficiency in utilising his scarce input factors and the ability to manage cost to maximise profit. As a primary source of carbohydrate for many people, studies, and findings of Akinyemi et al. (2010), showed that the crop ranked third among starchy staples after cassava (*Manihot esculent*) and yam (*Dioscorea* spp.) as it occupies a strategic place in the food basket of the nation, and is a perennial crop with a short gestation period. Although, there is no current statistical record to corroborate if this position still holds. Presently, there is no record on the production level from the State (Bayelsa), where this study was conducted to get the actual records. Without these records, it is not easy to know the output quantity is produced. This has been a significant challenge in the quest for sustainable food production among the smallholder farmers in Bayelsa. Furthermore, the farmers are inefficient in using resources for productive purposes. It is on this basis that this study was carried out to investigate the technical and allocative efficiency requirement of plantain farmers in Bayelsa State for sustainable food production with the specific objectives of describing the socio-economic characteristics of the plantain farmers, determining the technical efficiency and allocative efficiencies of the plantain farmers, ascertaining the determinants of efficiencies of the plantain farmers.

METHODOLOGY

Area of the study

The study was carried out in Bayelsa State, Nigeria, located within Latitude 04° 15, North, 05° 23 South and Longitude 04° 15 West and 06° 45, East. The State shares boundaries with Delta State on the North, Rivers State on the East, and the Atlantic Ocean on the west and south. Bayelsa State is a tropical rainforest zone with more than three-quarters of the area covered by water with moderately low land stretching from Ekeremore to Nembe. This area lies almost entirely below seas level with a maze of meandering creeks and mangrove swamps. It covers 21100 square kilometers with capital at Yenagoa with an estimated population of 2,2571,179 people (NPC, 2006). The climate is humid, with an annual rainfall of about 2400mm with a temperature of 27°C (Oyegun, 1999). The major occupations in the State are fishing, farming, palm oil milling, lumbering, palm wine tapping, local gin making, trading, carving and weaving (Edoumiekumo et al., 2014). It is one of the significant plantain growing States in the south-south, having some of its parts of the markets and market days concentrating on crop sales exclusively (Kainga et al., 2014). Plantain is the meal for an average Bayelsan and is used in other delicacies (Philip, 2016). Plantain pepper soup and *kekefia* (KKF) are primarily used on some occasions in the State.

Sample size and sampling techniques

A structured questionnaire was used to draw the sample size of two hundred (200) smallholder plantain farmers from the study population made up of all plantain farmers (male and female) in Yenagoa and Sagbama Local Government Area in Bayelsa State, Nigeria. Multistage sampling techniques were used to get the sampled farmers. The first stage involved a purposive selection of two local government areas from the two agricultural zone in the State. The selected local government areas are Yenagoa and Sagbama because they produce plantain in large quantities. At the second stage, two communities were randomly selected from each of the two Local Government Areas, making four communities. Finally, 50 plantain farmers were randomly selected from each of the four selected communities, making 200 respondents for the study. Information was collected on; (a) farmer's socio-economic characteristics such as age, household size, educational status, marital status, farming experience, contact with extension agents. (b) production information such as inputs and output in plantain production, farm size, and cost values.

Analytical technique

Objective (i), the socio-economic characteristics of plantain farmers was achieved using descriptive statistics such as mean, frequency distribution table, and percentages. Objective (ii), resource use efficiency of the plantain farmers and returns to scale (technical efficiency), was achieved using the Cobb-Douglas production function model and the ratio of marginal value product of the inputs to their marginal factor costs (allocative efficiency).

Model specification

A multiple regression model achieved the effects of production inputs on plantain production output. The model specification is specified as:

$Y = F(X_1 X_2 X_3, e)$

Where:

Y_1 = Total cost of production

X_1 = Cost of sucker (Naira)

X_2 = Cost of labour

X_3 = cost of organic manure (Naira)

e = stochastic error term

The regression was fitted for the plantain output using the linear, semi-logarithm and double logarithm. The lead equation from the three functional forms was chosen based on the value of multiple coefficients of determination (R^2) and the significance of the regression parameters. Resource use efficiency of plantain farmers was achieved by determining the marginal value product (MVP), plantain output, and the marginal factor cost of the inputs. The MVP of any resource is the product of marginal physical product (MPP) and the price of output (P_y) (Adegeye and Ditto, 1982). That is MVP = MPP_y x P_y. Depending on the functional form selected as a lead equation, MVP values were obtained as follows:

linear form MVP = $b_i p_y$

semi-log form MVP = $b_i p_i / x_i$

double-log MVP = $b_i Y p_i / x_i$

Resource use efficiency = MVP/MFC or MVP/P_y

Where:

b_i = regression coefficient of resources X_i

$\bar{Y}$ = mean output of plantain value

Xbar = mean value of resource

P_y = price of plantain output

Px_i = price of resource per unit = MFC

MFC = marginal factor per input

The MVP and MFC were calculated to know if the farmers were efficient, overused or underutilized the available resources. That is, O ≤ AE≤ I (Martin and Taylor, 2003); Ogundari and Ojo, 2006).

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

From the study, plantain production was female-dominated (Table 1); 71.5% were female farmers, while 28.5% were male farmers. Women had always been at the forefront of farming in Nigeria, dominating the sector to support the family income. This plays out in several communities, including Bayelsa, where this study was carried out. However, this is a variant of Olumba (2014) findings in Anambra State, where 67% were males and 33% were recorded. Most farmers had a formal education; 19% had primary, 45.5% had secondary, and 14.5% had tertiary education. This finding corroborates with the findings of Olumba, who recorded a high literacy level of the farmers, implying openness to innovations that can better utilize resources for output and profit maximization. The mean age of 36.38 years indicates the farmers in the study area are young and will be able to put in more energy to cultivate more area of land if they have the resources to do so. Farmers had a mean household size of 6 persons. This development implied the availability of family labour to realize plantain production potentials in the area at a reduced cost. Large household size was also recorded by Onu (2005), Olumba (2014), and Wilcox (2016). The majority (70.6%) of the farmers had 1-10 years of farming experience and a mean of 9.65years experience. It shows that majority of the farmers were inexperienced and could have many setbacks in plantain production in the area. The study further showed that the average farm size was 0.5 hectares cultivated by farmers during the farming season. It buttresses the reason for the low output of food generally in agriculture.

