

INTERNATIONAL JOURNAL OF SOCIAL SCIENCES

Volume 4, Number 1, June 2005

EDITOR

IMOH E. UKPONG
University of Uyo, Nigeria

ASSOCIATE EDITORS

Akpan H. Ekpo, *Nigeria*

Graham Chapman, *UK*

Uwem E. Ite, *UK*

Ukana Ikpe, *Nigeria*

Isidore Eyo, *Nigeria*

Akpan U. Akpan, *Nigeria*

*Published in cooperation with the
Faculty of Social Sciences, University of Uyo, Nigeria.*



An Econometric Approach to Resource use Efficiency in Multiple Cropping System by Small-holder Farmers in Ebonyi State of Nigeria

M. U. Awoke

*Department of Agricultural Economics Management and Extension,
Ebonyi State University, Abakaliki*

Accepted 17th June, 2004

ABSTRACT - Resource use efficiency in multiple cropping system in Ebonyi State, Nigeria was studied. The study was aimed at providing information on the level of resource utilization in farming operations in Nigeria using Ebonyi State as a case study. A multi-stage sampling technique involving pilot survey, purposive and simple random sampling techniques was used to select 240 small-holder farmers, which served as the sample size for the study. Result showed that the combined influence of the production inputs on farmers' output was about 37%. The regression analysis further showed that the coefficients of the production inputs of land, labour, capital and management were 0.9995, 0.1182, 0.1953 and 0.1289 respectively. Though they were all positively signed, the result showed that the inputs were not efficiently utilized, since their coefficients were less than 1.0. The study showed that land has 99.95% influence on output level while capital management and labour has an influence of 19.53%, 12.89% and 11.82% on output level respectively. Unfortunately, the study noted that these inputs were under utilized in multiple-cropping system. The study suggests among others, that the methods of land acquisition should be reviewed.

KEY WORDS: Resource Use, Efficiency, Multiple Cropping System, Small-holder Farmers, Ebonyi State, Nigeria.

INTRODUCTION

Farm resources have drawn the attention of many economists and researchers. These scholars expressed views about factor productivity or resource classifications based on their study needs. However, agricultural resources could be broadly grouped into two major groups; renewable resources and non-renewable resources. Renewable resources are those resources which have life and are capable of regenerating for sustainable growth. These include; forests, fisheries and wild life. On the other hand, non-renewable resources are known as wasting away resources and have no life, which cannot also regenerate.

Olukosi and Erhabor (1989) opined that only three principal farm resources exist, which include natural resources e.g. land, soil and human resources e.g. labour and non human resources in form of capital and management. Hawksworth (1984) believed that the conventional resources for agriculture are put under the main headings; land, labour, capital and management. Relatively, there are resources used in integrated rural enterprise schemes, which are also classified into two groups. Those resources which are mainly for rural sectors include (land, soils, labour) natural resources like forestry, fishery, water. The second resources are those ones that are generally non-renewable like metallic and non-metallic minerals, water, natural gas, coal, petroleum and rocks.

However, for the purpose of this research, our focus is on the four main farm resources; land, labour, capital and management.

MATERIALS AND METHODS

Study Area

The study was carried out in Ebonyi State, which has thirteen Local Government Areas (Abakaliki, Ebonyi, Izzi, Ishielu, Ohaukwu, Ikwo, Ezza South, Ezza North, Afikpo South, Afikpo North, Ohaozara, Onicha and Ivo). Ebonyi State lies between latitude $7^{\circ}30''$ and longitude $5^{\circ}40''$ E and $6^{\circ}45''$ E and belongs to the Igbo ethnic group with a total population of about 1.7 million inhabitants (Nigerian National Census, 1991). It is bounded in the North by Benue State and South by Abia State. On the East, it shares a common boundary with Cross-River State and on the West with Enugu State. The area is drained by the tributaries of Ebonyi River and has a land area of approximately 5,935 square kilometers (ABCCIMA, 1997).

