Credit Use and Technical Change in Smallholder Food Crop Production in Imo State of Nigeria

Nwaru[1], J. C. and R. E. Onuoha[2]

1. Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, PMB 7267 Umuahia, Abia State, Nigeria **E-mail: nwaruj@yahoo.com**

2. Department of Agriculture, Alvan Ikoku Federal College of Education, Owerri, Imo State, Nigeria E-mail: roserery@yahoo.com

Abstract: Harnessing the potentials of credit to stabilize and perhaps increase resource productivity and output growth in agriculture is particularly justified when farmers face very low savings capacity, poorly developed rural financial markets and availability of appropriate farm technologies whose adoption is constrained by shortage of funds. These conditions hold in Nigerian agriculture. Given the high level of poverty among farmers and other rural entrepreneurs, credit use has become a very important tool for enhancing technical progress and production. Therefore, this study was designed to assess the impact of credit use on the technical efficiency of smallholder food crop farmers in Imo State of Nigeria. Primary data from a simple random sample of 187 food crop farmers, consisting of 75 farmers producing with credit and 112 others producing without credit were used for the study. Data analysis was by the estimation of stochastic frontier production functions by the methods of maximum likelihood and ordinary least squares using the computer program, FRONTIER 4.1. The estimated farm level technical efficiency ranges from 0.2173 to 0.9014 with a mean of 0.5492 for the farmers producing without credit and 0.2009 to 0.9216 with a mean of 0.4462 for those producing with credit.. Factors directly related to technical efficiency are education, age, and farming experience while household size is indirectly related to it. It was concluded that none of the farmer groups achieved absolute technical efficiency, indicating that ample opportunities exists for them to increase their production efficiency. Moreover, the mean technical efficiency of the farmers producing without credit was significantly higher than that of the farmers producing with credit indicating that credit may not have been used properly. Economic policies and programmes for checking loan diversion and misapplication are necessary to enhance credit delivery and use.

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1. Introduction

In addition to contributing to the largest share of the Gross Domestic Product (GDP), agriculture has remained the largest non-oil export earner and employer of labour and a key contributor to wealth creation and poverty alleviation in Nigeria (National Planning Commission, 2004). For example, the National Planning Commission (2006) observed that agricultural sector accounted for 41.21 percent of GDP in Nigeria. Although agriculture has remained a rural enterprise, the National Bureau of Statistics (2005) indicated that about 65 percent of the working population was engaged in agriculture, fishing and agriculturally based trade.

A basic feature of crop production, as practised in Nigeria, is the predominance of smallholder farmers. A typical farmer usually cultivates an area of land that varies consistently from 1.5 to 2.0 hectares in fragmented and scattered smallholdings (Nwaru, 1993). These smallholder farmers, although individually look insignificant, collectively form an important foundation upon which the Nigerian agricultural economy rests. This category of farmers is desirable not only because they provide employment, but also because they provide a more equitable distribution of income as well as an

effective demand structure for other sectors of the economy (Dorner, 1975; Bravo-Uretta and Evenson, 1994). There is considerable agreement with the notion that an effective economic development strategy depends critically on promoting productivity and output growth in the agricultural sector, particularly amongst small-scale farmers (Bravo-Uretta and Pinheiro, 1997).

Previous studies have pointed out a number of constraints to agricultural production improvements. Among them are high cost and scarcity of feed and feed ingredients (Isika and Agom, 2005); over dependence on oil revenue (Onyenweaku and Nwaru, 2005); inappropriate policies and programmes for agricultural input procurement and distribution, pervasive corruption manifesting in misappropriation of resources and embezzlement, ethnic and religious conflicts resulting leading to a high sense of insecurity and inefficiency in production, and acute poverty (Nnadozie and Nwaru, 2002). It has been noted that owing to the escalating population and customary land ownership by descent which has resulted in the fragmentation of landholdings; increase in food crop output should be expected more from the application of superior technology than from land area expansion (Schultz, 1964; Seligson, 1982; Hayami and Ruttan, 1985).

