

**AGRICULTURAL LENDING DECISION:  
A TOBIT REGRESSION ANALYSIS**

**Olagunju FI\*<sup>1</sup> and A Ajiboye<sup>1</sup>**



**Funke Olagunju**

\*Correspondence author email: [olagfunk@yahoo.com](mailto:olagfunk@yahoo.com)

<sup>1</sup>Department of Agricultural Economics and Extension, Ladoke Akintola University of Technology, P.M.B 4000 Ogbomosho Oyo State, Nigeria.

## ABSTRACT

Using data from a survey of loan applicants and bank officials from Union Bank of Nigeria and First Bank of Nigeria in south-western Nigeria, this paper empirically evaluated the determinants of loan approval decision and the size of the loan given using a Tobit regression model. With a multi-stage sampling technique, data were collected with the aid of structured questionnaire drawn on 450 applicants. The respondents' ages varied between twenty five years and sixty nine years with a mean of fifty and a half years for all the respondents. The mean age recorded for each category of respondents suggests that middle-aged farmers who are expected to be economically active and energetic dominated the sampled population. They should be willing to explore avenues and adopt new methods in order to raise their level of productivity. The relatively large farm sizes owned by the applicants indicated that it is one of the major criteria for giving loans to the farmers; hence those with very small farm sizes may not have access to loans from the two institutions. Tobit estimates show that institutional, environmental and part of the resource variables were important determinant factors of loan approval decision and a decomposition of elasticities calculated at the mean of the variables revealed that a 10% increase in the RISK variable will lead to a total elasticity change of about -0.79 %. This indicates that the elasticity of probability of loan approval will decrease by about 0.36 % and elasticity of expected loan size will decrease by 0.43%. The result tends to imply risk-averseness of the lenders, as fewer loans are granted. The positive coefficient of HHZE indicated that high farm assistance was received from respondents' relations who positively influenced the implications for family labour and cultivation of large area of land and eventually influenced the approval decision. The coefficient of NFI positively influenced the loan approval decision since the farmer can expand his options to acquire more loans and use for profitable ventures since this variable is viewed as a proxy for wealth, thus the beneficiary will have sufficient resources to absorb the cost and risk of failure in their agricultural enterprises. In each of the two institutions, the marginal changes in most of the variables considered increased the probability of loan size influence than it increased the probability of approval.

**Key words:** Lending Decision, Tobit Regression, Credit

## INTRODUCTION

The role of agricultural credit in the agricultural development of a country cannot be overemphasized. One of the reasons for the decline in the contributions of agriculture to the economy is lack of a formal national credit policy and paucity of credit institutions, which can assist farmers. Credit (capital) is viewed as more than just another resource such as labour, land, equipment and raw materials [1]. The performance of loan contracts determines the profitability and stability of financial institutions, and screening the loan applications is a key process in minimizing credit risk. Before making any credit decisions, credit analysis (the assessment of the financial history and financial backgrounds of the borrowers) should be completed as part of the screening process. Good borrowers with low credit risk would be granted a loan, while a high risk borrower would be denied. A good credit risk assessment assists financial institutions on loan pricing, determining amount of credit, credit risk management, reduction of default risk and increase in debt repayment. Credit analysis is the primary method in reducing the credit risk on a loan request. This includes determining the financial strength of the borrowers, estimating the probability of default, and reducing the risk of non payment to an acceptable level [2].

The importance of agricultural credit varies widely from country to country. In the less developed countries, agricultural credit is closely related to providing needed resources which farmers cannot source from their own available capital. In this case, promotion of agricultural development through the provision of agricultural credit has become one of the most important government activities. However, in the developed countries, it is a basic tool of production which provides the farmer with capital to acquire resources in time, in the advantageous amount and efficient manner.

Modernizing agriculture requires large infusion of credit to finance the use of purchased inputs such as fertilizers, improved seeds, insecticides, additional labour and so on. In this regard, the provision of agricultural credit can be a powerful economic force for development if used to inject appropriate capital for the purchase of agricultural inputs that are not otherwise available to farmers from their own financial, physical and labour resources. To date, however, institutional supply of agricultural credit remains inadequate; and this continues to impede the transfer of technology and investment into agriculture. A study of some of these institutions has shown that rising operational cost is a major factor militating against their effective performance [3].

