



Probit Analysis of Cotton Farmers' Accessibility to Credit in Northern Guinea Savannah of Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author KPD designed the study, wrote the protocol and supervised the work. Author IIA carried out all field work and performed the analyses. Author KPD wrote the first draft of the manuscript and managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study examined the determinants of credit accessibility among cotton farmers in the Northern Guinea Savanna zone of Nigeria. A purposive sampling technique was adopted to select two hundred and forty (240) cotton farmers for enumeration. Primary data were collected using structured questionnaire. Descriptive statistics and the probit regression model were used to analyze the data. The results revealed that formal education, off-farm income, household size, farm size and farming experience were factors that significantly influenced credit accessibility to cotton farmers. Farmers had more access to informal sources of credit than the formal sources and the rate of accessibility to credit is highest among those sourcing from relatives and friends. The study recommends the need to educate farmers and create awareness on the importance of attaining higher level of formal education as it influences their farm output, credit demand and making rational choices.

Keywords: Probit regression; credit; accessibility; cotton farmers; Nigeria.

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1. INTRODUCTION

Access to financial services by small holder farmers is normally seen as one of the constraints limiting their benefits from credit facilities [1]. This is further complicated by the restriction of credit to a few sectors of the economy [2]. Consequently, access to credit is restricted to a small proportion of the population who can overcome significant barriers to credit such as high minimum balance for account opening, onerous collateral requirements and also a long and costly bureaucratic process [2].

In Nigeria, empirical evidence [3] has established a positive link between the declining agricultural productivity and limited credit facilities, a situation which threatens the capacity of farmers in their quest for sustainable production. Credit availability to agriculture is justified when farmers are faced with low savings capacity, poorly developed rural financial markets and limited availability of appropriate farm technologies such that adoption is constrained by shortage of funds. The demand for credit is increased as a result of increased economic activities in the informal sector [4]. This informs why farm credit has become a critical factor in modeling the growth of agricultural productivity and development of the rural economy, which consists mainly of agriculturally based economic activities.

Farmers require funds for both capital investment and other relevant expenses. Where this is available, farmers would be able to adopt various technologies. Farmers are also expected to use improved inputs to enhance productivity on farms. The absence of production oriented credit condition tends to limit the possibilities for improving and rehabilitating agricultural production, stabilizing and improving the economic activities and also limits the prospects of rural producers [5]. Information on the factors affecting the demand for agricultural credit would be helpful to educate farmers on how to improve their access to agricultural credit. It will provide base line information on credit availability to the farmers in the study area and consequently influence productivity on farms. As opined by [6], the policy made would also be appropriately guided through the expressed relationship between the access to agricultural credit and farmers' characteristics to enact effective policy that may boost productivity on farm through effective credit delivery system.

Cotton is one of the most important cash crops in the Nigerian economy and grown by about 0.8 million farmers on a total estimated area of 6000-7000ha [7]. In addition, cotton seeds provide edible oil for human consumption, while cotton seed cake are used for livestock feeds due to its high oil and protein content. The major feature of cotton production in Nigeria is that about 80% of the total production is carried out by peasant farmers under rain fed conditions with simple tools and animal drawn implements. Production of cotton in Nigeria is mainly in three zones: the Northern zone (60%), Eastern zone (30%) and the Southern zone (10%) [8]. This notwithstanding, cotton production needs to be fully exploited in order to achieve optimum agricultural growth and development and hence the economic development of the country at large.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the Northern Guinea Savanna zone of Nigeria. The zone extends between latitudes 9° 30' and 12° 31' N and longitudes 4° to 14° 30' E, occupying a geographical area of about 12.8 million hectares. Its rainfall is unimodal and ranges in space and in time between 600 and 1000 mm per annum while the relative humidity is generally low. The major source of livelihood in the area is agriculture and trading but the bulk of agricultural production is done or undertaken by small scale farmers of which women are included. Farming practices in the study area involve the use of hand tools and other simple implements. The prominent crops grown in this area include; vegetables, yams, maize, cowpea, sorghum, cotton, cocoyam and millet.

2.2 Sampling

The population used for this study was cotton farmers and focused on formal and informal credit users. Two hundred and fifty (250) cotton farmers (who are registered members of the Cotton-farmers Association) were used for the study. These were also credit users who obtained credits from either formal and/or informal sources.

2.3 Data Collection

Primary data were collected using structured questionnaire administered to cotton farmers in the area. The information collected from the

sampled farmers include: socio-economic characteristics of the farmers (age, marital status, gender, educational qualification, farm size, household size, off-farm income), types of agricultural credit sources available to them, amount of credit needed and the amount obtained by the farmers in the study area.

2.4 Analytical Techniques

Tools of analysis that were used for the study include: Descriptive and inferential Statistics.

