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The Impact of Micro-Credit on Food Crop Production in Osun State, Nigeria

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Abstract: This study examined the effect of micro-credit on food production using a cross-sectional data obtained from both the beneficiaries and non-beneficiaries of Nigeria Agricultural Credit and Rural Development Bank (NACRDB) in Osun State. Eighty respondents were randomly chosen from each group given a grand total one hundred and sixty respondents. The technical efficiency indices were examined to access their productivity and its determinants using a stochastic production frontier. It was observed that all the variables fitted in the model have the expected sign and significantly affected the total revenue for non-beneficiaries while, only labour and other costs significantly affected total revenue for beneficiaries.

Key words: Technical efficiency, stochastic frontier, productivity, micro-credit, food crop production

INTRODUCTION

Agricultural credit, its provision and availability operate within the national agricultural economy, the performance of agricultural credit programmes also depend on the financial environment of the farmer and the development of the nation's agricultural sector. Farm production development can be viewed from funding of the agricultural sector by the government since finance is believed to be a great facilitator of development in the sector. The major modes of financing farm producing development in this area are:

- Public Sector Direct Funding of Agriculture
- Agricultural credit schemes and
- Foreign investment in Agriculture

The second mode directly focuses on credit problems of farmers while the first and third are concerned with providing fund and facilities for both production (in some cases) and creating a conducive production environment for the farmers.

Public sector efforts at financing farm production development in Osun State are often stated in development plans or annual budgets and consists of direct budgetary of the Federal and State Governments and indirect financing incentives and related assistance on various agricultural development programmes. These includes input supply, extension service, agricultural research and training, water resources development irrigation schemes, pest and disease control schemes and land development and reform programme among others.

The first Federal Government major participation came with the setting up of the Nigeria Agricultural and Cooperative Bank (NACB) in 1973 now NACRDB (Nigeria Agricultural Credit and Rural Development Bank) and followed by the establishment of the Agricultural credit Guarantee scheme in 1977. Apart from increasing the volume of credit from institutional (formal) sources government policy has consciously made the terms of borrowing for farm production relatively more liberal than for most other sectors of the economy. These terms include concessional interest rate on agricultural loans, relatively long periods of moratorium and relaxation of conditions relating to collateral securities. Government also introduced the rural banking scheme In 1977 whereby banks were d irected to open up branches in the rural areas.

Private foreign investment in agriculture has been relatively insignificant in Nigeria and as well as in Osun State. There is however, appreciable inflow of loan and grants/technical assistance from foreign government and international financial institutions such as World Bank but is not reachable to the people of the grassroots, which are the rural farmers. One of the most notable forms of such assistance has been in respect of Integrated Agricultural Development Projects (IADP). The ADPs were basically designed to enhance the productivity of rural farmers and facilitate their access to basic farm input extension services.

Strictly in terms of credit provision to rural farmers in this area, there are essentially two main sources namely:

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- Formal (or institutional) sources and
- The informal (or non-institutional) sources.

Credit institution's capacity to contribute to development and survival is based ultimately on their capacity to make good loans and to avoid bias ones. To make good loans, lenders require realistic credit decision making and good loan administration. However financing agriculture especially in developing countries, is largely a problem of financing predominantly small farms with special risks and often only a limited return to lenders. It is also generally known that in all countries, developing as well as industrialized, small enterprises have limited success to financial assistance from banks and from other formal credit institutions (Levistsky, 1988).

Formal credit institutions in developing countries frequently finance only a small portion of small farm financial flows (Von Pischke, 1976). Only about 5% of farmers in African and 15% of farmers in Latin America and Asia (except Republic of china) have access to formal credit (World Bank, 1975; Braverman and Guash, 1984). Other literatures supporting this claim include World Bank policy paper (1975) stating that it is common to find 70% to 80% of small farmers in a given developing country with virtually no access to formal credit. Hossain (1988) stated that in Bangladesh only 15% of small holders and 7% of landless household had access to formal credit. While the role of credit and its need by smallholder farmers who constitute large percentage of farmers in developing countries including Nigeria cannot be ignored, it has been difficult for these farmers to be properly integrated into the formal credit market (Adams, 1971; Olomola, 1992). This study therefore intends to examine the effect of credit on food production.