### Background of the study

During the colonial era, intervention in the market started at the Local Government level and became increasingly pronounced at the Regional level even after independence. The earliest attempt in this regard was in 1930 when the Native Administration gave loans for mixed farming in the savannah areas of Northern Nigeria [4]. This was followed by the establishment of the Nigerian Loan Development Board which operated between 1946 and 1949; the Regional Loan

Development Boards which took over from the former; the Western Nigerian Finance Corporation (WNFC), which administered farm loans between 1955 and 1965, the Western Nigeria Agricultural Credit Corporation (WNACC), which took over all agricultural operations from WNFC; the Mid-Western Nigeria Agricultural Credit Corporation (MWNACC), which was established in 1964; and the Fund for Agricultural and Industrial Development of the defunct Eastern Regional Government (FAID). A review of the performance of these institutions indicates that several problems militated against their successful operation. According to Oluwasanmi [5], the critical problems were (i) Cumbersome lending procedures resulting in delays in loan approval (ii) Untimely delivery of credit (iii) Over-centralization of authority (iv) Political interference in loan administration, favouritism and corruption (v) High rate of default and (vi) Limited coverage of targeted clientele.

It was felt that some of the problems could be resolved if there was a nationally coordinated effort to control the disbursement of agricultural credit. Thus, the Federal Government started to show concern for agricultural financing beginning from the first National Development Plan Period (1962-68) when an equivalent of ₦6.0 million was provided for agricultural credit. During the Second Plan Period (1970-74), the concern of the Federal Government about a national agricultural credit institution to promote the development of agriculture led to the establishment of the Nigerian Agricultural and Cooperative Bank (NACB) in 1973.

The Agricultural Credit Guarantee Scheme Fund (ACGSF) was set up under Decree 20 of 1977 and commenced operations on April 3<sup>rd</sup>, 1978. It was established to provide some measure of risk coverage as an incentive to commercial banks to increase their lending to agriculture. The operations of Agricultural Credit Guarantee Scheme (ACGS) notwithstanding, the agricultural sector have been severely disadvantaged in terms of its allocation of Commercial Bank loans relative to other sectors of the economy [6].

Moreover, the share of agriculture in total Bank Loans had been falling below the minimum level prescribed by the Central Bank of Nigeria (the managing agent of ACGSF) from 1975 to 1984 in respect of Merchant Banks and from 1972 to 1985 in the case of Commercial Banks [7]. The apparent lack of full commitment to the objectives of the ACGSF by participating banks may not be unconnected with concessional rate of interest, the increasing rate of default and delinquency, high transaction costs and the reluctance often demonstrated by the Central Bank of Nigeria (CBN) in settling outstanding claims. For instance, as at the end of 1982, 112 default notices mostly in respect of individual borrowers with a value of ₦2.4 million had been filed. In that year only a total of 39 claims, amounting to ₦0.24 million, were settled by the fund for the first time. In 1983, there were 46 demands by participating banks for reimbursement due to default by borrowers. However, of the total claims put forward, 24 or 52% representing about ₦111,000 were paid by the fund, a performance considered to be below expectation [8]. A further attempt to improve the credit situation is the involvement of Non-Bank institutions in the supply of agricultural credit. Toward this end, the government restructured the operations of

the ADPs, Livestock Development Projects and the River Basin and Rural Development Authorities (RBRDAs) to combine the provision of credit with improved cultural practices and supply of inputs in order to effect an improvement in agricultural production.