2.5 Conceptual Framework and Model Specification

Accessibility could be described by the utility maximization theory. It is expected that a respondent will desire to access credit if the utility derived from credit accessibility ranks highest compared to the utility derived from not accessing the credit. In this study, accessibility is assumed to be binary choice such that a respondent is expected to either borrow or not. The preference of the *i*th respondent to access credit is therefore given by the difference between the marginal utility derived from credit accessibility against the marginal utility foregone. A farmer is therefore expected to have access to credit for the highest marginal benefits. Let the state of accessibility be represented by *P_r*, where *P_r*= 0 for no-access and *P_r*= 1 for access. If it is assumed that the error term follows a normal distribution, then the estimation can be achieved by using a probit distribution model as described by [9]. Specifically the model takes the implicit form as follows:

$$P_r = (Y = 1|X) = \phi(X'\beta) \dots\dots\dots (1)$$

Where *P_r* denotes probability and ϕ is the Probability Distribution Function of the standard normal distribution. The parameters β are typically estimated by maximum likelihood method. Motivating the probit model as a latent variable model, Equation (1) becomes:

$$Y = \beta_0 + \beta_1 \sum_i^n X_i + e_i \dots\dots\dots (2)$$

Where: $e \sim N(0, 1)$. Therefore *Y_i* becomes

$$Y = \begin{cases} 1 & \text{if } Y^* > 0 \text{ } (-e < X'\beta) \dots\dots\dots \\ 0 & \text{otherwise} \end{cases} \dots\dots\dots (3)$$

Therefore applying the normal CDF, equation (1) becomes explicitly written as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon_i \dots\dots\dots (4)$$

Where:

- Y_i* = Credit accessibility (1 if accessed and 0 if not)
- X₁* = Gender (1 if male, 0 if female)
- X₂* = Age of respondents (years)
- X₃* = Household size (number)
- X₄* = Educational level (years).
- X₅* = Farm size (hectares)
- X₆* = Farming experience (years)
- X₇* = Off- farm income (Naira)
- $\beta_1 - \beta_7$ = estimates of respondents' socio-economic characteristics
- ε = Error term

The maximum likelihood method of the probit model is specified as:

$$\text{Log}L = \sum \log(1 - \Phi_i) + \sum \log \left[\frac{1}{\sqrt{2\pi\sigma^2}} \right] \dots\dots\dots (5)$$

$$- \sum \log \frac{1}{2\sigma^2} (f_i - X_i\beta)^2 - (f_i - X_i\beta) - 16$$

3. RESULTS AND DISCUSSION

3.1 Description of Variables Included in the Model

Table 1 shows the distribution of respondents according to their various socio-economic characteristics. The cotton farmers had a mean age of 35 years with standard deviation of 12.80. The results imply that majority of the farmers in the area are young, strong and agile. The assumptions are the older the farmer, the greater his awareness about the availability of credit, the better placed he is to meet lending requirement and the greater therefore his access to credits. The second assumption is that the older the farmer, the more likely he is to have larger household and the greater the tendency for him to expand production for consumption and sale in order to meet the financial requirement of his household.

The education variable was employed in this study as a proxy for managerial activity. The respondents' mean level of formal education is 11.6 with a standard deviation of 10.6. A higher level of educational achievement may lead to better assessment and management of funds, good farming decision and efficient allocation of inputs cost. The farming experience variable had a mean of 18.0 with standard deviation of 13.7. Considering the fact that most of the farmers were illiterates (judging from the low mean value of the education variable 0.26) as shown in Table 1, farmers with more years of experience in this study are likely to be older and more conservative in attitude; therefore, less willing to adopt new practices that would enhance the efficiency of their production. The average annual off farm income of 14318.751 which is low shows that the farmers were likely to be credit strapped such that they would find it difficult to carry most of the farming activities that will be credit demanding.

3.2 Probit Regression Analysis of Credit Accessibility by Cotton Farmers

Table 2 shows that interest rate, age, off-farm-income, household size and farm size were all found to be significant at various level of significance (1%, 5% and 10%), implying that the independent variables included in the model were all important in influencing the dependent variables. In other words, the null hypothesis that socio-economic characteristics of farmers have no significant influence on the demand for credit is rejected. R² value which measures the proportion of the variation in dependent variable that is explained by the independent variables was 0.68. This implied that the variables included in the model could explain 68% of the variation that occur in the amount of credit demanded by the respondents in the study area.

