Indian Journal of Applied Economics and Business
Vol. 2, No. 1, 2020, pp. 49-58

ARF INDIA
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Allocative Efficiency of Scare Farm Production Resources Among Smallholder Sugarcane Farmers in Kwara State, Nigeria

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Received: 10 January 2020; Revised: 11 February 2020; Accepted: 3 March 2020; Publication: 16 April 2020

Abstract: *The study determined the utilization efficiency of farm productive inputs used in sugarcane production among smallholder farmers in Kwara State of Nigeria. Farm survey data of 2017 cropping season elicited from 105 farmers* viz. *structured questionnaire complemented with interview schedule were used. The sample size was drawn through multi-stage sampling techniques and the collected data were analyzed using multiple regression model estimated by ordinary least square (OLS) technique. From the results, it was observed that poor capital base caused the insufficiency in the application of agrochemicals by the farmers in the production of sugarcane in the studied area. However, there was excess use of hired labour due to the cheap mammoth available labour force in the studied area, thus affecting sugarcane production. Generally, the farmers were inefficient in the use of farm resources in the production of sugarcane as they operate in the irrational surface (stage I) with most of the important farm inputs (sucker and farm size) been under-utilized. Therefore, the study recommends that the farmers should increase the use of the aforementioned important inputs and are advised to pool their social capitals in order to take advantage of pecuniary economies, thus exploring the potentials in sugarcane production in the studied area. In addition, credit facilities and extension service delivery should be enhanced, thus increasing sugarcane production and doubling farmers' income for sustainable and enhanced farm family livelihood in the studied area.*

Keywords: *Farm inputs; Allocative efficiency; Sugarcane; Farmers; Small-scale; Nigeria*

INTRODUCTION

Literature has shown a continuous decline in the yield of small-scale sugarcane producers owing to capital paucity which affects their scale of production. In addition, pressure on available arable land *viz.* continuous fragmentation of land due to inheritance, land tenure problems, increase in urbanization as a result of population explosion, farmers-herders and communal clashes are seriously affecting agricultural production in the study area. This competing demand for land has made it a shrinking resource in the study area.

Despite that Nigeria is having firm footage on sugarcane production; the country is facing a formidable challenge to provide her burgeoning population with the needed sugar quantity. This population explosion is exerting more pressure on sugar food security of Nigeria as the country has to shore-up its domestic supply with import which gulps millions of dollars, thus draining the national income of the country. Furthermore, the opening of the agricultural sector for exports has aggravated the problem and has increased the pressure on the Nigerian farmers to produce more. Hence, a further increase in agricultural production has to be achieved by increasing the productivity of the land. Productivity can be increased through one or a combination of its determinants-the technology, the quantities and types of resources used and the efficiency with which the resources are used.

Researchers and policymakers alike have widely recognized the crucial role of allocative efficiency in increasing agricultural output. Bravo-ureta and Evenson (1994) as cited by Samarpitha *et al.*(2016) posited that if farmers are not making efficient use of the existing technology, the efforts designed to improve allocative efficiency would be cost-effective than introducing new technologies as a means of increasing agricultural output. Thus, embarking on new technologies would be meaningless unless the potential of the existing technologies at the disposal of the farmers are harnessed fully (Kalirajan *et al.*, 1996 as cited by Samarpitha *et al.*, 2016).

Of the various determinants, improvement in the allocative efficiency of the resources already at the disposal of the farmers is of great concern as it offers more immediate goals at modest costs if there are substantial inefficiencies present in agricultural production (Goyal *et al.*, 2006). An estimate on the extent of allocative efficiency will help in providing a guide on whether to enhance allocative efficiency or to develop new technologies to raise sugarcane production in the study area in particular and the country in general. In addition, for sufficiency in sugarcane production to be achieved and sustained there is need to overhaul the decision of the smallholder farmers who account for the bulk of sugarcane production in the study area with respect to the allocation of scarce farm resources available at their disposal using the prevailing technology. Therefore, considerable efforts need to be put forth in the analysis of farm-level allocative efficiency of sugarcane production in the study area in particular and Nigeria in general.