Analytical model and empirical methods: Aigner *et al.* (1977) and Meeusen and van den Broeck (1977) independently proposed the estimation of the stochastic frontier production function. The specification permits output to be specified as a function of controllable factors of production, random noise and a technical inefficiency term. The stochastic frontier production function, thus, has two error terms; one to account for random effects (e.g., measurement errors in the output variable, weather conditions, diseases, etc. and the combined effects of unobserved/uncontrollable inputs on production) and another to account for technical inefficiency in production. The stochastic frontier production function can be written as:

$$Y = f(X_i;\beta)\exp(V_i - U_i) \quad (1)$$

where Yi is the production of the ith farm, X*i* is a vector of inputs used by the ith farm; $\beta$is a vector of unknown parameters, Vi is a random variable which is assumed to be independently and identically distributed (iid) $N(0,\delta_V^2)$ and independent of the Ui and Ui is a random variable that is assumed to account for technical inefficiency in production and following Battese and Coelli (1995) it is assumed to be independently distributed as truncation (at zero) of the normal distribution with mean, μ and variance,

$$\delta_u^2 \left|(N(\mu_i, \delta_u^2)\right|), \text{where} \quad (2)$$
$$\mu_i = Z_i\delta$$

where *Z*i is a 1 x c vector of farm-specific variables that may cause inefficiency and $\delta$is c×1 vector of parameters to be estimated. The farm-specific stochastic production frontier representing the maximum possible output (Y*) can be expressed as:

$$Y^* = f(X_i;\beta)\exp(V_i) \quad (3)$$

Equation 1 may be rewritten using Eq. 3

$$Y_i = Y^*\exp(-U_i)$$

Thus, technical efficiency of the ith farm, denoted by TEi, is given by:

$$TE_1 = \frac{Y_1}{Y_1^*} = \exp(-U_1)$$

In short, the difference between Y and Y* is embedded in Ui. If Ui = 0, then Y is equal to Y*. This means production lies on the stochastic frontier and hence, technically efficient and the farm obtains its maximum possible output given the level of inputs. If Ui > 0, production lies below the frontier and the farm is technically inefficient. The Maximum-Likelihood Estimates (MLE) of the parameters of the model defined by (1) and (2) and the farm-specific TE defined by (5) are obtained using FRONTIER Version 4.1 (Coelli, 1994). The efficiencies are predicted using the predictor that is based on the conditional expectation of (Battese and Coelli, 1993; Coelli, 1994). In the process, the variance parameters ($\delta^2_u$and δ^2_v) are expressed as follows:

$$\delta^2 = \delta^2_u + \delta^2_v$$

and

$$\gamma = \frac{\delta^2_u}{\delta^2}$$

The value of γ ranges from 0 to 1, with value equal to 1 indicating that all the deviations from the frontier are due entirely to technical inefficiency (Coelli *et al.*, 1998). The use of the generalized likelihood-ratio test is another way of testing if technical inefficiency effects are absent in the model. This is used in testing the significance of the model just like the F-test in ordinary least square computations. It is also used in testing the functional form of the model (e.g., Cobb-Douglas versus transcendental logarithmic or translog) and is more or less equivalent to the chow test (Greene, 1993) in ordinary least squares estimation. The generalized likelihood-ratio test statistic is defined by:

$$\lambda = -2\left[(H_0) - L(H_1)\right]$$

where $L(H_0)$ is the value of the log-likelihood function of a restricted frontier model as specified by a null hypothesis Ho; and L(H1) is the value of the log-likelihood function under the alternative hypothesis H1 (i.e. unrestricted model). The test statistic (λ) has a x^2 or a mixed x^2 distribution with degrees of freedom (df) equal to the difference between the parameters involved in H0 and H1.

MATERIALS AND METHODS

Osun State has a farm settlement which is Agric Oke Osun farm settlement and is at the extreme of the Osogbo local government area. Agriculturally, a bench mark survey of the territory conducted by the Osun State ADP in 1992 revealed that maize, cassava, yam, melon Sorghum, rice are among major crops grown by over 60% of the farmers. Other crops grown include vegetable, sugar cane, millet, cowpea, soyabean, groundnut etc. The study made use of primary data collected from randomly selected farmers in this farm settlement.