The state lies in the semi savannah region with seasonal variations of wet and dry climate. The vegetation consists of all transitional forest-savannah prototypes including agrarian, forestry and swamp ideal for rice cultivation. It has a mean temperature of 30°C during the hottest period (February –

April) and 21°C during the relatively mild period (December – January). The mean annual rainfall is between 1,500mm and 1,800mm. The climate is a humid tropical type characterised by high rainfall, high temperature and sunshine with two marked seasons; the rainy and dry season. However, rainy season occurs for a period of seven months, from April to October, while dry season last for a period of five months from November to March. Ebonyi State is richly endowed with natural resources and solid mineral deposits which are at present largely unexploited. These minerals are found in commercial quantities across the state and include; Zinc, Copper, Aluminum, Coal, Granite, Lignite, Gypsum, Salt, Limestone, Kaolin, Bauxite and others. Therefore, agriculture appears to be the main-stay of Ebonyi State economy. Hence, Ebonyi State is popularly known as the “food basket” of the nation.

Nevertheless, it is found that about 80% of the inhabitants are mostly small-holder farmers, who live in the rural areas. Notwithstanding the primitive nature of agriculture in the state, it still provides foods, to the people as well as raw-materials to the small-scale industries in the state.

Sampling Procedure

This study concerns mostly small-holder farmers in the various autonomous communities of twelve out of the thirteen Local Government Areas in Ebonyi State, with three geopolitical zones; Ebonyi North, Ebonyi Central and Ebonyi South. Administratively, it is divided into thirteen Local Governments with sub-division into communities and wards. Also, the state is agriculturally delineated using the Agricultural Development Programme model, into stratas from zones to blocks and circles to sub-circles as well as contact farmers.

However, for the purpose of this study, the first sampling procedure was to carry out a pilot survey in the three zones of the state. This enabled the researcher to be acquainted with the socio-cultural and physical environment of these farmers for vital information. It was necessary to use extension staffs, teachers and local leaders in order to generate more useful information and also assist the illiterate farmers in answering questions as contained in the questionnaire.

Specifically, the sampling techniques adopted for this research was multi stage sampling technique. It was not necessary to adopt “EBADEP” model of blocks, circles, sub-circles and contact farmers because of the geopolitical spread. Therefore, the multistage sampling method adopted here involved a stage by stage technique of simple-random sampling of the small-holder farmers in all the autonomous communities of the twelve Local

An econometric approach to resource use efficiency in multiple cropping system

Government Areas studied. Thus, the first stage was to purposively choose twelve (12) Local Government Areas out of the thirteen (13) existing Local Government Areas in the state. This was done for reasons of proximity and accessibility. The next stage was a random sampling of five (5) autonomous communities each in the already chosen twelve (12) local government areas for the research. This gave a total of sixty (60) autonomous communities. Then, stage three involved sampling three villages in each of the sixty (60) autonomous communities. This gave a total of one hundred and eighty (180) villages required for the research.

Furthermore, two (2) small-holder farmers were randomly sampled out of the one hundred and eighty (180) villages. This also gave a total of three hundred and sixty (360) small-holder farmers which represented the required sample frame for the study. Finally, it was necessary to sample randomly a total of two hundred and forty (240) multiple-cropping small-holder farmers out of the three hundred and sixty farmers (360) for the research sample size.

It is also important to note that for a proportional representation of each village, a proportional percentage of the population per village was a "sine qua non" in the simple random sampling. This was properly adopted and gave a more convenient analysis to the research.

Source of Data

Data for this study were obtained from mainly primary source. These were obtained by using a well-structured questionnaire which was augmented with interview schedules. The respondents for the research were the small-holder farmers who engaged in the multiple cropping system.

Therefore, the information provided by these farmers formed the bulk of the primary data including direct field observation. It is noteworthy that the data also provided such useful information on socio-economic status of the small-holder farmers, resource sources and uses including the crop types adopted in multiple cropping system in the study area.