RESEARCH METHODOLOGY

Kwara State of Nigeria lies between longitudes 4^0 20′ and 4^0 25′ East of the Greenwich meridian and latitudes 8^0 30′ and 8^0 50′ North of the equator.

The population of the state is approximately 2.3 million and has a landmass of approximately 36,825 square kilometres with varying physical features like hills, lowland, rivers etc. Its vegetation is a derived savannah with two distinct wet and dry seasons, with mean annual precipitation and monthly temperature of 1000-1500mm and 25^0C-34^0C, respectively (Anonymous, 2010). The major occupation of the inhabitants is agricultural activities complemented by trade, artisanal, *Ayurvedic* medicine etc. The present research used undated data elicited through structured questionnaire complemented with interview schedule from 105 active sugarcane farmers during the 2017 production selected *via* multi-stage sampling design. In the first stage, one agricultural zone, namely zone B was purposively selected due to its comparative advantage in the production of sugarcane. In the second stage, the two LGAs *viz.* Edu and Patigi which made-up the selected agricultural zone were automatically selected as both have the comparative advantage in the production of sugarcane. Because of the limited number of villages producing sugarcane in the selected LGAs all the villages were considered. Therefore, a total of seven villages: five (5) villages from Edu LGA and two (2) from Patigi LGA were the areas of coverage. In the last stage, fifteen sugarcane farmers from each of the selected villages were randomly selected: seventy-five (75) and Thirty (30) active farmers from Edu and Patigi LGAs respectively. Therefore, a total of 105 active farmers formed the sample size for the study.

For reliability test of the questionnaire, the questionnaire was pre-tested in a pilot survey made up of 15 farmers from the sampling population and the estimated Cronbach Alpha value was 0.86, indicating high reliability and consistency of the questionnaire. With the aid of trained enumerators, ex-post data of 2017 sugarcane cropping season were collected in the year 2018. The collected data were analyzed using multiple regression model estimated by OLS technique.

Model Specification

The multiple regression model is presented below:

Implicit form

$$Y = f(X_1, X_2, X_3, X_4 \ldots \ldots .., X_n) \quad (2)$$

Explicit form

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots \ldots . + \beta_n X_n + \varepsilon_i \quad (3)$$

Where;

Y = Sugarcane output (kg)

X_1 = Sucker (kg)
X_2 = NPK fertilizer (kg)
X_3 = Urea fertilizer (kg)
X_4 = Herbicides (ltr)
X_5 = Family labour (manday)
X_6 = Hired labour (manday)
X_7 = Depreciation on capital items (₦)
X_8 = Farm size (ha)
β_0 = Intercept
β_{1-8} = Regression coefficients
ε_t = Stochastic

The functional forms fitted into the specified equation are as follow:

(a) Linear function

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots\dots\dots\dots\dots + \beta_n X_n + \varepsilon_t \qquad (4)$$

MPP = β

Elasticity = $\beta * \bar{X} / \bar{Y}$

(b) Semi–log function

$$Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 \dots\dots\dots\dots + \beta_n \log X_n + \varepsilon_t \qquad (5)$$

MPP = $\beta / \bar{X}$

Elasticity = $\beta / \bar{Y}$

(c) The Cobb Douglas (double log) function

$$\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 \dots\dots\dots\dots\dots + \beta_n \log X_n + \varepsilon_t \qquad (6)$$

MPP = $\beta * \bar{Y} / \bar{X}$

Elasticity = β

(d) Exponential function

$$\log Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots\ \dots\dots\dots\dots + \beta_n X_n + \varepsilon_t \qquad (7)$$

MPP = $\beta * \bar{Y}$

Elasticity = $\beta * \bar{X}$

Determining technical efficiency of resource use

The elasticity of production was used to estimate the rate of return to scale which is a measure of a firm's success in producing maximum output from a set of variable inputs.