One major input necessary for the sustainable application of superior technology to traditional agricultural production systems by resource poor farmers in a depressed economy is credit (Nwankwo, 1983; Palmer and Ojo, 1983; Emereole, 1995; Nwaru, 2004). Farm level credit, when extended properly, not only for crop farming but also for dairying and other directly related farm level economic activities, encourages diversified agriculture which stabilizes and perhaps increases resource productivity, agricultural production, value added and net incomes of farmers (Desai and Mellor, 1993). Nwagbo (1989) stated that credit, if well applied, should increase size of farm operations, productivity and therefore income, facilitate adoption of innovations in farming, encourage capital formation, improve marketing efficiency and the smoothening of farmers' consumption. Furthermore, credit availability stirs up the farmers' latent entrepreneurship qualities. Credit to a small-scale farmer would generate in him the optimism and determination to venture into new fields. This is because credit constitutes the key to unlock the farmers' latent talents, abilities, vision and opportunities that in turn act as the mover of economic progress.

Credit availability to agriculture is particularly justified when farmers have very low savings capacity, poorly developed rural financial markets and availability of appropriate farm technologies whose adoption is constrained by shortage of funds. These conditions hold in Nigerian agriculture. In this realisation, Nigerian governments, supported by multi- lateral and bi-lateral aid agencies, have devoted considerable financial resources to supplying cheap credit facilities to the farmers and other rural entrepreneurs in a myriad of institutional settings (Nwaru, *et al*, 2004). On the other hand, there are informal or non-institutional sources of credit services to the rural borrowers. These include kinship associations, age grades, social clubs, friends and relatives, cooperative thrift and savings; etc which offer credit services in a wide array of unorganised terms (Nwaru, 2004). Unfortunately, these rural credit structures have not been able to achieve the desired aim of effectively and efficiently facilitating the inflow of financial services into the rural economy to enable rural entrepreneurs, including the farmers to employ efficient production techniques designed to raise their physical output and incomes (Nwaru, *et al*, 2004).

However, credit can by itself grow no crop (Nwaru, 2004). It can best be seen as an instrument whose effectiveness depends on the economic and financial policies that go with it. The German Foundation for International Development (1986) stated that granting credit is not a cure-all for poverty and every social group is not automatically helped by being given a loan. According to the Foundation, certain preliminary conditions modulating the application of credit should be respected. The absence of these conditions has often led to failure of credit schemes in Nigeria. The non-existence of entrepreneurs with the knowledge, skill and energy to put the loan to good uses; inadequacy of well trained loan officers to accurately screen loan applications and supervise loan usage; negative attitudes of Nigerian farmers towards government funds (Igben, 1981) and poor savings habits among the entrepreneurs in the rural areas are major factors for loan defaults. Moreover, it has been emphasised that credit to smallholder farmers in the absence of the knowledge and use capacity of the technology can prove harmful to the user (Bailey, *et al*, 1986). At the level of subsistence farming, only a little credit can be used beneficially; large amounts of credit can be harmful because it is difficult to raise production capacity in farms fast (Turtiaineu, 1992).

Therefore, this study was aimed at measuring the relative technical efficiencies and their

determinants for food crop farmers producing with credit and those producing without credit in Imo State of Nigeria. A production unit is regarded as technically efficient if it is operating on the best practice production frontier in the industry. That is, given the input mix used by the industry, the degree of technical efficiency of a farmer is defined by the ratio of the minimal input required to the actual input used.

2. Materials and Methods

The study was conducted in Imo State, located in the South Eastern Zone of Nigeria. Imo State is one of the 36 states that constitute the Nigerian federal structure. The State consists of 27 administrative units called Local Government Areas, which are grouped into 3 agricultural Zones of Owerri, Okigwe and Orlu. According to the Federal Office of Statistics (1997), the land area of Imo state is 312,000 hectares. The National Population Commission (1991) put the population of Imo State at 2.485 million people, giving a land: man ratio of 0.126 ha/man while the National Bureau of Statistics (2005) projected it to be 3738260 implying a land: man ratio of 0.084 ha/man. This reflects how binding the constraint of land scarcity imposes on productivity growth and efficiency. The settlement structure is still rural with over 70 percent of its population living in the rural areas (Nwachukwu, 1994) and agriculture as the predominant occupation. Essentially, cereals, root and tubers, vegetables, nuts and tree crops are grown in the State. National Bureau of Statistics (2005) indicated that about 69.9 percent of the working population in Imo State was engaged in agriculture, fishing and agriculturally based trade.

