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ALLOCATIVE EFFICIENCY AND PROFITABILITY OF MAIZE PRODUCTION INPUTS IN ORU EAST LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA

Ugwumba, C.O.A. and Omojola, J.T.
Department of Agricultural Economics and Extension
Anambra State University, Igbariam
E-mail: veecel326@yahoo.com

ABSTRACT

This study specifically investigated profitability, allocative efficiency and constraints to maize production in Oru East Local Government Area of Imo State, Nigeria. Simple random sampling technique was used to select 120 respondents. Well structured and pre-tested interview instruments were administered to the respondents to obtain data. Data were analyzed by means of descriptive statistics, budgetary method and power function model. Results revealed that the enterprise was profitable based on the positive values of net farm income (₦1,511,905) and net return on investment (0.86). Farm size, labour, fertilizer, capital and maize seeds had allocative efficiency values of 1.39, 0.0037,-0.000008, 0.0075 and 0.0018 respectively; implying that cost of labour, fertilizer, capital and maize seeds were over-utilized, while farm size was under-utilized. Production was most seriously constrained by inadequate extension services, lack of information on modern technologies and poor storage facilities. Maize farmers' problems would be ameliorated by proper implementation of the current Federal Government Extension Transformation Agenda (AETA) to make modern maize production techniques available, affordable and adoptable. This would improve efficiency of resource-use, enterprise profitability and sustainability.
Keywords: *Maize, Efficiency, Profitability, Return to scale, Imo State, Nigeria*

INTRODUCTION

Small scale farming has being a key feature of the agricultural sector in Nigeria. Available statistics show that over 12 million farmers located in different ecological zones of the country engage in the production of a wide variety of staple crops and this has been possible through using traditional subsistence agriculture (Oluwatayo *et al.,* 2008); which is characterized by the use of crude tools, traditional techniques and low capital investment, hence low productivity, output, soaring domestic food prices and rising food imports abound (Omojola, 2004; Effiong and Seboila, 2010). Therefore, effective economic development strategy will depend critically on promoting productivity and output in the agricultural sector, particularly by proper allocation of production inputs among small scale producers. Omojola *et al.* (2006) and Oluwatayo *et al.* (2008) noted that domestic production of food crop has not been able to meet the domestic demand for food. The reason for this is that there are some problems at the micro level, one of which is the relationship between inputs used in production such as seeds, land, labour and capital. Therefore, appreciable increase in yield could be obtained through the use of modern technologies in the production of crops. Maize *(Zea mays)* has been recognized widely as one of the most potential cereals produced. Due to high productivity and adaptability of maize, its cultivation has spread so rapidly around the globe (Anupama, 2005). Maize is one of the main staple crops consumed in Nigeria, and it is featured among the five crops (cassava, maize, wheat, rice and sugar cane) whose production is to be promoted for the attainment of food self-efficiency as revealed by the Federal Ministry of Agriculture and Water Resources (Sayaid, 2008). Food and Agriculture Organization (FAO), (2009) revealed that maize production ranks third after sorghum and millet among the cereal crops produced in Nigeria. Maize is a good source of carbohydrate, and has significant quantities of protein and oil, small amount of minerals, vitamins A, E and C as well as a number of essential amino acids. In addition to being a food crop, maize has equally become a commercial crop on which many agro-based industries depend as raw material. Maize alone contributes about 80% of poultry feed and this has a great implication for protein intake in Nigeria (FAO, 2008). Maize is therefore, considered a very vital food crop to the economic growth of the nation through its contribution to food security and poverty alleviation. Farmers in Oru East Local Government Area (LGA) produce and market maize fresh and dry to earn additional income for their households. However, continuous increase in price of the produce, attributable to dwindling supply, contrary to the ever increasing demand, has resulted in the widening of demand-supply gap. This situation is probably due to inefficient allocation of production inputs such as maize seeds, land, fertilizers, labour and capital. Also, problems may arise due to lack of modern maize production technologies, inadequate extension services, problems of diseases and pests, etc (Oluwatayo *et al.,* 2008; Nenna and Ugwumba, 2012). Farmers in the area have no option than to strive to maximize the use of available productive resources at their disposal to achieve optimal output. This study originated from this background with the specific aims of investigating profitability of the maize enterprise, the efficiency of resource-use in maize production, and problems being experienced by maize producers in the study area.