$$EP = MPP/APP \tag{8}$$

Where:

EP = elasticity of production

MPP = marginal physical product

APP = average physical product

If

EP =1: constant return to scale

EP < 1: decreasing return to scale

EP > 1: increasing return to scale

Determining the allocative efficiency of resource-use

The following ratio was used to estimate the relative efficiency of resource use (r):

$$AEI = MVP/MFC \tag{9}$$

Where:

MFC or P_x = Unit cost of a particular resource

MVP = value added to sugarcane output due to the use of an additional unit of input is calculated by multiplying the MPP by the unit price of output i.e. $MPP_{xi} * P_y$

Rule of Thumb

If $r = 1$, resource is efficiently utilized

If $r > 1$, resource is underutilized

If $r < 1$, resource is over-utilized

Economic optimum takes place where $MVP = MFC$. If AEI is not equal to *1*, it suggests that resources are not efficiently utilized. Adjustments could, therefore, be made in the quantity of inputs used and costs in the production process to restore $r = 1$ and the model is given as follows:

$$Divergence\ percentage\ (D\%) = (1 - 1/r_i) \times 100\ or \left[\frac{(r_i - 1)}{r_i}\right] \times 100 \tag{10}$$

RESULTS AND DISCUSSION

Of the four functional forms fitted into the specified equation and estimated using the ordinary least square (OLS) technique, the double-logarithm was found to be the best fit as it satisfied the economic theory criterion (size and signs of the parameter estimates), the statistic criterion (standard error and coefficient of multiple determination) and the econometric criterion (OLS assumptions). Furthermore, the diagnostic test results *viz.* homoscadesticity and multicollinearity showed no evidence of heteroscedasticity and collinear relation between two or more pairs of explanatory variables as indicated by the non-significant of the Bruesch-Pegan test at 10% degree freedom and the predictor variables variance inflation factors (VIF) of the estimated coefficients which were lower than the benchmark VIF value of 10.0, respectively. The residual term was found not to be normally skewed as evident by the significance of Chi^2 test statistic at 10% degree. However, non-normality of the residual term is not considered a serious problem as data in their natural form in most cases are not normally distributed. The significance of the F-statistics at less than 10% degree of freedom showed that the inputs from the population point of view influenced the output of sugarcane in the studied area (Table 1).

The coefficient of multiple determination been 0.9187 implies that 91.87% of the variation in the output was explained by the explanatory factors included in the model while the remaining percentage is accounted for by the stochastic disturbance term which represents those variables that were omitted either due to ignorance, uncertainty, non-availability of some variables in statistical form, joint influence etc. The variables which exhibited influence on the output of sugarcane in the study area were the sucker, family labour, hired labour and farm size as indicated by the significance of their respective estimated coefficients at less than 10% degree of freedom. Furthermore, it was observed that all the significant coefficients had a direct relationship with sugarcane output except hired labour which exhibited an inverse relationship.

The positive significance of the sucker coefficient implies that the farmers used improved variety and also understand the technical recommendations made by the extension agents in the studied area. The marginal (technical productivity) and elasticity implications of an additional 1kg increase in the use of sucker will lead to an increase in the sugarcane output by 5.64 kg and 0.101% respectively. The positive significance of the family labour which is contrary to *a prior* expectation owing to the fact that it is free of charge is an indication that only capable hands were deployed in the sugarcane production due to the tedious nature involved. Therefore, the marginal and elasticity implications of employing an additional 1 manday of family labour will lead to an increase in the output by 30.78 kg and 0.063% respectively.