Major problems, however, facing these agricultural credit programmes, irrespective of the institution channel, are low credit recovery rates and patronage. For instance, between 1978 and 1990, the cumulative number and value of loans guaranteed by Agricultural Credit Guarantee Scheme Fund (ACGSF) stood at 122,246 valued at ₦765.4 million, while the total number and value of loans fully repaid by all categories of borrowers stood at 34,744 and valued at ₦179.68 million representing only 23.5% of the total loan value [9]. The main effect of non-repayment of loans is that it reduces the vitality and viability of credit institutions. It appears that if the obstacles relating to loan repayment are eliminated, the resolve of the government to encourage massive participation of small-scale farmers in credit programmes is apt to yield desirable results. It is well known that as farming becomes more capital intensive, good financial management becomes more crucial in the context of overall farm management [10]. An increasing number of decisions need to be based on project productivity of the loan itself, as well as on the likelihood that the farmers will successfully manage the borrowed funds for more effective management of their farms. Repayment ability of a farmer is affected by the riskiness of farming operations, the effectiveness of the farmers in resource allocation and the prevailing socio-economic environment.

In Nigeria, several attempts have been made to enhance farmers' accessibility to credit through a multiplicity of institutional designs. Nonetheless, access to credit by small-scale farmers is still highly restricted. Most of the credit agencies have been confronted with several operational deficiencies including gross inadequacies in staffing, organization and management and poor recovery performance [11]. Ever since the establishment of these credit institutions, coupled with policies put in place over the years, one would have thought that the problem of agricultural credit inadequacies would have been solved. The problem still persists and bedevilled with many bottlenecks in the administration of credit facilities. However, previous studies have not been able to establish empirically how credit administrations have influenced accessibility and impacted on repayment performance. Viewing from this background, it is felt that there is the need to examine the operations of major agricultural institution in terms of loan approval, loan size and rejection, with the aim of identifying the key determinants of loan approval/ loan size in their decision making process.

The credit control mechanisms put in place by the government to enhance farmers' accessibility to formal credit remain largely ineffective [12]. There were several bottlenecks especially prior to 1986 when the Structural Adjustment Programme (SAP) was introduced including leakage of credit funds to unintended beneficiaries, non-compliance of banks with portfolio requirements, persistent high rates of loan default and negative interest rate in real terms.

Agricultural credit has been found to have positive output and employment effects in many developing countries [13, 14, 15] but there is a growing concern about its potentials in this regard. Concern is growing because lending to small-scale farmers by credit institutions is becoming increasingly difficult. Yet, farmers account for over 80 percent of agricultural output (in the case of Nigeria) and constitute the majority of those financially handicapped in the rural areas [16]. There are overwhelming requests for loans by various business concerns including large-scale agribusiness ventures even when the supply of loanable funds is grossly inadequate. Usually, requests from large business concerns are more favoured by banks than those from small businesses. Studies have shown that where there had been augmented credit supplies in support of agricultural output increases, relatively little of the additional loanable funds have gone to the rural poor [17,18, 19, 20]. The major function of Commercial Banks is to advance credit to borrowers. However many banks perceive agricultural loans as risky and seek to channel credit into less risky enterprises. Thus, banks tend to eliminate or greatly restrict the loans they give to farmers. Because capital or loanable fund is an uncertain but critical resource, the discretionary decision making of banks places real and potential constraints on farmers. Banks control loans to agriculture by determining which firms receive credit and which do not [21].

In Nigeria due to these considerations, loans to farmers are small compared with loans to commercial and industrial enterprises. What is then the underlying factors informing the Banks' decisions? The demand for credit by the borrowers (farmers) is constrained by lack of information because it is costly to identify profitable investment projects and to assess their risk. The supply of credit is constrained by lack of information because the level of mediated funds is limited as financial authorities are neither sufficiently informed about whether financial intermediaries (bank or others) are trustworthy or are they sufficiently informed of the degree of inflationary tendencies in the future that is, whether the value of the money will be relatively stable. Moreover, financial intermediaries suffer from lack of information, as they are uncertain about the borrowers' willingness and ability to service the debt. These information problems are – apart from specific core beliefs and ignorance – the main cause of market failure in urban and rural financial markets. The concern about loan default among farmers derives partly from the argument that non-recovery of loans will tend to destroy the long – run viability of a credit institution. This is because the amount in default essentially becomes non-revolving, in the sense that it cannot be passed on to prospective needy applicant farmers [22].