Other sources of data include secondary data collected from the related sources to this research. These include data from journals, research reports, and Ebonyi State Agricultural Development Programme (EBADEP). Such information are mostly related to the nature and list of small-holder farmers in the chosen villages for this study.

Analytical Techniques

The primary data obtained were analyzed by using multiple regression technique. This technique was used primarily to determine the degree of

relationship existing between the resource inputs used in multiple cropping system, and the returns in form of outputs obtained by the small-holder farmers.

It was also necessary to find the correlation coefficient of multiple determination, R^2 and result obtained tested at 5% level of significance. Therefore, the result of R^2 helped to explain the variations in the dependent variable due to a single or a set of independent variables.

Multiple Regression Model

This is a production function model of non-linear regression with a modification of Cobb-Douglas Production Function. (Awoke and Obetta, 1998). This model however, explained the technical relationship between the inputs and outputs obtained in production process.

Thus, we have;

$$Q_t = A_t K_t^{\beta_1} L_t^{\beta_2} L_t^{*\beta_3} + M_t^{\beta_4} + et \dots \dots \dots (1)$$

$$Q_t = f(X_1, X_2, X_3, X_4, et) \dots \dots \dots (2)$$

From equation 3, it implies that

$$Q_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + et \dots \dots \dots (3)$$

Modification of Cobb-Douglas original production function using double log, mainly for obtaining the marginal physical products and rate of technical substitution.

$$\text{Double log} = \log Q_t = \log A_t + \beta_1 \log L_t + \beta_2 \log L_t^* + \beta_3 \log K_t + \beta_4 \log M_t + \log et \dots \dots \dots (4)$$

Where specifically;

Q_t	=	Quantity of crop yield at the period t.
A_t	=	Constant factor at t
X_1	=	K = Amount of capital input at t period in Naïra.
X_2	=	L = Amount of land input at hectare per Naira value or equivalent
X_3	=	L^* = value of labour inputs in either mandays or hours cum Naira equivalent.
X_4	=	M = Management value equivalent in Naira for the services rendered or coordination of other factors/resources used in crop production.
U_t	\equiv	et = Stochastic disturbances or error term at period t.
$\beta_1 \dots \dots \dots \beta_4$	=	Parameters or coefficients measuring the degree at which the above resources or variables affected the output/yield of crops at particular period t.

RESULTS AND DISCUSSION

Multiple – Regression Analysis

In order to determine the degree of existing relationship between the farm inputs used and the outputs obtained in the multiple cropping system, multiple regressions were ran. The usual statistical and econometric criteria were employed in evaluating the results and for selecting the most satisfactory of the three regression lines viz; linear, semi-logarithmic and double logarithmic functions. Some of these criteria used include; the level of coefficient of multiple determination (R^2), passing the significant test at 5% (percent) probability by the independent variables, direction of signs of coefficients and absence of auto correlation as indicated by Durbin-Watson test (DW). Moreover, the standard error of estimation was also considered.

Therefore, based on the above criteria, the double-logarithmic regression function was finally selected since it yielded the best overall result when compared to the rest. To this effect, the final result and model for the farm resources used and the output obtained in multiple cropping system for the year 1999 as presented on Table 2. The farm inputs, which were the independent variables in the regression equation included, land, labour, capital and management represented by X_1 , X_2 , X_3 and X_4 respectively while Y is the output.

As is evident from the result on Table 2, extracted from Table 1, the coefficient of multiple determination (R^2) was rather low with a value of (0.36580) showing that the variables in the regression model accounted for 37 percent of the general variations in the output of the crops in the multiple cropping system studied. What this means is that the explanatory variables of the farm inputs were not enough to explain the overall variations in the yield of the crops. However, this does not mean that the activities of the resources were insignificant in the production process. As it were, there are other exogenous factors, which come into serious play in determining the level of farm output. For example, the climatic condition of an area must be taken into consideration since climatic elements such as rainfall and solar insolation, all have their effects on the yield of crops. However, the research was based on only economic resources or inputs of land, labour, capital and management.