The study used essentially primary data obtained through a farm management survey. A multistage sampling technique was used. Imo State was stratified into 3 according to the agricultural zones of the State namely Owerri, Okigwe and Orlu. In the second stage, blocks were selected by simple random sampling (SRS) procedure. In the third stage, the circles in each chosen block were delineated and the list formed a frame from which a sample of 2 circles was chosen per block by SRS procedure. In all, a total of 6 circles were chosen. The village head and the extension agents of the Imo State Agricultural Development Programme in charge of the chosen circles were contacted to provide the list of farmers in the circles. This formed the frame from which a sample of 187 food crop farmers, consisting of 75 credit users and 112 non-credit users. The sampling units were farm household heads in the frames.

The main data collection instruments were well structured questionnaires administered on the sample farmers. Data collected were those on socioeconomic characteristics of the respondents such as age, sex, household size, farming experience and credit use. Others were on farm input-output coefficients and costs.

The empirical model used in this study was specified as:

$$\ln Y = a_0 + a_1 \ln x_1 + a_2 \ln x_2 + a_3 \ln x_3 + a_4 \ln x_4 + a_5 \ln x_5 + a_6 \ln x_6 + V_i - U_i \quad (5)$$

Where In is logarithm to base e; Y is food crop output (N); X_1 is land area under cultivation (ha); X_2 is hired labour (mandays) and X_3 is household labour (mandays). A man-hour is defined as the work done by an adult male for an hour. A manday was considered to be 8 man-hours. The work done per hour by an adult female was considered as two-thirds and that by children one-third of that done per hour by men (Upton; 1973); X_4 is material inputs like seeds, seedlings, cuttings and agrochemicals excluding fertilizer (N); X_5 is fertilizer (N); X_6 is capital made up of depreciation, interest charges and rent (N); the V_is are assumed to be independently and identically distributed random errors that have normal distribution with mean zero and variance, σ_v^2; and the U_is are non-negative technical inefficiency effects, that are assumed to be independently distributed such that U_i has truncated normal distribution with mean, μ_i, and variance, σ_u^2, where μ_i is defined as:

$$\mu_i = b_0 + b_1 \ln Z_1 + b_2 \ln Z_2 + b_3 \ln Z_3 + b_4 \ln Z_4 + b_5 \ln Z_5 + b_6 Z_6 \quad (6)$$

where Z_1 is age of the farmer (in years); Z_2 is household size; Z_3 is years of formal education; Z_4 is farming experience (in years); Z_5 is the number of socio-cultural/ farmers' associations like farmers' cooperative societies, church groups, age grade and kindred associations to which the farmer belong; Z_6 is a dummy variable to capture the sex of the farmer (1=female; 0= male). The parameters of the model; a_is, b_is, σ_v^2 and σ_u^2 in equations (5) and (6) were estimated by the method of maximum likelihood and ordinary least squares using the computer program, FRONTIER 4.1 (Coelli, 1994).

3. Results

3.1 Average statistics of the farmers:

The average statistics of the respondent farmers are summarised and presented in Table 1. The average farmer using credit was about 52 years old with 11 years of education, 23 years of farming

Table 1: Average Statistics of the Farmers

Variable	With Credit	Without Credit
Output (₦)	80373.739	83476.650
Age (years)	51.560	54.743
Household size	6.733	7.566
Education (years)	10.747	10.208
Farming experience (years)	23.493	25.923
Cooperatives/Farmer associations	2.707	3.061
Farmland (ha)	2.745	3.540
Hired labour (m/days)	80.409	64.819
Household labour (m/days)	60.711	88.410
Planting materials (₦)	17845.520	15445.633
Fertilizer (₦)	4534.520	2960.078
Capital (₦)	7315.724	2210.574
Females (males)	20(55)	28(84)

Source: Computed from survey data, 2003. ₦ = naira, the Nigerian national currency with about 130 units to the American dollar.

experience, household size of 7persons and belonged to 3 cooperative/farmers' associations. He cultivated 2.75 hectares of land, used 80 mandays of hired labour, 61 mandays of household labour and fertilizer, planting materials and capital inputs worth N4534.53, N17845.52 and N7315.72 respectively. A typical farmer, producing food crops without credit, was 55 years old with 10 years of education, 26 years of farming experience, household size of 8 persons and belonged to 3 cooperatives/farmers' associations. He cultivated 3.54 hectares of land, used 65 mandays of hired labour, 88 mandays of household labour and fertilizer, planting materials and capital worth N2960.08, N15445.63 and N2210.57 respectively.