Farming experience was significant at 10% level of significance but the sign of the coefficient shows that a direct relationship exists between

Table 1. Descriptive statistics of variables employed in the probit model

Variable	Description	Mean	Std Deviation
Credit accessibility	Measured as dummy for 1 if accessed, 0 if not accessed	0.457	0.128
Gender	Measured as dummy for 1 if male, 0 if female	1.000	1.000
Age	Age of respondent in years	35.114	12.799
Farm size	Total farmland area of farmer devoted to cotton production in hectares	1.016	0.149
Education	Number of years spent in formal education	11.611	10.590
Off- farm income	Amount of the respondent's annual off-farm income measured in naira (₦)	14318.751	13.783
Household size	Number of persons within the respondent's household	8.7234	0.559
Farming experience	Number of years spent by a farmers in cotton production	18.000	13.703

Table 2. Estimates of the probit regression model

Variables	Coefficients	Standard error	t-value
Constant	37086.886	15920.152	2.332**
Interest rate	-0.096	0.013	-7.613***
Sex	25346.603	9593.821	2.643**
Age	31.713	25.112	1.263
Household size	829.063	263.719	2.761**
Formal education	0.375	0.116	2.258**
Farm size	0.059	0.045	1.311
Farming experience	5403.651	3201.101	1.671*
Off- farm income	0.274	0.023	11.915***
Pseudo R ² = 0.681 F = 17.01			

* P<0.1, ** P<0.05 and *** P<0.01

the farming experience and the credit demanded by the farmers. This implies that with a unit increase in farming experience, credit demanded increases by a magnitude of the coefficient and vice versa. This is similar to the result obtained by [10] that farming experience is a significant factor influencing farm management and decision making. It determines the farmers' ability to make effective farm management decisions, not only adhering to agronomic practices but also with respect to input combination or resource allocation.

Off-farm income was significant at 1% level of significance and the sign of the coefficient shows a direct relationship with credit demanded by farmers in the study area. That is as farm income increases, credit demanded also increases and vice versa. Farmers with high farm income have better abilities of repaying loans given to them by financial institutions. Due to farmers' ability to generate farm income, they have had accumulated collaterals to help them in securing loans.

Level of formal education attained was significant at 5% level and the sign of the coefficient shows a direct relationship with the credit accessibility of farmers. That is, the more educated the farmers are, the more the credit demanded by them. Farmers with higher education were more inclined to seek for external funds, while those with little or no formal education would not appreciate the demands of modern technology.

The significance of household size on credit accessibility could be associated with the household head's responsibility in catering for the family. However increase in size of household may increase per-capita consumption expenditure of farm household, hence reduce the farmers' capital that could be used for production

activities since the respondent needs to pay a certain amount before the credit is made available. It also means that large households may not have the ability to meet with terms of collateral and interest rates due to extra mouth to feed. This is consistent with findings by [11,12] which showed that access of households to credit was determined by farmers' age, size of landholding, location of the household head farm, access to other credit, financial contribution of the household head in his or her group, access to agricultural extension services and membership of registered farming groups. Also, [10,13] findings of similar studies revealed that accessibility to credit facilities was significantly affected by level of education, household size and occupation.

3.3 Rate of Accessibility to Credit from Different Sources

From Table 3, it shows that the respondents had more access to credit from relatives and friends with an accessibility rate of 25.6%. 23.2% of the farmers obtained money from money lenders, 10.91% obtained from informal savings/credit groups, 4.93% from NGO/Church/Mosque, 35.27% obtained from Bank or Microfinance. It shows that informal sources of credit were the main options of sourcing for credit the respondent had because they borrowed more from the informal sources than the formal sources. In addition, the highest interest rate (24.56%) was found on credit sourced from informal/ local/ traditional money lenders. This shows that despite the high rate of interest charges on the informal sources, the farmers still borrow as these sources have higher degrees of accessibility. This agrees with findings by Udoh [4].

Table 3. Farmers' rate of accessibility to credit from different sources

Credit source	Amount	Rate	Interest (%)
Relatives and friends	873000	35.66	18.76
Informal money lenders	270000	10.91	24.56
Cooperatives	575000	23.23	10.00
NGO/Church/Mosque	122000	4.93	0.00
Bank/Microfinance	635000	25.27	12.50
Total	2475000	100	

4. CONCLUSION

From the findings of the study, it can thus be concluded that formal education, farm income and farming practices are factors significantly influencing credit demand by cotton farmers. Farmers have more access to informal sources of credit than the formal sources and the rate of accessibility of the credit is highest with those farmers sourcing from relatives and friends. Also, farmers are highly constrained with high interest rate on loans. Based on the findings of this study, the following recommendations were therefore made;

- (i) Extension agents should intensify their work by educating farmers and creating awareness on the importance of attaining higher level of formal education as it influences their farm output and credit demand.
- (ii) Due to the fact that farmers need credit/loans to purchase other farm inputs that would maximize productivity, their general income and hence the general well-being of the beneficiaries, there is need for the appropriate agencies and government to render the necessary services such as timely provision of loans.
- (iii) Farmers should be assisted by NGOs/CBOs in providing subsidized farm inputs (fertilizer, chemicals and improved seeds) and improved farming practices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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