The issues of loan repayment that have an indirect bearing on the default or recovery rates should be well handled to avoid distress and a shaky foundation for the establishment of the financial institutions. Banks in their lending to agriculture, as in other sectors of the economy, expect that the principal be repaid when due with the interest rate margins. This problem of non – repayment of agricultural loans has been observed as one of the problems against the development of the agricultural sector in Nigeria, as it dampens the willingness of the financial system to increase lending to the sector. It is, therefore, a matter of serious concern that the financial institutions

must, among other things, ensure repayment of their loans bearing in mind the need to operate in an economic environment that emphasizes self-survival [23]. In addition to this, credit demand assessment models have been developed to evaluate both new loan applications and the credit potentials of existing borrowers. There is a dearth of such studies in a developing agriculture such as that of Nigeria. In this context, the present work attempts to bridge the gap in the literature by considering a major financial institution, the Agricultural Credit Guarantee Scheme (ACGS) as operated by First Bank of Nigeria Plc and Union Bank of Nigeria Plc.

Lenders placed significant weight on the borrower's financial information and personal characteristics (honesty, integrity, and production-management ability) when making decisions regarding approval, levels of credit, and need for servicing action [24]. Agricultural banks in Illinois and Iowa utilized a survey to examine credit evaluation procedures, risk assessment methods, and credit model consistencies [25]. They found that, following the farm financial crisis of the 1980s, lenders used more formal and comprehensive methods to evaluate the creditworthiness of agricultural borrowers. Substantial research on credit risk assessment in agricultural lending has yielded mixed results about which factors to include in the development and validation of credit scoring models [14, 26].

The number of studies examining the agricultural lending decision provides strong evidence that lenders consider both financial and non-financial variables when evaluating the credit-worthiness of farm borrowers. However, various credit evaluation procedures and methods have been studied without achieving a consensus as to which variable measures should be used when analyzing agricultural loan applications. Furthermore, while there have been many studies, the majority of them do not explicitly consider how lenders use credit bureau scores when lending to farm borrowers. Thus, further research pertaining to the lender's assessment, especially as it relates to the agricultural loan decision-making process, is needed.

Several statistical methods have been used to estimate credit scoring models, such as discriminant analysis [27, 28, 29], linear probability models [29, 30], logit models [28, 29, 31, 32, 33] and probit models [28, 34,]. The logit model has dominated the literature and has been widely used because of its simplicity. Recently, artificial neural networks (ANN) were used to make a lending decision process [16, 26 29].

Seventh Farm Credit District's loan portfolio was analyzed from 1995 to 2002 using repayment capacity, solvency, and liquidity to determine the accuracy of financial performance ratios in predicting the expected probability of default status [35]. Results from the study showed that the underwriting guidelines in place within the Seventh Farm Credit District were statistically significant in predicting the expected probability of default. The lending institutions have to battle with the problem of credit management, credit transaction costs, credit risks, loans default and lending constraints. They have to determine the quantum of credit to give, the type of farmers who can benefit, when to give, the type of enterprises and the credit worthiness of the borrowers. Lending decisions like investment decisions are fraught with risks. The

ability of the lender to assess and analyze such risks often led to qualitative and more pragmatic decisions [8]. Agriculture and the financial institutions do not operate in isolation from conditions in the other sectors of the economy. Hence, concessionary interest rate or not, the sector must compete for the available funds with public and private borrowers. No matter what the final objectives of credit institutions may be, it is basically the generation of concrete benefits to the borrowers, which make for the success or failure of the credit programmes. It is, therefore, essential that a full recognition and understanding of the borrower's point of view, interest and problems be considered in relation to the credit recovery of the institutions concerned and in decision making processes of the stakeholders in credit management. Factors influencing the lending decision to farms can significantly affect their financial capacity and performance. During recent years, farm operations have become more capital intensive, thus requiring more funds to meet both seasonal operating needs and capital expansion.