3.2 Estimated Production Functions

The estimated production functions by the methods of maximum likelihood (MLE) and ordinary least squares (OLS) were summarised and presented in Table 2. A comparison of the OLS and MLE estimates for the farmers that used credit and those that did not indicate that in each case that the intercepts from the MLE is higher than those from the OLS. Furthermore, the slope parameters are different in both functions. This implies that the stochastic frontier production functions presented non-neutral upward shifts over the ordinary least squares. This result agrees with those of Onyenweaku and Nwaru (2005) for food crop production in Imo State of Nigeria; Ehirim and Onyeka (2002) for aquaculture in Oyo State of Nigeria; Bravo-Ureta and Evenson in eastern Paraguay and Bravo-Ureta and Pinheiro (1997) in Dominican Republic. Therefore, the stochastic frontier functions were used in further analysis.

The coefficients of the estimated parameters are statistically significant and positive in both functions. Given the log linear specification of the models, the coefficients are directly the elasticities of production for each resource. Each of these coefficients is positive and less than unity, implying that the use of production inputs is fairly elastic and indicating decreasing but positive returns to scale for each resource and for both groups of farmers. The coefficients of returns to scale, derived bz summing up all the estimated coefficients in each function is 0.630 for farmers that produced with credit and 0.770 for those without, indicating both groups of farmers are producing at decreasing returns to scale and reflecting disguised unemployment of resources in food crop production. This indicates the need for policies and programmes for an overall decrease in their current levels of resource employment.

Table 2: Estimated production functions

Variable	Para-meter	With Credit		Without Credit	
		(MLE)	(OLS)	(MLE)	(OLS)
Intercept	a_0	0.777 (3.374)***	0.619 (2.811)***	0.892 (3.164)***	0.841 (3.817)***
Farm size	a_1	0.108 (3.557)***	0.106 (1.472)	0.161 (2.225)**	0.042 (1.388)

Hired labour	a_2	0.051 (2.555)**	0.041 (2.072)**	0.055 (2.623)**	0.160 (2.259)**
Household labour	a_3	0.066 (3.134)***	0.051 (2.552)**	0.070 (3.269)***	0.072 (2.247)**
Planting materials	a_4	0.072 (2.682)***	0.022 (3.066)***	0.211 (3.282)***	0.068 (2.603)**
Fertilizer	a_5	0.242 (3.022)***	0.062 (2.866)***	0.082 (2.818)***	0.077 (3.493)***
Capital	a_6	0.091 (2.888)***	0.072 (3.017)***	0.191 (2.972)***	0.251 (1.192)
R^2			0.6912		0.6702
$\overline{R}^2$			0.6603		0.6512
F-ratio			10.503***		15.319***
σ_v^2		0.8216		0.7982	
σ_u^2		0.1729		0.2011	
Log likelihood		-98.418		-118.513	
Sample size (n)		75	75	112	112

Source: Computed from survey data, 2003. Figures in parenthesis are t-ratios.
** and *** = Significant at 5 percent and 1 percent respectively.

3.3 Technical efficiency estimates of the farmers

A significant characteristic of the stochastic frontier production model is its ability to provide farm specific technical efficiency indices. Those for the respondent farmers are summarized and presented in Table 3. A range of technical efficiency was observed across the sample farmers and the spread is quite large.

None of them achieved an efficiency index of unity indicating that each of them produced below the maximum efficiency frontier. The best farmer producing with credit has a technical efficiency index of 0.9216 while the worst farmer has 0.2009 and the mean is 0.4462. On the other hand, the best farmer producing without credit has a technical efficiency index of 0.9014 while the worst farmer has 0.2173 and the mean is 0.5492. This implies that on the average, the farmers producing with credit are able to obtain 45 percent and those without credit 55 percent of their potential output from a given mix of farm production resources. This indicates that a large room exists for the improvement in production through improvements in technical efficiency.