MATERIALS AND METHODS

Oru East Local Government Area (LGA) is one of the twenty seven LGAs of Imo State. It has an area of 136km^2 and a population of 111,822 people as at the 2006 census (National Population Commission (NPC), 2006). The LGA shares boundaries with Oru West LGA to the West and Mbaitolu LGA to the East of Imo State. It lies approximately within latitudes 4^0 45′ and $7^0$15′N and longitudes $6^0$50′ and $7^0$25′E. The climate of the area is tropical marked by two distinct seasons – the dry and rainy seasons. The average annual temperature of above 20^0C (68^0F) crates an annual relative humidity of 75% and reaching 90% mostly in the rainy season. The LGA is made up of six communities namely Akatta, Akuma, Amagu, Amiri, Awo-Omamma and Omuma. The area is mostly associated with rural dwellers and their main occupation is farming of tree crops like oil palm, cocoa and rubber; and staple crops such as yam, cassava, cocoyam, maize, vegetables, etc. The LGA was chosen for the study because of the preponderance of maize producers in the area. The study population comprised of maize farmers operating in the six communities in the area. A simple random sampling technique was used to select 20 maize farmers from each of the six communities to arrive at a total 120 respondents for the survey. Data were collected by the administration of well structured pre-tested interview instruments to the respondents. Data on constraints to production were collected through a 4-point Likert Scale method (very serious = 4, serious = 3, moderately serious = 2, and not serious = 1); which produced a critical mean of 2.5 (ie 4+3+2+1 =10/4 = 2.5). The net farm income analysis (budgetary method) was used to estimate the profitability of maize production, data on the allocative efficiency variables were analyzed using the relationship between Marginal Value Product (MVP) and Marginal Factor Cost (MPC), while mean ranking was used analyze data on constraints to production. The budgetary technique used in determining profitability of the enterprise is given as:

NFI = TR-TC (TVC+TFC)

Where:

NFI = Net farm income (profit)
TR = Total revenue
TVC = Total variable cost
TFC = Total fixed cost
TC = Total cost
NROI = Net return on investment

The power function was used to determine the marginal physical products of maize production inputs. The implicit form of the regression model is given as:

$$OTP = \beta(FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})$$

Where:

OTP = Output of maize in kilogrammes
FAS = Farm size farmed in hectares
LAB = Labour utilization in man-days
CAP = Capital as annual depreciation value of fixed inputs in naira (₦). The straight line method of depreciation was used in the computation.
SED = Quantity of maize seeds planted in kilogrammes
β = Intercept
δ_i = Function coefficients
e = Error term

The allocative efficiency of maize production input was subsequently determined using the formula: $AE_{x_i} = \frac{MPP_{x_i} * P_{otp}}{P_{x_i}} = \frac{MVP_{x_i}}{MFC_{x_i}}$

Where:

AE_{xi} = Allocative efficiency index of i^{th} input
MPP_{xi} = Marginal physical product of i^{th} input
P_{otp} = Per unit price of output
P_{xi} = Per unit price of i^{th} input
MVP_{xi} = Value of marginal product of i^{th} input (product of marginal physical product of i^{th} input and unit price of output)
MFC_{xi} = Marginal factor cost of i^{th} input (per unit cost of i^{th} input – ie total cost of i^{th} input divided by the quantity of the input utilized)

Meanwhile, the marginal physical products with respect to each of the inputs in the implicit power function are given as:

$$MPP_{fas} = \frac{\partial OTP}{\partial FAS} = \frac{\partial(\beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})}{\partial FAS}$$

$$= \frac{\delta_1 \beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu}}{FAS} = \frac{\delta_1 OTP}{FAS}$$

$$MPP_{lab} = \frac{\partial OTP}{\partial LAB} = \frac{\partial(\beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})}{\partial LAB}$$

$$= \frac{\delta_2 \beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu}}{LAB} = \frac{\delta_2 OTP}{LAB}$$

$$MPP_{fer} = \frac{\partial OTP}{\partial FER} = \frac{\partial(\beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})}{\partial FER}$$

$$= \frac{\delta_3 \beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu}}{FER} = \frac{\delta_3 OTP}{FER}$$

$$MPP_{cap} = \frac{\partial OTP}{\partial CAP} = \frac{\partial(\beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})}{\partial CAP}$$

$$= \frac{\delta_4 \beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu}}{CAP} = \frac{\delta_4 OTP}{CAP}$$

$$MPP_{sed} = \frac{\partial OTP}{\partial SED} = \frac{\partial(\beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu})}{\partial SED}$$

$$= \frac{\delta_5 \beta FAS^{\delta_1} LAB^{\delta_2} FER^{\delta_3} CAP^{\delta_4} SED^{\delta_5} e^{\mu}}{SED} = \frac{\delta_5 OTP}{SED}$$