The study is to explicitly test the relative importance of the underlying decision variables for a given loan request and analyze the interacting effects of this set of farm loan decision variables with credit considerations in the decision process of the individual loan officer. The model of decision variables was derived with the assistance of a group of senior loan officers. Extensive literature has been reported on the testing of credit scoring models in the lending decision. Credit considerations are significant in all the studies but this study differs from the credit scoring approaches, first, by expanding the model of lender decision making to include the farmers' socio-economic characteristics, resource characteristics, institutional specific characteristics and environmental characteristics. Second, the model is empirically tested using responses by loan officers' loan situations. Many studies have examined the methods used by lenders without achieving a consensus as to which quantitative and qualitative factors are most important in the agricultural loan decision-making process. The primary objective is to analyze the factors financial institutions consider when lending to farm borrowers. The specific objective is to determine the important borrower and lender characteristics in determining loan approval.

### **Theoretical Framework**

Traditionally, lenders have applied the five C's of credit when analyzing the creditworthiness of a farm borrower. The first C, which is capacity, refers to a borrower's ability to repay a loan obligation and bear the subsequent financial risk [36]. Lenders generally analyze a borrower's repayment capacity by conducting an analysis of both historical and projected profitability and cash flow of the farm business. Capital is the second C of credit and refers to the funds available to operate a farm business. To assess capital, lenders review balance sheets from both current and previous years, and calculate financial measures of liquidity and solvency. This allows the lender to gauge the amount of equity a borrower has invested in the operation and how effectively that investment generates cash flows. The third C, which is collateral, represents a security agreement that serves as a final source of repayment to the lender if the borrower defaults on the terms of the loan agreement.



Since lenders seek to maximize profits, they carefully consider the risk/return relationship of the loan request. As risk increases, lenders will seek larger amounts and/or higher quality collateral. Conditions are the fourth C of credit and refer to the intended purpose of the loan. Lenders consider factors such as the loan amount, the use of the funds, and the repayment terms. The lender also considers the overall economy, including interest rate levels, inflation rate, and demand for money. The fifth C, which is character, encompasses personal factors such as honesty, integrity, and reliability. The borrower's risk attitude is an important element of this human factor considered in the loan decision-making process. If a borrower has a negative evaluation on this factor, the loan may be rejected even if the other four factors are acceptable.

### Explanation on Tobit

In a Probit model the variable of theoretical interest,  $y_i^*$ , is unobserved; what is observed is a dummy variable,  $y_i$ , which takes on a value of 1 if  $y_i^*$  is greater than 0, and 0 if otherwise. In contrast, Splett, et. al.[1994] devised what became known as the Tobit (Tobin's probit) or censored normal regression model for situations in which  $y_i$  is observed for values greater than 0 but is not observed (that is censored) for values of zero or less [37].

The standard Tobit model is defined as

$$\begin{aligned} y_i^* &= x_i \beta + \epsilon_i \\ y_i &= y_i^* \quad \text{if } y_i^* > 0 \\ y_i &= 0 \quad \quad \text{if } y_i^* \leq 0 \end{aligned} \quad (1)$$

where  $y_i^*$  is the latent dependent variable,  $y_i$  is the observed dependent variable,  $x_i$  is the vector of the independent variables,  $\beta$  is the vector of coefficients, and the  $\epsilon_i$ 's are assumed to be independently normally distributed:  $\epsilon_i \sim N(0, \sigma^2)$  (and therefore  $y_i \sim N(x_i \beta, \sigma^2)$ ).<sup>1</sup>

It should be noted that observed 0's on the dependent variable could mean either a "true" 0 or censored data. At least some of the observations must be censored data, or  $y_i$  would always equal  $y_i^*$  and the true model would be linear regression, not Tobit. Maximum-likelihood estimation of the Tobit model is straightforward. Let  $f(\cdot)$  and  $F(\cdot)$  denote the density function and the cumulative density function for  $y^*$ . Then the model implies that the probabilities of observing a non-zero  $y$  are  $f(y)$  and  $p(y^* < 0) = F(0)$ , respectively. The log-likelihood function for the model is therefore

$$\begin{aligned} \ln L &= \left( \prod_{y_i > 0} f(y_i) \prod_{y_i = 0} F(0) \right) \\ &= \sum_{y_i > 0} \ln f(y_i) + \sum_{y_i = 0} \ln F(0) \end{aligned} \quad (2)$$

because  $y^*$  is normally distributed (as the  $\epsilon$ 's are normally distributed),  $f(\cdot)$  and  $F(\cdot)$ , and, therefore, the log-likelihood function, can be re-expressed in terms of the

