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A Comparative Analysis of Cooperative and Non-Cooperative Farmers in Food Production in Imo State

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Abstract

The cooperative movement is a strongly recommended strategy for the development of Nigeria's agriculture because of its numerous advantages over the small scale individual production units. This study attempts to provide more empirical evidence on the above statement by comparing cooperative and individual farmers in food production in Imo State in terms of technical and allocative efficiency. Technical efficiency was evaluated by estimating a production function and using a dummy variable to distinguish farmer type while allocative efficiency was calculated as ratios of *marginal revenue productivity* to the opportunity costs of resources.

The analysis showed both types of farmers to be of equal technical efficiency in food production. However, the two groups of farmers were found to be allocatively inefficient in resource use. In relative terms, cooperative farmers were more allocative efficient in capital use. Non-cooperators were more allocative efficient in the use of both land and labour while both types of farmers exhibited the same level of allocative efficiency in the use of other farm inputs as seeds/planting materials, fertilizer, agrochemicals, etc.

Introduction

The bulk of agricultural production in Nigeria is in the hands of a multitude of small scale farmers who are scattered all over the country. The systems of production comprise small uneconomic production units, predominance of primitive techniques of production, excessive fragmentation of holdings and consequently little mechanization of farm operations, limited use of biological and chemical technology, high dependence on rudimentary storage and marketing facilities, inadequate supply of credit and low capital investment with attendant low productivity and income.

The cooperative movement is, thus, considered a viable strategy for the development of the country's agriculture. Many writers in Nigeria including Olayide et al (1975), Osuntogun, (1980), Ijere (1981), Gbenebichie (1981), Okuneye (1982) Akinwumi (1986), Adeyeye (1986), and Fabiyi and Ziwa (1987) have highlighted the advantages of co-operative farming over individual small scale farming. These advantages include economies of scale, technology adoption, efficiency in resource utilization, improved access to credit

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and other production inputs, better marketing of farm products, mechanization of farm operations as well as more effective extension services.

In this paper, attempts are made to compare cooperative and no-cooperative farmers in Imo State in terms of economic efficiency. The concept of economic efficiency is often decomposed into technical efficiency and price/allocative efficiency. While the former refers to the ability to obtain the highest amount of output with given amounts of factor inputs, the latter refers to the situation where resources are allocated in profit maximising sense so that the marginal value products of resources are equal to their unit prices. Differences in economic efficiency among groups of farmers may therefore, result from variations in technical and/or allocative efficiencies.

Methodology

(a) *The Data*

From the 6 agricultural zones in Imo State, three, Aba, Owerri and Umuahia were randomly selected for study. In each zone, a Local Government Area was further selected at random for detailed study. With-in each Local Government Area, five villages were randomly chosen from which farmers were interviewed with pretested and semi-structured questionnaire. On the whole, 290 farmers were interviewed in the State comprising 139 members of cooperative societies, on their private farms and 151 individual farmers. The farm management data collected were for 1987/88 cropping season with respect to such principal food crops in the state as yam, cassava and maize.

(b) Methods of Analysis

The data were subjected to the Cobb Douglas Production function by methods of ordinary least squares and using a dummy variable to distinguish farmer as follows:

$$\text{Ln } Q = a_o + a_1 \text{Ln } X_1 + a_2 \text{ Ln } X_2 + a_3 \text{Ln } X_3$$

$$+ a_4 \text{Ln} X_4 + a_5 D_c + e$$

where Q = farm output in naira

X_1 = farm size in hectares

X_2 = Labour input in Mandays

X_3 = Capital input in naira in terms of depreciation on tools and equipment. Straight line method of computing depreciation was used. For hoes and cutlasses 5 years economic life and zero salvage values were assumed.

X_4 = Other farm inputs in naira in terms of costs of seeds/planting materials, fertilizer, agrochemicals, etc.

Dc = Dummy variable for farmer type which takes the value of unity if the farmer is a member of a cooperative society and zero otherwise.

e = the disturbance term while a_o, a_1, ... a_5, are the parameters to be estimated.

Results

The estimated production functions by methods of ordinary least squares for the different groups of farmers are presented below with t-ratios in parentheses. The coefficients of all the estimated.