The positive significance of the farm size coefficient indicates the presence of economies of size among the farmers in sugarcane production in the studied area. In addition, it can be inferred that the farmers were efficient in the management of the existing technologies at their disposal in sugarcane production. Therefore, the marginal and elasticity implications of an additional 1 hectare will increase the output by 4966.84kg and 0.84% respectively. However, the negative significance of the hired labour coefficient implies that it was used in excess owing mammoth available labour force which makes its reward/ cost to be cheap. Therefore, the marginal and elasticity implications of a unit increase of hired labour by 1 manday will lead to a decrease in the output of sugarcane by 29.07kg and 0.083% respectively.

The non-significance of the agrochemicals may be attributed to inadequate application owing to high costs associated with them. The negative sign associated with the urea fertilizer coefficient is an indication of farmers' poor understanding of the dosage recommended by the extension agents in the studied area. The non-significance of the depreciation on capital items coefficient may be associated with the use of primitive tools by the farmers in the production of sugarcane, thus making its' contribution to the output to be insignificant. The non-significance of these variables did not come as a surprise as these resource-poor farmers who lack economic capital failed to pool their social capital to harness the potentials in sugarcane production in the studied area.

Based on the technical contribution, it can be inferred that farm size and depreciation on capital items had the highest and lowest contributions to the sugarcane output in the studied area. The return to scale value of 1.047, implies that the farmers were operating at stage I (increasing return to scale) of the production surface which is an irrational region in the production process (Table 1). An increase in the inputs will lead to a more than proportional increase the output i.e. the production frontier is elastic. Therefore, the farmers are advised to increase the use of their inputs until they reach the economic region wherein optimization of input-output is achieve keeping in view the input costs and output price: minimization of input costs and maximization of profit.

The results of the allocative efficiency showed that the resources *viz.* sucker and farm size were under-utilized while human labour resource was over-utilized in the production of sugarcane. Therefore, for the farmers

Table 1
Production determinants of sugarcane output

Inputs	*Ordinary least square (OLS)*				*Col. Test*
	Linear	*Exponential*	*Semi-log*	*Double log*	*VIF (+)*
Constant	–2317.54(1531.21)	8.485(0.1152)	–6413.42(10299.4)	7.648(0.416)	-
	1.514^{NS}	73.60***	0.6227^{NS}	18.35***	
Sucker	–0.9703(3.723)	0.000599(0.00029)	–2184.20(1484.40)	0.101(0.060)	2.817
	0.260^{NS}	1.998**	1.471^{NS}	1.685*	
NPK	3.849(8.859)	0.00092(0.00062)	248.55(1235.48)	0.0628(0.0499)	1.674
	0.435^{NS}	1.467^{NS}	0.201^{NS}	1.257^{NS}	
Urea	19.609(14.518)	–7.18E-5(0.00089)	2142.30(1571.09)	"0.0030(0.00236)	1.241
	1.351^{NS}	0.080^{NS}	1.364^{NS}	1.50^{NS}	
Herbicides	114.39(150.96)	0.0069(0.0098)	142.77(762.23)	0.0035(0.00308)	2.053
	0.758^{NS}	0.709^{NS}	0.187^{NS}	1.129^{NS}	
Family labour	56.851(34.259)	0.00388(0.0023)	1883.20(1899.97)	0.0633(0.00769)	3.010
	1.659^{NS}	1.669*	0.991^{NS}	8.23^{NS}	
Hired labour	–2.8708(18.256)	0.00016(0.0016)	–1834.11(1204.19)	"0.0825(0.0487)	1.568
	0.157^{NS}	0.096^{NS}	1.523^{NS}	1.695*	
Depreciation on capital items	–0.0178(0.0279)	–2.58E-6(1.83E-6)	1105.91(719.87)	0.0441(0.0291)	3.085
	0.636^{NS}	1.407^{NS}	1.536^{NS}	1.517^{NS}	
Farm size	5301.30(312.49)	0.2367(0.0226)	17023.6(1323.26)	0.859(0.0535)	3.063
	16.96***	10.50***	12.86***	16.05***	
				1.047	
R^2	0.9122	0.8493	0.8529	0.9187	
Adjusted R^2	0.9048	0.8368	0.8407	0.9119	
F-stat	124.61***	55.96***	69.58***	135.62***	
Heteroskedasticity (B-G)	**34.60{ 3.15E-5}*** **	**8.68{ 0.369}^{NS}**	**21.06{ 0.0069}*** **	**11.122{ 0.20}^{NS}**	
Normality test	**11.38{0.0034}*** **	**4.815{ 0.089}* **	**7.816{ 0.020}** **	**20.05{4.41E-5}*** **	

