Resource Use Efficiency in Arable Crop Production Among Smallholder Farmers in Owerri Agricultural Zone of Imo State, Nigeria

Eze Christopher Chiedozie
Department of Agricultural economics Federal University of Technology Owerri, P.M.B 1526 Owerri Imo State. chrisceze2003@yahoo.com , +234 8033807761,

Amanze Blessing
Department of Agricultural Economics, Extension and Rural Development, Evan Enwerem University Owerri, PMB 2000. Imo State, Nigeria. blessingamanze@yahoo.co.uk, +234 8035699643

And
Nwankwo Oliver
Department of Agricultural Economics, Extension and Rural Development, Evan Enwerem University Owerri, PMB 2000 Imo State , Nigeria. +234 8038757794.

Abstract: The study evaluated resource use efficiency in arable crop production among smallholder farmers in Owerri Agricultural Zone of Imo State. Specifically the study determined the influence of the farm inputs used in arable crop production, estimated the allocative efficiency of smallholder farmers in arable crop production, determined the elasticity of the production and their return to scale. A multistage random sampling technique was adopted in selecting six Local Government Areas (LGAs), two communities from each selected LGA, two villages from each selected community and five farmers from each selected village. Data were collected with the aid of a well-structured questionnaire from one hundred and twelve farmers. Data were analyzed using multiple regression analysis and efficiency ratio. Results of the analysis showed that resources were not efficiently allocated by the farmers. The farmers over-utilized the resources of labour, planting materials, fertilizer, capital, and underutilized land. There was a significant relationship between output and various inputs used by the farmers. The double log function showed that 86% of the variations in the crop output was determined by the independent variables in the model. There was an increasing return to scale (1.2787) in arable crop production. To reduce the negative consequences of inefficient resource use, farmers should be educated by government and non-governmental agricultural agencies on some fundamental farm management skills which will enable them to plan, evaluate, and appraise their farm business activities. [Researcher. 2010;2(5):14-20]. (ISSN: 1553-9865).

Key words: Resource use, allocative efficiency, smallholder farmers, Imo State .

1 . Introduction

Agriculture in Nigeria as in most other developing countries is dominated by small farm producers (Oladeebo, 2004). Smallholder farmers constitute about 80% of the farming population in Nigeria (Awoke and Okorji, 2004). These smallholder farmers although individually look insignificant but collectively form an important foundation upon which the Nigerian agriculture rests. Several constraints and barriers, which appear insurmountable, limit the overall farming activities and if this is anything to go by, the destiny of a developing economy heavily rests on the shoulder of the small producers . Smallholder farmers are farmers whose production capacity falls between 0.1 and 4.99 hectares holding (Federal Office of Statistics, 1999). According to Awoke and Okorji (2004), smallholder farmers are those farmers who produce on small scale, not involved in commercial agriculture but produce on subsistence level, and cultivate less than five hectares of land annually on the average.

The question of how efficient smallholder farmer use farm resources is of considerable interest to agricultural economists. The farm-level efficiency of smallholder resources has important implications for the agricultural development of a nation. Efficient farms make better use of existing resources and produce their output at the lowest cost. Thus, achieving the food security objective. The efficient method of producing a product is that which uses the least amount of resources to get a given amount of the product. An increase in efficiency in arable crop production could present a ray of hope and could lead to an improvement in the welfare of the farmer and consequently a reduction in their poverty level and food insecurity. Low yields are as a result of inefficient production techniques manifested in technical and allocative inefficiencies, over-reliance on household resources, labour-intensive agricultural technology and rapidly declining soil productivity (Likita, 2005).

The smallholder farmers in Owerri agricultural zone are mostly arable crop producers. Production of arable crops in the zone by smallholder farmers is achieved through two main intercrops namely yam, maize, cassava, egusi (melon) intercrop and cassava, maize, egusi (melon) intercrop (Imo ADP, 2000).There is need to improve the efficiency in food crop production so that output could be raised to meet the growing demand. Lack of knowledge on the level of efficiency in the use of resources by smallholder arable crop production farmers in the zone has made the study imperative. Moreover, efforts at improving agricultural production have always been concentrated on increasing production through the breeding of high yielding varieties with little emphasis on efficiency of production output and the conservation of what is produced (Offor , Oparaeke and Ibeabuchi, 2010). This study therefore investigated the resource use efficiency in arable crop production among smallholder farmers in Owerri Agricultural Zone of Imo State. The specific objectives determined the influence of the farm inputs used in arable crop production, estimated the allocative efficiency if smallholder farmers in arable crop production, determined the elasticity of the production and their return to scale.