1. ***Cooperative Farmers***

$$\begin{aligned} LnQ = {} & 3.6989 + 0.5524\,LnX_1 + 0.5755\,LnX_2 + 0.0644\,LnX_3 \quad (2) \\ & \quad (2.437)^{**} \quad (2.754)^{***} \quad (0.537) \\ & + 0.1707\,LnX_4 \\ & \quad (2.254)^{**} \end{aligned}$$

$R^2 = 0.2108$, $F = 8.948^{***}$, $n=139$

(2) ***Non cooperative farmers***

$$\begin{aligned} LnQ = {} & 3.5090 + 0.3246\,LnX_1 + 0.416\,LnX_2 + 0.2787\,LnX3 + 0.2263LnX_4 \\ & \quad (1.918)^{*} \quad (2.449)^{**} \quad (3.361)^{***} \quad (4.531)^{***} \quad (3) \end{aligned}$$

$R^2 = 0.4692$, $F = 32.487^{***}$ $n = 151$

(3) ***Pooled Data***

$$\begin{aligned} LnQ = {} & 4.769 + 0.5289\,LnX_1 + 0.2878\,LnX_2 \\ & \quad (3.482)^{***} \quad (2.158)^{**} \\ & + 0.012_4\,LnX3 + 0.3016\,LnX_4 + 0.1756\,Dc \\ & \quad (0.811) \quad (7.647)^{***} \quad (1.326) \quad (4) \end{aligned}$$

$R^2 = 0.2679$, $F = 20.641^{***}$ $n = 290$

Parameters are positive in the three production functions indicating direct relationship with output in each case.

For cooperative farmers, the coefficients of labour input is significant at 1 percent while those of farm size and other farm inputs are significant at 5 percent. However, the coefficient of capital input is non-significant. The R^2 value is low at 0.2108 but is significant at 1 percent.

For non-cooperative farmers, the coefficients of all the estimated parameters are significantly different from zero. Those of capital input and other farm inputs are significant at 1 percent while those of labour and farm size are significant at 5 percent and 10 percent respectively. The R^2 value is 0.4692 and is highly significant at 1 percent.

For the pooled data, the coefficients of farm size and other farm inputs are significantly different from zero at 1 percent while that of labour is significant at 5 percent. Conversely, the coefficients of capital input and the dummy variable representing farmer type are both non-significant. The R^2 value is also low at 0.2679 but is significant at 1 percent.

(a) Test of Technical Efficiency of Cooperative and Non Cooperative Farmers

The technical efficiency of the two groups of farmers was evaluated by estimating a production function eq. (4) using a dummy variable to distinguish farmer type and testing for

* Significant at 10 percent
** Significant at 5 percent
*** Significant at 1 percent

the statistical significance of its estimated parameter. An examination of equation (4) shows that the coefficient of the dummy variable (Dc) is non significant even at 10 percent. This implies that the production functions for cooperative and non-cooperative farmers have the same intercept term thereby suggesting equal technical efficiency of the two types of farmers in food production in the state. This result is consistent with that of Fabiyi and Ziwa (1987) in Oyo State.

Moreover, Chow's (1960) F-statistic was calculated as 1.182 and is non significant at 5 percent (Onyenwaku and Fabiyi, 1991). This implies that the farm production function is stable across the two groups of farmers as the slope coefficients are equal in both production functions.

(b) Test of Price/Allocative Efficiency of Cooperative and Non-Cooperative Farmers

The tests for the allocative efficiency were performed by deriving the following equation from the Cobb Douglas production function estimated for each farmer type; equations (2) and (3).

MV Pij = aij (QJ/Xij) Poj = Kij Pij (5)

where j = 1, 2, represents the cooperative and non-cooperative farmer groups

MVPij = the marginal value productivity of the i-th input
aij = the output elasticity of the i-th input
Qj = the geometric mean of the gross value of farm output
Xij = the geometric mean of the i-th input
Poj = the unit price of output
Kij = the allocative efficiency parameter of the i-th input
Pij = the unit price or opportunity cost of the i-th input

In this study, the dependent variable, the gross value of farm output, is measured in naira. Thus, the marginal value products and marginal revenue products will be equal in this analysis. Marginal revenue product is the change in total revenue brought about by a unit change in the variable factor. It is given by the partial derivative of total revenue in terms of the variable of interest.

Thus, the allocative efficiency indices may be calculated as:

$$dQj/dXij = Kij\ Pij \quad (6)$$

or

$$aij\ (Qj/Xij) = Kij\ Pij \quad (7)$$

or

$$Kij = aij\ (Qj/Xij/Pij \quad (8)$$

that is, the allocative efficiency index is equal to the marginal revenue productivity to opportunity cost ratio, (Onyenwaku and Awuja, 1991).

The opportunity costs of the various resources are approximated by their market prices. For land, the annual rental value for agricultural use in the state is taken as an estimate of its opportunity cost, for labour, the market wage rate in the state has been taken to represent its opportunity cost while capital and other farm inputs valued in monetary terms, the opportunity cost of one naira capital is taken as one naira plus the annual market rate of interest (15 percent).

The allocative efficiency index is a measure of efficiency in resource use. The input is over-utilized if K<1, and under-utilized if K>1. Absolute allocative efficiency requires that Kij

= 1, for all input. the two groups of farmers would have achieved equal allocative efficiency if ki_1 = ki_2, for every input.