Further analysis showed that the coefficient of land input (X_1) is 0.099, which is rather on the low side. However, it tested highly significant at 0.05 probability. The significant value of t-test for land input with a positive sign therefore lends credence to the fact that land as a factor of production influences the output of crops. Thus, the greater the size of the land, the

Table 1: Multiple Regression Equation for Multiple Cropping System

Forms of Equation	Constant	Land (X_1)	Labour (X_2)	Capital (X_3)	Mgt (X_4)	R^2	Coeff. of Det. (R^2)	Adjusted R^2	Standard Error (SSE)	F	Durbin Watson (DW)
1. Linear											
Direction	+	+	+	+	+	+	+	+	+	+	+
Coefficient	17854.803242	2.286403	0.221554	0.018810	1.904343	0.40216	0.16174	0.14747	19443.29743	11.33535	2.00723
Test (%)	4.974	3.227	0.325	0.120	1.576						
Std. Error	3589.533544	0.7085	0.6807	0.1566	1.2082						
Sig. T	0.0000	0.0014	0.7451	0.9045	0.1163						
Direction	+	+	+	+	+						
2. Semi-Log											
Direction	+	+	+	+	+	+	+	+	+	+	+
Coefficient	149653.8348	4982.6524	3014.743085	8090.191419	5925.375643	0.38551	0.14861	0.13406	19633.74168	10.21152	1.93452
Test (%)	-4.859	1.994	0.708	1.819	1.513						
Std. Error	30802.03239	2499.021943	4259.902273	4447.001864	3915.813898						
Sig. T	0.0000	0.0473	0.4798	0.0702	0.1316						
Direction	+	+	+	+	+						
3. Double log											
Direction	+	+	+	+	+	+	+	+	+	+	+
Coefficient	5.848685	0.99950	0.118205	0.195297	0.128937	0.60482	0.36580	0.35496	0.26647	33.74241	1.80921
Test (%)	13.990	2.947	2.045	3.236	2.426						
Std. Error	0.149049	0.033917	0.057816	0.06355	0.053146						
Sig. T	0.0000	0.0035	0.0420	0.0014	0.0160						
Direction	+	+	+	+	+						

Source: Field Survey, 1999

Table 2: Regression Result for Double-Log Equation

	Constant	Land (X ₁)	Labour (X ₂)	Capital (X ₃)	Mgt (X ₄)	R	R ²	Adj R ²	SSE	F	DW
Direction	+	+	+	+	+	+	+	+	+	+	+
Coefficient	5.848685	0.99950	0.118205	0.195297	0.128937	0.60482	0.36880	0.35496	0.26647	33.74241	1.80921
T-test	13.990	2.947	2.045	3.236	2.426						
SSE	0.149049	0.033917	0.057816	0.06355	0.053146						
Sig	0.0000	0.0035	0.0420	0.0014	0.0160						
Test	+	+	+	+							
Direction											

Source: Field Survey, 1999

greater the output. On the other hand, labour input (X_2) was also positively signed with low coefficient value of 0.118, which tested highly significant at 5% giving a value of 2.045. Again, it has been pointed out earlier in the theoretical frame-work that small-scale production especially in multiple cropping system is labour intensive. Thus, the result means that the output of crops in multiple cropping depended partly on the amount of labour involved in the production process.

Furthermore, the capital input (X_3) had a coefficient of 0.118 with a positive sign and also tested highly significant (3.236) at 5%. Theoretically, capital either in form of money or machinery plays vital roles especially when little interests and no collaterals are involved. Therefore, the result of the regression equation confirms the fact that capital is a very important factor of production, which controls the level of output to a great extent.