2. Materials and Methods

This study was carried out in Owerri Agricultural Zone of Imo State, Nigeria . Imo State is located in the southeast Zone of Nigeria and lies between latitude 5^0 10^I N and 6^0 35^I N and longitude 6^0 35^I E and 7^0 28^I E (Ministry of lands Survey and Urban planning Owerri, 1992). Owerri Agricultural Zone is one of the three Agricultural Zones in Imo State. It is located at the southwestern part of Imo State. It is bounded on the East by Abia State, on the west by Anambra and Rivers State, on the North by Isu and Isiala Mbano Local Government Areas of Imo State and on the South by Abia and Rivers States (Imo ADP, 2000). It comprises eleven local Government Areas, namely; Aboh Mbaise, Ahiazu Mbaise, Ezinihitte Mbaise, Ikeduru, Mbaitoli, Ngor-okpuala, Ohaji/Egbema, Oguta, Owerri Municipal, Owerri North and Owerri West. There are two main seasons in the zone –dry and rainy seasons. The annual rainfall is between 2000mm and 2500mm while the mean annual temperature is between 26^0C – 28^0C with a relative humidity of about 98% during the wet season (Imo ADP, 1990). The zone is richly endowed with fertile land suitable for the growth of arable crops like yam, cassava, maize, melon, rice, etc. It has other favourable conditions for arable crop production. Arable crops intercrop is the main cropping system practiced in the zone. The farmers in the zone are mainly smallholder farmers (Imo ADP, 2000). All these necessitated the choice of the zone as the study area.

Owerri Agricultural Zone was chosen purposively for the study because of the existence of arable crop farming among the smallholder farmers in the area. Multi-stage random sampling technique was adopted in selecting the respondents for the study. Six out of the eleven LGAs (Local Government Areas) were randomly selected. The second stage of the selection involved the random selection of two communities from each of the chosen six LGAs making a total of twelve communities. Another stage involved a random selection of two villages from each of the twelve selected communities making a total of twenty-four (24) villages.

Finally, a random selection of five smallholder farmers was done from each village making a total of one hundred and twenty respondents for the study. These farmers were selected from the list of households who are into smallholder arable crop production in the villages and this list was collected from the village heads and Agricultural Development Project (ADP) Extension Agents. These Farmers are those that are into Cassava, Maize, Egusi (Melon) intercrop. This is because from the survey carried out, majority of the farmers are into (CME) intercrop in the zone with the reason that there are problems of sourcing for staking sticks, high cost of seed yam and high labour demand in yam production. However , only 112 of the respondents returned a valid and usable data for further analysis in the study.

Data were collected from both primary and secondary sources. Information on the resource sources, quantity of resources used, input and output quantities, cost of input and income from output were collected. Multiple regression analysis was used in determining the influence of the various inputs used in arable crop production on the output. Four functional forms (Linear, Double-log, Semi-log, and Exponential) were fitted into the production function in this study. The functional form equation with the best fit was chosen as the lead equation.

The implicit form of the multiple regression model (production function) is as follows;

$Y = f(x_1, x_2, x_3, x_4, x_5, e)$. …………………….. (1)

Where Y = value of output in naira,
X_1 = labour (Mandays)
X_2 = Farm size (hectarage)
X_3 = cost of planting materials, (cassava cuttings and seeds)
X_4 = cost of fertilizer
X_5 = capital inputs in naira (depreciation in farm tools and implement, land rent, interest on borrowed capital, etc.)
e = error term.

(Olayemi, 1998).

The functional forms are expressed explicitly as: -

Linear: $Y = b_o + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e$ …………… (2)

Cob-douglas (Double Log):- $\text{Log } Y = \text{Log } bo + b_1\text{Log}x_1 + b_2\text{Log}x_2 + b_3\text{Log}x_3 + b_4\text{Log}x_4 + b_5\text{Log}x_5 + \text{Log } e$ ---- (3)

Semi Log: $Y = \text{Log } bo + b_1\text{Log}x_1 + b_2\text{Log}x_2 + b_3\text{Log}x_3 + b_4\text{Log}x_4 + b_5\text{Log}x_5 + \text{Log}e$………… (4)

Exponential: $\text{Log } Y = bo + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e$ …………… (5)

Log = Natural logarithm
Y = Output
X_1-x_5 = Input Variables as defined in equation (1)
bo = Constant term
b_1-b_5 = Regression coefficients
e = error term

In this study the coefficients satisfied the condition of MPPXi (PY) and are direct MVPs since the output is measured in monetary terms (Okon, 2005; Ohajianya and Onyenweaku, 2002). Due to the fact that the lead equation was Cobb-Douglas, the MVP of the input variables not measured in naira (land and labour) was computed using the input formular

$$MVP_i = \frac{b_i . y}{X_i} \text{ …………… (7)}$$

Where MVP_i = Marginal value product of ith input
b_i = The regression coefficient of ith input
y = Total revenue (₦)
X_i =Quantity of ith input used (Ohajianya and Onyenweaku 2002; Uchegbu, 2001).