Source: Field survey, 2018
Note: * ** *** ^{NS} significance at 1%, 5%, 10% and Non-significant respectively.
Values in ( ); [ ]; and { } are standard error, t-statistic and probability value, while Col. = Collinearity

Table 2
Technical and Allocative efficiencies of sugarcane farmers

Inputs	*Mean*	*APP*	*EP*	*MPP*	*MPV*	*MFC*	*AEI*	*D(%)*	*Decision*
Sucker	359.2381	55.79772	0.101	5.63557	56.3557	5	11.27114	91.12778	UU
NPK	114.8095	174.5906	0.063	10.99921	109.9921	160	0.687451	-45.465	OU
Urea	79.26933	252.8679	-0.003	0.758604	7.586036	180	0.042145	-2272.78	OU
Herbicides	3.225619	6214.208	0.0034	21.12831	211.2831	1500	0.140855	-609.948	OU
Family labour	41.02667	488.5765	0.063	30.78032	307.8032	1300	0.236772	-322.348	OU
Hired labour	57.22933	350.2516	-0.083	29.07088	290.7088	1300	0.223622	-347.183	OU
Depreciation	11272.67	1.778165	0.044	0.078239	0.782393	1.08	0.724438	-38.0381	OU
Farm size	3.466667	5782.115	0.859	4966.837	49668.37	5000	9.933674	89.93323	UU

Source: Field survey, 2018

Note: UU = Under-utilization; OU = Over-utilization

RTS = 1.047; Output = 20044.67; /kg = ₦10 to be allocative efficient in the production of sugarcane they need to increase the utilization of the sucker and farm size by 91.13% and 89.93% respectively; and decrease the utilization of the family and hired labours by 322.35% and 347.18% respectively. Though not significant, all the remaining variables were over-utilized in the production of sugarcane, thus the need to be reduced for the farmers to be profit efficient in the production of sugarcane in the studied area.

CONCLUSION AND RECOMMENDATIONS

It can be inferred that the farmers were not efficient in the use of the productive resources as they were operating at the irrational production region which is due to lack of economic capital and failure to pool their social capital to explore the potentials in sugarcane production in the studied area. Therefore, the study recommends that the farmers should utilize their social capital by forming social organizations so as to take advantage of the pecuniary economies which will help them to maximize profit in the production of sugarcane in the studied area. In addition, credit facilities and extension service delivery need to be enhanced in the studied, thus increasing sugarcane production in the studied area and doubling farmers' income for sustainable and enhanced farm family livelihood.

REFERENCE

Goyal, S.K., Suhag, K.S. and Pandey, U.K. (2006). An estimation of technical efficiency of paddy farmers in Haryana state of India. *Indian Journal of Agricultural Economics*, 61(1): 108-122.

Kalirajan, K.P., Obwona, M.B. and Zhao, S.(1996).A decomposition of total factor productivity growth: The case of Chinese agricultural growth before and after reforms. *American Journal of Agricultural Economics*, 78(2): 331-338.

Bravo-Ureta, B.E. and Evenson, R.E.(1994). Efficiency in agricultural production: the case of peasant farmers in Eastern Paraguay. *The Journal of the International Association of Agricultural Economics*, 10(1): 27-28.

Samarpitha, A., Vasudev, N. and Suhasini, K. (2016). Technical, economic and allocative efficiencies of rice farms in Nalgonda district of Telangana State. *Economic Affairs*, 6(3): 365-374.