Elasticity of production

Estimated results of the Cobb-Douglas analysis for the elasticity of production is shown in (Table 2). The coefficient of the three input factors showed that they were all inelastic been less than one. The coefficient of beta for the sucker, labour and chemicals used for production were 0.27970, 0.05075 and 0.22857, respectively. The summation of all three is 0.55901. Less than one figure indicates that the farmers had decreasing returns to scale. Furthermore, the number of suckers used for production was significant with a t-value of 6.46, at the probability level of 5% (*$P \leq 0.05$*). Implies a 1% increase in the number of suckers planted will result in a 2.7% increase in the output of plantain.

Resource use efficiency of the plantain farmers

The efficiency of plantain production shown in (Table 3) indicates that the marginal physical product (MPP) of labour and chemical input was negative, except that of plantain suckers. The efficiency analysis of plantain suckers was more significant than one, indicating that

Table 1. Socio-economic characteristics of the plantain farmers.

Gender	**Frequency**	**Percentage**	**Mean**
Male	57	28.5	
Female	143	71.5	
Total	200	100.0	
Education			
No formal education	42	21.0	
Primary	38	19.0	
Secondary	91	45.5	
Tertiary	29	14.5	
Total	200	100.0	
Age			
14 - 26	51	26.2	
27 - 39	63	32.3	
40 - 52	63	32.3	
53 - 65	17	8.7	
66 - 78	1	.5	
Total	195	100.0	36.38
missing	5		
Total	200		
Farming Experience			
0.5 – 10.5	139	70.6	
10.6 – 20.5	43	21.8	
20.6 – 30.5	10	5.1	
30.6 – 40.5	5	2.5	
Total	197	100.0	9.65
missing	3		
Total	200		
Household size			
1 – 5	85	42.7	
6 - 10	96	48.2	
11 - 15	18	9.0	
Total	199	100.0	6.49
missing	1		
Total	200		
Plot size			
0.046 – 0.929	176	88.0	
0.930 – 1.394	14	7.0	
1.395 – 2.787	10	5.0	
Total	200	100.0	0.54

Source: Field Survey, 2020

plantain suckers were underutilized and inefficiently allocated by the farmers. The efficiency analysis of labour and chemical used was less than one, indicating that farmers over-utilized labour and chemical in plantain production (that is, both factors were inefficiently allocated). The result indicates that the farmers in the study area had yet to achieve an absolute degree of allocative efficiency in using plantain suckers, labour and

Table 2. Estimated Cobb-Douglas production function and determinants of technical efficiency of the plantain farmers in Bayelsa.

Variable	Coefficients	Standard Error	t-Stat
Constant	7.27130	1.59	4.59
Sucker (number)	0.27970	0.04	6.46**
Labour (Man-days)	0.05075	0.07	0.77
Chemical (liter)	0.22857	0.20	1.15*
R Square	0.22		
Adjusted R Square	0.20		
F-Statistics	17.90**		

Source: Field Survey, 2020 **significant at p ≤ 0.05, *significant at p ≤ 10.

Table 3: Estimated (resource) allocative efficiency of plantain production in Bayelsa.

Input	MPP	PPO	MVP	PPI	Efficiency	Decision
Cost of sucker	1.132	147.09	166.51	43.347	3.84> 1	underutilized
Cost of chemical	0.002	147.09	0.29	266.417	0.01< 1	over utilized
Labour cost	-0.004	147.09	-0.59	564.447	-0.01< 1	over utilized

Source: Field survey, 2020, MPP = marginal physical product, PPO = price per unit output, MVP = Marginal value product, PPI = price per unit input

chemical production factors. Therefore, to attain efficiency, the farmers should increase the number of suckers planted while reducing the quantity of labour and chemical employed to maximise output and profit. Furthermore, when the MVP of these farm inputs compared to their respective MFCs, the MVP of plantain suckers was higher than the corresponding MFCs, while the MVP of chemical and labour was less than their corresponding MFCs. This result implies that plantain suckers were efficiently managed, while chemical and labour were inefficiently utilised. The result further indicates that any unit increase in the use of suckers would lead to increase in total output and revenue by 1.132 and ₦166.51, but total revenue would be reduced by 0.29 if there is any unit increase of chemical. Moreso, any unit increase in labour would reduce total revenue by 0.59, respectively, and chemical and labour were over-utilised. Therefore, any unit increase in labour and chemical will not increase the total output of plantain, and this means a high cost of labour associated with plantain production in the study area. This result agrees with the finding of Fakayode et al. (2011) and Kainga et al. (2014), which posited that labour and plantain suckers were under-utilized in plantain production among smallholder farmers in Rivers and the Bayelsa States.

Conclusion and Recommendation

Farmers were inefficient in using and allocating plantain suckers, labour, and chemicals. By lowering the cost of suckers, labour, and chemicals, technical and allocative efficiency for sustainable plantain production can be improved. Furthermore, the efficient use of suckers should be increased, and more family labour should be used to reduce labour costs in the production processes. Based on the allocative efficiency result, farmers should reduce the quantity of labour and chemicals used to reduce production costs and maximise profit.

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