And the marginal factor cost (MFC) was taken to be the market price of input since it was bought from a competitive market (Eze, 2003). For the inputs measured in value (naira) terms rather than physical units, their allocative efficiency parameters are calculated as: Ei = MVPi (Onyenweaku, 1992; Ohajianya and Obasi, 2007). A firm maximizes its profit with respect to an input if the ratio of its MVP to its MFC is one. A ratio of less than unity shows over utilization of the resource and profit would be increased by decreasing the rate of use of that input. A ratio greater than unity shows under utilization of resources. And an increase in the rate of use of that input will increase the level of profit of the firm (Eze, 2003; Mbanasor, 2002; Olayide and Heady, 1982; Okon, 2005).

Allocative efficiency of the resources used was assessed based on the ratios of the marginal value product (MVP) to the marginal factor cost (MFC).

Ei = MVP/MFC ---------------- (6)

Where Ei = Allocative Efficiency of ith input
MVP = Marginal Value product of ith input and it is given by $MPPX_i$ (PY)
MFC =Marginal Factor Cost of ith input
$MPPX_i$ = Marginal physical product of the ith resources
PY = Output price per unit (Okon, 2005).

The cob-Douglas functional form is expressed as :

$\text{Log } Y = \text{Log } b_o + b_1 \text{ Log } x_1 + b_2 \text{ Log}X_2 + b_3 \text{ Log } X_3 + b_4 \text{ Log}X_4 + b_5 \text{ Log}X_5 + \text{Loge}$

Where Y = Output

Cobb-Douglas functional form of regression analysis was used to determine the elasticities and the summation of individual production input elasitcities (regression coefficients) gave the return to scale. Sum of elasticities that is greater than I implies increasing return to scale and vice versa.

b_o = Constant term
$b_1 - b_5$ = regression coefficient
$X_1 - X_5$ = Input variable (labour in mandays, farm size, cost of planting materials

(cassava cuttings and seeds), cost of fertilizer, capital input measured in naira (depreciation of tools and implements, land charges, interests on loan etc) respectively.

e = error term.

3. Results and Discussion

3.1 Influence of the farm Inputs Used in Arable Crop Production on the Output.

The linear, semi-log, double-log and exponential functional forms were fitted to the data, and the results of analysis are presented in Table 1

Table 1: Results of Multiple Regression Analysis on the Relationship Between Output and Inputs of Arable Crop (Cassava, maize, melon intercrop) Farmers

Explanatory Variables	Linear function	Semi-Log function	Double-Log function	Exponential f unction
Constant	2113.589	103.443	83.101	79.421
Labour (x_1)	14.738	1.874	0.142	0.009
	(2.332)*	(1.150)	(2.421)*	(2.735)**
Farm size (x_2)	5.116	3.886	0.047	0.006
	(1.006)	(1.309)	(3.155)**	(2.625)**
Planting mat (x_3)	8.337	2.371	0.321	0.006
	(1.091)	(1.179)	(2.992)**	(2.762)**
Fertilizer (x_4)	14.339	2.719	0.510	0.007
	(2.857)**	(3.229)**	3.944)**	(3.259)**
Capital (x_5)	9.209	2.872	0.259	0.004
	(1.032)	(1.241)	(3.224)**	(1.310)
R^2	0.493	0.422	0.862	0.614
F-Value	20.568**	15.443**	132.295**	33.753**
Sample size	112	112	112	112

** Significant at 1%. Figures in parenthesis are T- rates.

* Significant at 5%

Source: Field data result; 2008.

The double-log function was chosen as the lead equation based on the value of the coefficient of multiple determination (R^2), the signs and statistical significance of the estimated regression parameters. About 86% of the total variation in arable crop output are jointly explained by the independent variables included in the model. The F-ratio was significant at 1% level implying that the regression model was of good fit. The coefficients for farm size (x_2), planting material (x_3), fertilizer (x_4) and capital (x_5) were found to be significant at 1% level, while the coefficient for labour input (x_1) was found to be significant at 5% level. This result implies that these five variables are important factors influencing arable crops output in the study area.