TABLE 1. PRODUCTION STATISTICS OF COOPERATIVE AND INDIVIDUAL FARMERS, IMO STATE, 1987/88 CROPPING SEASON.

	item	Cooperative Farmers	Individual Farmers
(i)	***Production Elasticities***		
	Land	0.5524	0.3246
	Labour	0.5755	0.4165
	Capital	0.0644	0.2787
	Other Farm Inputs	0.1707	0.2763
	Sum of Elasticities	1.3630	1.2461
	Number of Observation	139	151
(ii)	***Sample Means***		
	Land (hectare)	1.298)	1.227
	Labour (Mandays)	235.500	214.880
	Capital (₦)	32.809	31.268
	Other Farm Inputs (₦)	100.930	123.121
	Output (₦)	2974.50	2752.80
(iii)	***Marginal Revenue Products (aij (Qi/Xij)***		
	Land (₦ per hectares)	1265.784	782.010
	Labour (₦ per manday)	7.269	5.336
	Capital (₦ per ₦)	5.839	24.536
	Other Farm Inputs (₦ per ₦)	5.031	5.060
(iv)	***Opportunity Costs (Pij)***		
	Land (₦ per hectares)	582.00	582.00
	Labour (₦ per manday)	7.269	5.336
	Capital (₦ per ₦)	5.839	24.536
	Other Farm Inputs (₦ per ₦)	5.031	5.060
(iv)	***Opportunity Costs (Pij)***		
	Land (₦ per hectare)	582.00	582.00
	Labour (₦ per manday)	6.25	6.25
	Capital (₦ per ₦)	1.15	1.15
	Other Farm Inputs (₦ per ₦)	1.15	1.15
(v)	***Allocative Efficiency Index (Kij)***		
	Land	2.17	1.25
	Labour	1.16	0.85
	Capital	5.08	21.34
	Other Farm Inputs	4.38	4.40

An examination of these indices in Table 1 shows that both types of farmers are allocatively inefficient in the use of all the reso urces considered in this study. These results are contrary to those of Adeyeye (1986) as well as Fabiyi and Zziwa (1987) in Oyo State. In terms of land use, both cooperative and non cooperatives farmers under-utilized this resource. While cooperative farmers would need to expand their area under cultivation by 117 percent to attain optimal allocative efficiency, no cooperative farmers need an increase of only 25 percent. This implies that non-cooperative farmers are relatively more allocatively efficient than cooperative farmers in land use. With regard to farm labour, while cooperative farmers under-utilized this resource in their farm operations, non-cooperative farmers actually over-utilised labour. In order to attain optimality in labour use, cooperative farmers would need to increase employment by 16 percent while non-cooperative farmers would require to decreased employment by 15 percent. Thus, non-cooperative farmers are relatively more allocative efficient in labour than cooperative farmers. As regards capital use, both farmer types under utilise this factor input. However, while cooperative farmers would need to increase their capital use by 408 percent to attain optimality, non-cooperative farmers would need an increase of 2034 percent. This implies that cooperative farmers are relatively more allocative efficient in capital use. Finally with regard to the use of other farm inputs such as seeds/planting materials, fertilizer, agrochemicals, etc., both types of farmers under utilise these resources. In order to attain optimal allocative efficiency in the use of these inputs, cooperative farmer would need an increase of 338 percent while non-cooperative farmers would require an increase of 340 percent. Thus, both types of farmers are of equal allocative efficiency in the use of other farm inputs.

Summary and Conclusion

This study was designed to compare co-operative and non-cooperative farmers in Imo State in terms of technical and allocative efficiency. Technical efficiency was compared by estimating a production function and using a dummy variable to distinguish farmer type while allocative efficiency was evaluated in terms of the marginal revenue products of resources relative to their opportunity costs.

The result of the analysis showed both cooperative and non-cooperative farmers to be equally technically efficiency in food production. However both types of farmers were allocatively inefficient in the use of all the production resources considered in the study. In relative terms, cooperative farmers were more allocative efficient than non-cooperators in capital use. Non cooperative farmers were relatively more allocative efficient in the use of both land and labour while both farmer types exhibited the same levels of allocative efficiency in the use of other farm inputs such as seeds/planting materials, fertilizer, agrochemicals, etc. Since the two groups of farmers have been found to be equally technically efficient and to face identical output and input prices, their differences in allocative efficiency may be ascribed to differences in managerial abilities.

For policy consideration, the allocative efficiency index exceeded unity for all the resources for cooperative farmers. This implies that cooperative farmers under-utilised all the inputs considered in the study. Optimal allocative efficiency cannot, therefore, be attained through the substitution of one resource for another. Rather, the needed reorganisation is that of scale involving increased employment of all the resources by cooperative farmers. However, for non-cooperative farmers the allocative efficiency index exceeded unity for all the inputs except labour. This implies that non-cooperative farmers under utilized land, capital and other farm inputs while over-utilizing labour. Therefore, there is scope for non-cooperators to further increase the use of land, capital and other farm inputs while reducing the use of labour in order to attain optimal allocative efficiency.

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