The beneficiaries list was obtained from the Nigerian Agricultural Rural Development Bank (NACRDB) while those of non beneficiaries were obtained from the Agricultural Development Programme (ADP) Osogbo zone. The study scheduled 80 questionnaires to randomly selected farmers who are beneficiaries of agric loan and also 80 questionnaires was scheduled to non beneficiaries to make up a total of 160 questionnaires.

Model specification: The stochastic frontier production function of the Cobb-Douglas type was specified for this study. Due to its advantages over the other functional forms, it is widely used in the frontier production function studies (Kalirajan and Flinn, 1983; Dawson and Lingard, 1989). The model used was

$$Y_i = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + v_i + u_i$$

I = 1, 2, 3 and 4
Y = Total Revenue (₦)
X_1 = Land (hectare)
X_2 = Labour (man-day)
X_3 = Fertilizer (kg)
X_4 = Other costs (₦)
u_i = Farm specific technical efficiency related factor
v_i = Random variable

Farm specific Technical efficiency was obtained using the relationship
Technical Efficiency (TE_i)= exp (U_i)

RESULTS AND DISCUSSION

Estimates of Cobb-Douglas for food crop farmers who benefited from NACRDB loan are presented in Table 1. All the explanatory variables included in the model for the food crop farmers followed the "*a priori*" expectation, that is, positive sign with other cost having positively significant impact on the food crop production. Other costs have high coefficient value of 10.51. This implied that 1% increase in other cost will result in 10.51% increase in yield keeping other factors constant at their mean level. The regression coefficients in the Cobb-Douglas production function are the production elasticities and their sum indicates the return to scale. The estimate of return to scale is 12.13 which is greater than 1 and this implies an increasing return to scale. This showed that an increase in the use of the selected explanatory variable would result in more than proportionate increase in total food crop production.

The maximum function likelihood estimate of the frontier production function estimates for beneficiaries of NACRDB loan is shown in Table 2. The estimate of sigma

Table 1: Estimated parameter of OLS estimates for beneficiary and non-beneficiary

		Beneficiary		Non-beneficiary	
Variable	Parameter	Coefficient	T-ratio	Coefficient	T-ratio
Constant	β_0	0.42	6.73	0.30	2.50
Land	β_1	0.28	1.32	0.87	2.33**
Labour	β_2	1.17	0.93	3.91	2.44**
Fertilizer	β_3	0.17	0.52	0.69	2.41**
Other costs	β_4	10.51	2.46**	1.32	0.39

Source: Data analysis, 2006, ** indicates significance at 5 %

Table 2: Maximum likelihood estimates for beneficiary and non beneficiary

		Non-beneficiary		Beneficiary	
Variable	Parameter	Coefficient	T-ratio	Coefficient	T-ratio
Constant	β_0	0.67	1.60	0.48	04.59
Land	β_1	0.69	2.13**	9.85	0.45
Labour	β_2	2.41	0.39	2.09	2.15**
Fertilizer	β_3	0.64	1.23	0.14	0.45
Other cost	β_4	4.61	1.89*	10.13	5.15***
Inefficiency					
Constant	Z_0	0.38	0.93	5.52	0.40
Expenses	Z_1	0.02	0.51	0.12	0.50
Education	Z_2	0.12	1.37	3.74	0.41
Extension	Z_3	0.03	1.23	0.26	1.38
Credit	Z_4	0.05	1.69*	4.60	1.17
Sigma Square	δ^2	0.01	1.90*	1.34	2.44**
Gamma	γ	1.00	0.81	0.33	0.64
LR			11.36	6.0	
Loglihood function			31.32	34.70	

*, ** and *** indicates Significance at 10, 5 and 1% level respectively
Source: Data analysis, 2006

square is significantly different from zero indicating a rved good fit and correctness of distributional assumption specified. The variance ratio (gamma) which measures the effect of technical efficiency in the variation of obse output has a value of 0.33. This means that about 33% of the difference between the observed and maximum production frontier output were due to differences in farmers' level of technical efficiency and not related to random variability. These factors are under control of the farmer and the influence of which can be reduced to enhance technical efficiency of the farmer. An upward shift in the constant term is observed with an improvement in the value of coefficient with the exception of other costs. The positive signs were maintained with labour and other costs having significant impact on the yield. It was also observed that the farm specific technical efficiency varied 0.75 to 0.99 with mean value of 0.93. Therefore in the short run, it is possible to increase yield in the study area on an average by 7% by adopting the technology of best practical farmer. The farm specific technical efficiency distribution is shown in Table 3, it was found that none of the farmers were technically efficient in the strict sense of it as none is operating on the frontier. It was further observed that about 75% of the respondent could be said to be "efficient" with an index that is greater than 0.9.