The coefficient for labour input was positive and significant, implying that increases in the use of labour input leads to increases in output in arable crop production. The coefficient of farm size or land input was positive and significant, indicating that cultivation of larger hectarage of land leads to increase in arable crop out put. Planting material was positively and significantly related to arable crop output implying that increases in the use of planting materials leads to increases in arable crop output. Fertilizer was positively and significantly related to arable crop output suggesting that increases in fertilizer use leads to increases in arable crop output. The coefficient of capital was positive and significant implying that increases in the magnitude of capital input used leads to increases in arable crop output. These results are in consonance with those of Ohajianya (2006) in Imo State, Nigeria, and Onyenweaku et al (1996).

3.2 Estimation of Allocative Efficiency of Smallholder Arable Crop Farmers

Table 2 presents the estimation of allocative efficency of smallholder arable crop farmers.

Table 2: Estimation of Allocative Efficiency of Smallholder Arable Crop Farmers.

Item	Production Elasticities	Sample Means	Marginal Value Products (MVP	MarginalFactor Prices (MFC)	Allocative Efficiency Indices (AE)
Labour (Manday)	0.1421	105.71	270.38	76924.87	0.0035
Land (ha)	0.0467	1.39	6757.73	5820.31	1.1600
Planting Material (N)	0.3207	26038.08	0.3207	1	0.3207
Fertilizer (N)	0.5103	7116.65	0.5103	1	0.5103
Capital (N)	0.2589	3122.68	0.2589	1	0.2589
Output price (N)		201140.01			

Source: Field Survey Data, 2008.

With regard to allocative efficiency of arable crop farmers in the study area (as shown in Table 2), the ratios of marginal value product (MVP) to marginal factor cost (MFC) showed that labour, land, planting material, fertilizer and capital inputs had values of 0.0035, 1.1600, 0.3207, 0.5103 and 0.2589 respectively. This result implies that within the limits of statistical error, none of the inputs was efficiently allocated by the arable crop farmers. The results further indicated that arable crop farmers over-utilized the resources of labour, planting material, fertilizer and capital, and under-utilized the resources of land. This result suggests that there exists the possibility of increasing output under the existing level of technology through the use of lower levels of capital, labour, fertilizer and planting materials, and the use of larger farmland area in arable crop production.

So, to attain absolute efficiency, there should be decrease in the use of labour, planting materials, fertilizer and capital by 99.65%, 67.93%, 48.99% and 74.11% respectively while the use of land should be increased by 16%.

3.3 Determination of Elasticities and Return to Scale for Arable Crop Production.

Table 3 presents the elasticities and return to scale for arable crop production in the study area

Table 3: Computation of Elasticities and Return to Scale for Arable Crop Farmers

Input	Production Elasticity
Labour	0.1421
Land	0.0467
Planting Material	0.3207
Fertilizer	0.5103
Capital	0.2589
Total (Return to Scale)	1.2787

Source: Field data , 2008.

Since Double – log function is the lead equation as shown in table 1, the coefficients are now automatically the elasticities as found in table 3. Return to scale was calculated as the sum of individual production inputs elasticities. The sum of elasticities resulted to a value of 1.2787, which implies increasing return to scale for arable crop farmers in the study area.This result further implies that an increase of 10% in any of the factor inputs would lead to an increase of 12.8% in arable crop output in the study area. The result of increasing return to scale is in line with the findings of Ajibefun (2002) and Uchegbu (2001) but disagreed with the finding of Obasi (2007).

4. Conclusion and Recommendations

The results of the study showed that the farm resource inputs were not efficiently allocated and managed by the farmers. To attain optimality in the use of farm resource inputs, farmers should be advised by government and non-governmental agricultural agencies through radio, television, workshops etc to reduce their use of labour, planting materials, fertilizer and capital and increase their use of land resources. To reduce the negative consequences of poor resource allocation and utilization, there is need to educate farmers on some fundamental farm management skills which will at least enable them to plan, evaluate, and appraise their farm business and also enable them to predict the economic implications of their investments in arable crops production and other crops.

Correspondence to: Eze Christopher C.
Department of Agricultural Economics, Federal University of Technology Owerri,
PMB 1526 Owerri, Imo State, Nigeria
Chrisceze2003@yahoo.com

References

[1] Ajibefun, I. A. "Analysis of Policy Issues in Technical Efficiency of Small Scale Farmers Using the Stochastic Frontier Production Function". With Application to Nigerian Farmers". Paper prepared for presentation at the international farm Management association congress, Wageningen, Netherland, July 2002.