Therefore, the respective allocative efficiency indices for the various maize production inputs are given as:

For farm size: $AE_{fas} = \frac{\langle \delta_1 OTP / FAS \rangle * P_{otp}}{P_{fas}}$

For labour: $AE_{lab} = \frac{\langle \delta_2 OTP / LAB \rangle * P_{otp}}{P_{lab}}$

For fertilizer: $AE_{fer} = \frac{\langle \delta_{3OTP} / FER \rangle * P_{otp}}{P_{fer}}$

For capital: $AE_{cap} = \frac{\langle \delta_4 OTP / CAP \rangle * P_{otp}}{P_{cap}}$

For seed: $AE_{sed} = \frac{\langle \delta_5 OTP / SED \rangle * P_{otp}}{P_{sed}}$

A firm maximizes its profit with respect to an input if the ratio of its MVP to MFC is unity. A ratio less than unity shows over-utilization of that input and profit would be increased by decreasing the quantity used for that input. Input under-utilization is indicated by a ratio greater than one and profit would be increased by increasing rate of use of the input. Mathematically,

If $\frac{MVP}{MFC} = 1$, use of the inputs is at optimum (optimal utilization)

If $\frac{MVP}{MFC} > 1$, use of input is above optimum (under utilization)

If $\frac{MVP}{MFC} < 1$, use of input is below optimum (over utilization)

Estimation of the regression coefficients using the Ordinary Least Squares (OLS) regression technique was done by linearizing the power function by logarithmic transformation to:

$$\ln OTP = \psi + \delta_1 \ln FAS + \delta_2 \ln LAB + \delta_3 \ln FER + \delta_4 \ln CAP + \delta_5 \ln SED + e_i$$

Where the variables are as defined earlier, and $\psi = \ln\beta$. The regression was run using E-Views version 5.

RESULTS AND DISCUSSION

Profitability of Maize Production in the Area

The net farm income method was used to assess maize production profitability in the study area. Result of the analysis as presented in Table 1 showed that cost of fertilizer constituted 55.95% of the total cost of producing maize in the area; followed by cost of labour (31.22%) and the least cost item was annual depreciation value of hoe (1.29%). This implies that fertilizer is an important variable cost item that greatly determines maize productivity and profitability. The result is in tandem with Ugwumba (2010) which reveals fertilizer input as a significant determinant of "egusi" melon production output in Owerri West LGA of Imo State, Nigeria. Furthermore, the result revealed that farmers realized net farm income and net return on investment values of ₦1,511,905 and 0.86 respectively. The net return on investment value of 0.86 implied that the farmers returned 86 kobo for every 100 kobo invested in maize production. By this result, maize production in the area was profitable. The estimated allocative efficiency of maize production input in the study area is shown in Table 2. The ratios of MVPs to MFCs of the inputs showed that farm size, cost of labour, fertilizer, capital and maize seeds had allocative efficiency values of 1.39, 0.0037,-0.0000082, 0.0075 and 0.0018 respectively. This result implied that within the limit of statistical error, none of the inputs was efficiently allocated by the farmers. The result further indicated that maize farmers in the area over-utilized the resources of labour, fertilizer, capital and maize seeds and under-utilized farm size resource. Similar over-utilization of labour and capital inputs are reported by Ugwumba (2010a) in "egusi" melon production, and only labour input in catfish production (Ugwumba, 2010b). Increasing maize output in the area is possible, with the existing technologies, through reducing the use of over-utilized inputs (labour, fertilizer, capital and maize seeds), and increasing the use of under-utilized input (farm size). This is in corroboration with the recommendations of Okoye *et al.* (2006) on allocative efficiency of small holder cocoyam farmers in Anambra State, Nigeria; and Dung *et al.* (2010) on allocative efficiency of potato-maize intercrop system in Jos, Plateau State, Nigeria; that an under-utilization input should be increased, while over-utilization input reduced to achieve optimal production.