For policy purposes, it is useful to identify the sources of this inefficiency which can be done by investigating the relationship between the computed technical efficiency and expenses, education, extension and credit. All these firm-specific factors have a positive relationship with computed technical efficiency.

Estimates of Cobb-Douglas for food crop farmer who are non-beneficiaries of NACRDB loan are presented in Table 1. All the explanatory variables included in the model for the food crop farmers followed the "*a priori*"

Table 3: Frequency table of efficiency distribution of beneficiary and non-beneficiary

	Beneficiaries		Non-beneficiaries	
	Frequency	(%)	Frequency	(%)
0.40 –0.49	-	-	1	2.5
0.50 – 0.59	-	-	8	20.0
0.60 – 0.69	-	-	13	32.5
0.70 – 079	2	2.5	5	12.5
0.80 – 0.89	18	22.5	9	22.5
0.90 –0.99	60	75.0	4	10.0
1.00	-	-	-	-
	80	100	80	100
Mean	0.930		0.713	

Source: Data analysis, 2006

expectation, that is, positive sign with other cost having positively significant impact on the food crop production. Other cost have coefficient of 1.32. This implied that one% increases in other cost will result in 1.32% increase in yield keeping other factors constant at their mean level. The regression coefficients in the Cobb-Douglas production function are the production elasticities and their sum indicates the return to scale. The estimate of return to scale is 6.795 which are greater than 1 and this implies an increasing return to scale. This showed that an increase in the use of selected explanatory variable would result in more than proportionate increase in total food crop production.

The maximum likelihood estimate of the frontier production function estimates for non-beneficiaries of NACRDB loan is shown in Table 2. The estimate of sigma square is significantly different from zero indicating a good fit and correctness of distributional assumption specified. The variance ratio (gamma) which measures the effect of technical efficiency in the variation of observed output has a value of 1.00. This means that 100% of the difference between the observed and maximum production frontier outputs were due to differences in farmer's level of technical efficiency and not related to random variability. These factors are under the control of the farmer and the influence of which can be reduced to enhance technical efficiency of the farmer. An upward shift in the constant term is observed with an improvement in the value of coefficient with the exception of other costs. The positive signs were maintained with labour and other costs having significant impact on the yield. It was also observed that the farm specific technical efficiency varied from 0.47 to 0.96 with mean value of 0.71. Therefore in the short run, it is possible to increase yield in the study area on an average by 7% by adopting the technology of best practical farmer. The farm specific technical efficiency distribution is shown in Table 3, it was found that none of the farmers were technically efficient in the strict sense of it as none is operating on the frontier. It was further observed that about 25% of the respondent could be said to be "efficient" with an index that is greater than 0.9.

For policy purposes, it is useful to identify the sources of this inefficiency which can be done by investigating the relationship between the computed technical efficiency and expense, education, extension and credit. All these firm-specific factors have a positive relationship with the computed technical efficiency.

CONCLUSION

In this study, we have estimated the stochastic production frontier and predicted farmer-specific technical efficiencies for a sample of 80 smallholder farmers each of both beneficiaries and non-beneficiaries of NACDRB loan. The results showed that the potential for improving the production efficiency of farmers is immense in the two groups, as production can still be increased with the present levels of inputs by simply improving farmers' level of efficiency.

The production efficiency at farm level depends on a number of institutional support, demographic characteristics and farm practice. These factors have been identified to positively contribute to improving farmers' efficiency in the study area. This finding should be taken with caution as the model used in this study did not incorporate several other factors that might influence technical efficiency of fish farmers such as market imperfections, cash constraints and other social factors.

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