[2] Awoke M. U. and C. Okorji The Determination and Analysis of Constraints in Resource Use Efficiency in Multiple Cropping Systems by Small-holder Farmers in Ebonyi State, Nigeria *Africa Development*. 2004; Vol. xxix, No. 3, Pp. 58-69.

[3] Eze, C. C. Resource Use Efficiency in Cocoyam Production in Ihitte/Uboma Area of Imo State, Nigeria . *Journal of Applied Sciences. 2003;* Vol.6, No.3, pp. 3865- 3871.

[4] Federal Office of Statistics (FOS), Poverty and Agricultural Sector In Nigeria, Poverty incidence of Farmers by Region, FOS. 1999; Pp. 22-23.

[5] Imo State Agricultural Development Programme (ADP), *Work Programme.* Imo ADP. 1990.

[6] Imo State Agricultural Development Programme (ADP), An Assessment Study of the Performance of the National Agricultural Technology Support Project in Imo State with focus on Farmers Adoption of Technologies and their Socio-economic Improvements. 2000; Cochita Nig Ltd. February.

[7] Likita, T. Technical Efficiency in Arable Crop Production In Kebbi State Nigeria. *Journal of Agriculture and Food Science.* 2005 ; Vol. 3, No. 2, Pp. 165-174.

[8] Mbanasor, J. A. Resource Use Pattern Among Poultry Enterprises in Abia State, Nigeria. Nigerian *Journal of Animal Production.* 2002; Vol. 29, No.1, Pp.. 64-70.

[9] Ministry of Lands Survey and Urban Planning Owerri, Area of Imo State by Local Government Area.1992 .

[10] Obasi, P.C. Farm Size Productivity Relationship Among Arable Crops Farmers' In Imo State, Nigeria. International Journal of Agriculture and Rural Development .2007; Vol.9, PP.91-99.

[11] Offor M.O. , A.M. Oparaeke and I.I Ibeabuchi . Indigenous Knowledge Systems for Storage of Yams in Nigeria: Problems and Prospects. Researcher Journal. 2010; 2(1) 51-56.

[12] Ohajianya D.O. Resource use Efficiency of land Owners and Tenants in Food Crop Production in Imo State Nigeria . Journal of Sustainable Tropical Agricultural Research,2006; Vol.17, PP.26-30.

[13] Ohajianya, D.O and C.E. Onyenweaku . Farm Size and Relative Efficiency in Rice Production in Ebonyi State, Nigeria. Modeling, Simulation and Control D' France, 2002 ; Vol. 23, No.2, PP.1-16.

[14] Ohajianya, D.O. and P.C. Obasi. Economics of Mulching in Cocoyam Production in Imo State, Nigeria. *International Journal of Tropical*

Agriculture and Food System. 2007 ; Vol. 1, No. 4, PP. 303 -309.

[15] Okon, E. T. Comparative Analysis of Large and Small Scale Farmers Resource Use Efficiency in Food Crop Production in Akwa-Ibom State, Nigeria. *Journal of Agriculture And Food Science.* 2005 ; Vol.3, No. 1, April 2005, Pp. 75-84.

[16] Oladeebo, J. O. Resource-Use Efficiency of Small and Large Scale Farmer in South Western Nigeria: Implication For Food Security. *International Journal of Food And Agricultural Research.* 2004; Vol. 1, No. 12, Pp 227-235.

[17] Olayemi, J. K. *Elements of Applied Econometrics.* 1998; Elshaddai Global ventures Ltd, Ibadan, Nigeria.

[18] Olayide, S. O. and E. O. Heady *Introduction to Agricultural Production Economics*.1982; University Press Ibadan.

[19] Onyenweaku C.E. Economics of Irrigation in Crop Production In Nigeria. Issues in Africa Rural Development.1992; Vol. 2, PP. 129 -138.

[20] Onyenweaku, C.E, P.C Obasi and S.O Anyanwu Production Relationships Among Compound and Non-Compound Farmers in Imo State Nigeria. Journal of Applied Science in Southern Africa,1996; 2(1): 31-36.

[21] Uchegbu, B. A. A Comparative Analysis of Small and Large Scale food Crops Farmers in Imo State . 2001; Unpublished M.sc Thesis, Imo State University Owerri.

4/25/2010