For the management input, (X_4) the coefficient was again low but with a positive sign. However, the test of significance at 0.05 percent gave a significant value of 2.426, which implies that management as a production input also had a positive impact on the output of crops in the study area. Not surprisingly, one of the reasons could be as a result of over dependence on family or household managerial abilities instead of skilled or trained managers, which may not be very necessary in the small-scale production. This result seem to agree with the theoretical consideration which defined management as the 'life-wire' of production function.

Generally, the success or failure of the farm enterprise depends mostly on the performance of the farm manager. Although, in small-scale farming of this sort, trained manager as already pointed out, is not a sine-qua-non for high productivity or efficiency. Therefore, it could be argued that the unskilled managers still managed the farms efficiently at this level of production.

Finally, the observation of low standard error of 0.026 was an indication of non-presence of multi-collinearity in relation to the sample size of 240 small-holder farmers used in the study and the independent variables involved in the model. The low Durbin-Watson of 1.80 also proved the absence of auto-correlation among the independent variables in the equation Tables 1 and 2. Thus, the final estimated equation is as follows;

$$\hat{Y} = 5.8487 + 0.9995X_1 + 0.1182X_2 + 0.1953X_3 + 0.1289X_4$$

(13.99) (2.95) (2.05) (3.24) (2.43)

CONCLUSION

The regression analysis to determine the degree of existing relationship between the inputs obtained in the multiple cropping, showed that the coefficients of all the inputs (land, labour, capital and management) were positively signed. Moreover, each of these coefficients tested significant at 0.05 percent level. Then the result of R^2 value was obtained as .36580 showing that 37 percent of the variation in output of the crops was accounted for by the variables in the multiple regression equation.

Therefore, the positive performance of all other factors of farm resources (land, labour and capital) with output is an indication of the near-efficient coordination of production by management input in multiple cropping system.

Nevertheless, since the resources were underutilized as shown by result, it is necessary to employ more of the resources in multiple cropping system in the study area.

REFERENCES

- ABCCIMA (1997): Abakaliki Chamber of Commerce, Industry, Mines and Agriculture Brochure.
- Adesinmi, A.A. (1988): *Farm Management With Perception Through Development Process*. Obafemi Awolowo University Press. Ile-Ife.
- Ahmed, I. (1980): "Technological Change and Agrarian Structure: A Study of Bangladesh". *Genera International Labour Office*.
- Arid, B.O. (1981): "The Inverse Relationship Between Productivity and Farm Size. A test Using Regional Relationship Data from India". *American Journal of Economics*. Vo;. 74. N04. pp. 468 – 485.
- Armstrong, I. (1990): *The New Managers Handbook. A Reference Guide to the Best in Management Practice*. Kogan Pub. Ltd., Worcester.
- Awoke, M.U. and Obeta, M.E. (1998): "Economic Analysis of Small-Scale Yellow Pepper Enterprises in Nsukka Area". *Citadel Journal*. Vol 1.2, N0 5, 1998. pp. 40 – 49.
- Chidebelu, S.A.N.D. (1985): "Some Neglected Farm Management Problems Facing Food Farmers in Anambra State of Nigeria. A Case Study of Nsukka Local Government Area". *Nigeria Journal of Rural Development and Co-Operative Studies*. N02. Vol 1.
- Conventry, F.W. (1970): *Management Made Simple*. W.N. Allen, London.
- Famoriye, S. (1979): *Land Tenure and Agricultural Development in Nigeria*. NISER Ibadan, pp. 12 – 22.
- Famoriye, S. (1981): "Significance of Security Under the Traditional Tenure Arrangement in Nigeria". *Rural Africa*. N0 23. Michigan State University, East Lansing. pp. 13 – 14.
- Forth, H.D. (1978): *Fundamentals of Soil Science*. 6th Ed., John Wiley and Sons Inc., London.
- Hawksworth, D.L. (1984): "Advancing Agricultural Production in Africa". *Proceedings of CAS's First Scientific Conference*. Arusha, Tanzania.