Table 1: Estimated profit for maize farmers in area

Variable	Amount (₦)	% of TC
Total revenue (TR)	3,264,800	
Variable cost:		
Maize seed	133384	7.61
Cost of labour	547200	31.22
Fertilizer	980,820	55.95
Total variable cost	1,661,404.00	94.78
Fixed cost:		
Machete	39317.4	2.24
Wheel barrow	29638	1.69
Hoe	22539.6	1.29
Total fixed cost	91,495.00	5.22
Total cost (TVC + TFC)	1,752,895.00	100
Gross margin (TR-TVC)	1,603396.00	
Net farm income (TR-TC)	1,511,905.00	
Net Return on Investment (NFI/TC)	0.86	

Source: Computed from survey data, 2012. Note: % = Percentage. TC = Total cost

Estimated Returns to Scale for Maize Production in the Area

Returns to scale (RTS) is the sum of individual elasticities of output with respect to the production inputs (Ugwumba, 2011). In this case, the returns to scale is 0.94 (i.e. 0.3474 + 0.3750 - 0.01858 + 0.15941 + 0.0736, Table 2). This implied decreasing returns to scale for maize farmers in the study area and meant that the maize farmers who doubled their production inputs would realize less than double their output. The reason for this decreasing returns to scale could be that the farmers were over-utilizing most of the inputs. There is need for farmers to reduce quantities of labour, fertilizer, capital and maize seeds used in production so as to achieve optimum productivity.

Table 2: Estimated allocative efficiency levels of the inputs

Variable	Coefficient	Sample mean	MVP	MFC	AEI	Use of inputs
Farm size	0.3474	0.85	11114.13	8000	1.39	Under utilized
Labour cost	0.3750	4560	2.236	600	0.0037	Over utilized
Fertilizer	-0.0186	8173.5	-0.0618	7500	-0.0000082	Over utilized
Capital	0.159	762.5	5.685	762.5	0.0075	Over utilized
Maize seed	0.074	1478.2	1.354	750	0.0018	Over utilized

Source: Computed from survey data, 2012. Notes: MVP = Marginal value product. MFC = Marginal factor cost. AE = Allocative efficiency index.

Constraints to Maize Production in the Study Area

Constraints militating against maize production in the study area included high cost of inputs, inadequate extension serviced; lack of information on modern technologies; poor storage facilities; pest, disease and weed infestation; high cost of agro-chemicals; and lack of credit facilities. Result of mean ranking of the constraints is shown in Table 3. The problem of inadequate extension services ranked 1st with mean score of 3.9 to become the most serious problem faced by the farmers in maize production. This was followed by lack of information on modern technologies (2nd 3.8); poor storage facilities (3rd 3.0); pest, diseases and weed infestation (4th 2.4); high cost of agrochemicals (5th 2.3); high cost of inputs (6th 2.3); and lack of credit facilities which ranked 7th with mean score of 2.2. The result implied that the 4th to 7th problems were not serious since they fell below the critical mean of 2.5, while the 1st, 2nd and 3rd constraints with scores above 2.5 were serious problems militating against maize production in the area.

Table 3: Constraints to maize production in the study area

Constraint	Mean score	Rank
Inadequate extension services	3.9	1st
Lack of information on modern technologies	3.8	2nd
Poor storage facilities	3.0	3rd
Pest, disease and weed infestations	2.4	4th
High cost of agro chemicals	2.3	5th
High cost of inputs	2.3	6th
Lack of credit facilities	2.2	7th

Source: Computed from survey data, 2012.

CONCLUSION AND RECOMMENDATIONS

Maize production in Oru East Local Government Area of Imo State was a profitable enterprise. Due to over-utilization of most of the inputs, the farmers were operating at decreasing returns to scale. Production output would increase through reducing the use of over-utilized inputs; increasing the use of under-utilized input; and formulating policy to mitigate the problems of inadequate extension services; lack of information on modern technologies and poor storage facilities identified by study as the most serious constraints to maize production in the area.

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