A test of difference for means was conducted at 5 percent between the technical efficiency indices for the two farmer groups, those producing with credit and those producing without it. The t- value calculated is 3.759 while the value tabulated is 1.980. This implies that the mean technical efficiency of farmers producing without credit was significantly higher than those producing with credit. This result is contrary to *a priori* expectations but agrees with the result from Okike, *et al*, (2001) who reported that receiving credit contributed to farmers' inefficiency. This could be as a result of disbursement of credit in cash rather than in kind or loan misapplication as a result of resource poverty. Von Pischike (1991) discussed the problem of agricultural loan diversion, which occurs when funds are borrowed for agricultural purposes that are not undertaken. Furthermore, Ladman and Tinnermeier (1983) discussed what they termed "agricultural illusion" that is, a situation some loans appear to go into agricultural production but in fact, are used elsewhere. This indicates the need for policies to deal with agricultural loan diversion.

3.4 Determinants of technical efficiency

The estimated determinants of technical efficiency are summarised and presented in Table 4. The technical efficiency of the farmers that produced with credit was significantly influenced by age, household size, education, farming experience and membership of cooperatives/farmers' associations. The technical efficiency of those that produced without credit was significantly influenced by age, education, farming experience and cooperatives/farmers' associations. The sex of the farmer had no significant effect on technical efficiency irrespective of whether he produced with or without credit. These had *a priori* signs except age of the farmer, which is signed positively and membership of cooperative/farmers' association,

which is signed negatively. It could be adduced that the negative sign for the coefficient of socio-cultural/farmers' associations for the farmers producing with credit could arise from the fact that credit has given them a better footing to raise capital for alternative enterprises outside the farm. Moreover, some of the farmers' associations might entail expensive cultural festivals with adverse implications for farmers' financial resources.

Table 3: Distribution of the farmers by their technical efficiency indices.

Efficiency range	Without credit		With credit	
	Frequency	Percentage	Frequency	Percentage
0.2000 - 0.3201	14	12.50	25	33.33
0.3210 - 0.4411	21	18.75	21	28.00
0.4420 - 0.5621	19	16.97	4	5.33
0.5630 - 0.6831	36	32.14	15	20.00
0.6840 - 0.8041	8	7.14	6	8.00
0.8050 - 0.9251	14	12.50	4	5.34
Total	112	100.00	75	100.00
Mean	0.5492 (0.1724)		0.4462 (0.1906)	
Minimum value	0.1273		0.2009	
Maximum value	0.9014		0.9216	

Source: Computed from survey data, 2003. Figures in parenthesis are standard deviation.

Table 4: Socioeconomic determinants of technical efficiency

Variable	Parameter	With Credit	Without Credit
Intercept	b_0	0.672 (3.335)***	0.679 (3.213)***
Age	b_1	0.061 (3.008)***	0.060 (2.958)***
Household size	b_2	-0.042 (-2.632)**	-0.242 (-1.508)
Education	b_3	0.032 (3.153)***	0.052 (2.482)**
Farming experience	b_4	0.068 (3.242)***	0.081 (2.005)**
Sociocultural/ farmers' association	b_5	-0.130 (-2.502)**	0.102 (2.543)**
Sex	b_6	0.021 (1.059)	-0.056 (-1.205)

Source: Computed from survey data, 2003. Figures in parenthesis are t-ratios. ** and *** = Significant at 5 percent and 1 percent respectively.

4.0 DISCUSSION

Results from this study indicate that food crop farmers producing without credit perform better than their counterparts producing with credit. The ranges and means of technical efficiency indices indicate that both farmer groups have ample opportunities to increase their efficiency. Derived indices of returns to scale indicate that both farmer groups are operating at decreasing returns to scale and therefore need resource reallocation to alternative enterprises. Important factors directly influencing technical efficiency are education, age, and farming experience while household size is indirectly related to it.

Economic policies and programmes for enhancing resource productivity and incomes of the smallholder food crop farmers in Imo State should involve those for making credit schemes appropriately positioned to meet the needs of the farmers. They should aim at tackling loan diversion and misapplications through timelines in disbursement, effectiveness in loan supervision, reducing loan processing costs and bottlenecks and ensuring optimal interest rates in the rural economy. This should be targeted more at educated farmers and should involve more accessibility of formal and informal educational facilities to the farmers. Such policies should be targeted more at households with smaller sizes and/or increasing the efficiency of household labour utilisation. They should aim at refocusing farmers' cooperatives/associations to cope with the dynamics of farm production and resource use in a distressed rural economy.

Corresponding Author:
Dr Jude Chukwudi Nwaru
Department of Agricultural Economics
Michael Okpara University of Agriculture, Umudike, PMB 7267 Umuahia Abia State, Nigeria

Email: nwaruj@yahoo.com

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