- Herath, H.M.U. (1983): "Production Efficiency, Return to Scale and Farm Size in Rice Production. Evidence from Srilanka". *Journal of Agricultural Economics*. Vol. 61. NO 1. pp. 64 – 67.
- Ijere, M.O. (1980): *Foot Prints in African Economic Development*. University of Nigeria, Nsukka.
- Ijere, M.O. (1987): "Agricultural Credit and Economic Development". In: Aja Okorie and Obeta, M.E. (ed)
- Kaine, A. and Nwanneamaka, I. (1991): "Resource Management (Land/ Soil) in Ndoka Local Government Area of Bendel State". Department of Agricultural Economics. University of Nigeria, Nsukka.
- Khan, M.H. and Maki, D.R. (1979): "Effects of Farm Size on Economic Efficiency. The Case of Pakistan". *American Journal of Agric Economics*. Vol 61. NO 1. pp. 64 – 67.
- Koch, F. (1985): "Indigenous Work Groups in Nigerian Savannah Agriculture. A Strategy Against Labour Shortage". *Quarterly Journal of International Agriculture*. Vol 24, NO 4. pp. 332 – 328.
- Lan, I.J. and Yotopoulouse, P.A. (1971): "A Text of Relative Efficiency and Application to Indian Agriculture". *The American Economic Review*. Vol 61. pp. 94 – 109.
- Meek, C.K. (1957): *Land Tenure and Land Administration in Nigeria and Cameroon*. Her Majesty's Stationery Office. London.
- Mijindadi, N.B. and Norman, B.W. (1982): "Determination of Technical Efficiency on Traditional Farms in the Zaria Area of Northern Nigeria". *Journal of Nigeria Agricultural Economics*. Vol 1, NO 1. pp. 41 – 51.
- Nweke, F.I. and Winch, F.E. (1979): "Bases for Farm Resource Allocation in the Small-Holder Cropping Systems of South Eastern Nigeria. A Case Study of Awka and Abakaliki Villages". *I.I.T.A. Ibadan Discussion Papers*. NO 4/80.

- Okorji, E.C. (1985): "Bases for Farmers Resources Allocation in the Traditional Farming System. A Comparative Study of Productivity of Farm Resources in Abakaliki Area of Anambra State, Nigeria". *Agricultural System*. Vol. 17. pp. 202.
- Okorji, E.C. (1986): "Productivity of Yam Under Alternative Cropping Systems Adopted by Small-Holder Farmers of Southern Nigeria". *Agricultural Systems*. pp. 213 – 241.
- Olayide, S.O. (1980): "Characteristics Problems and Significance of Farmers". In: *Nigerian Small Farmers. Problems and Prospects in Integrated Rural Development*. CARD, Ibadan University Press, Ibadan.
- Oluwasemi, H.A. (1972): "The Rate of Credit in Transformation of Traditional Agriculture. West African Experience". *West African Council of Agric. Economics*. N01 Vol.1.
- Olukosi, J.O. and Erhabor, P.O. (1989): *Introduction to Farm Management, Economic Principles and Application*. AGUTAB Publishers, Zaria, Nigeria. P67.
- Olayide, S.O. and Heady, O. (1982): *Introduction to Agricultural Production Economics*. Ibadan University Press, Ibadan, Nigeria. pp. 96 – 114.
- Oruchi, A.S.N. (1980): "Economics of Resource Allocation in Food Crop Farming. A Case of Selected Villages in Anambra State of Nigeria". Department of Agricultural Economics, University of Nigeria, Nsukka.
- Udo, R.I. (1990): *Land Use Policy and Land Ownership in Nigeria*. Ebieakwu Ventures. Lagos.
- Udu, E. and Agu, G.A (1992): *New System Economics*. A Senior Secondary Course. African Fep. Pub. Ltd, Onitsha.
- Upton, M. (1973): *Farm Management in Africa*. Oxford University Press. London. pp. 126 – 148.