<sup>1</sup> Hereafter we omit subscripts where harmless

density function and the cumulative density function of the standard normal distribution,  $\phi(\cdot)$  and  $\Phi(\cdot)$ , and the log-likelihood function can be written in the familiar form:

$$\ln L = \sum_{y_i > 0} (-\ln \sigma + \ln \phi(y_i - x_i \beta)) + \sum_{y_i = 0} \ln \left( 1 - \Phi \left( \frac{x_i \beta}{\sigma} \right) \right) \quad (3)$$

Maximum likelihood estimation can then proceed in the usual fashion.<sup>2</sup>

To interpret the estimation results, the Marginal Effects (ME) of the independent variables on some conditional mean functions should be examined. In the familiar OLS model  $y = x + \epsilon$ , there is only one conditional mean function,  $E(y) = x$ , and  $ME(y)/Mx_k = \beta_k$ , where  $x_k$  is the  $k$ th independent variable. This makes interpretation easy:  $\beta_k$  measures the marginal effect on  $y$  of the  $k$ th independent variable. In the Tobit model, though, there are three different conditional means: those of the latent variable  $y^*$ , the observed dependent variable  $y$ , and the uncensored observed dependent variable  $y / y > 0$ . Accordingly, interpretation depends on whether one is concerned with the marginal effect of  $x$  on  $y^*$ ,  $y$ , or  $y / y > 0$ . Once the marginal effect that is of interest is determined, then the marginal effects of  $x$  on the appropriate conditional expectations are examined. The three marginal effect expressions are derived using standard results on moments of truncated/censored normal distributions [36] as follows:

$$\frac{ME(y^*|x)}{Mx} = \beta \quad (4)$$

$$\frac{ME(y|x)}{Mx} = \beta \Phi \left( \frac{x\beta}{\sigma} \right) \quad (5)$$

$$\frac{ME(y|y > 0, x)}{Mx} = \beta \left( \Phi \left( \frac{x\beta}{\sigma} \right) + \frac{x\beta}{\sigma} \phi \left( \frac{x\beta}{\sigma} \right) \right) \quad (6)$$

where

$$\phi(\cdot) = \frac{1}{\sigma} \phi \left( \frac{\cdot}{\sigma} \right), \quad \Phi(\cdot) = \int_{-\infty}^{\cdot} \phi(t) dt, \quad \text{and} \quad \phi(\cdot) = -\frac{d}{dx} \Phi(\cdot).$$

Clearly, only for the latent index  $y^*$  can  $\beta$  be interpreted as the marginal effects of the independent variables.<sup>4</sup>

To reiterate, the standard Tobit model assumes, among other things, that the dependent variable is censored at zero. *If no censoring has occurred or if censoring has occurred but not at zero, then the standard Tobit specification is inappropriate.* For example, Mabawonku and Olomola clearly warned against using the Tobit model

<sup>2</sup> The model is described in most econometrics texts e.g. Green (1997). The purpose here is to highlight its most essential aspects.

<sup>3</sup> Equation (5) can be decomposed into two parts for ease of interpretation (McDonald and Moffitt 1980). Roncek (1992) provides an example.

<sup>4</sup> There can be cases in which the mean of the latent  $y^*$  is of central interest, but when the data are censored the mean of the observed  $y$  is usually of greater interest.

when no censoring has occurred [7]. One might, for example, consider using a Tobit model to study lending decisions in agricultural institutions. In a situation where the institution decides on how much it prefers or wishes to give an applicant then the data configuration can be modelled via Tobit, for the lending institution might wish that it could make a “negative response” to an unworthy candidate by not giving him any amount. In that case the underlying propensity to lend to a particular candidate can be imagined to include negative as well as positive values, with  $\text{N0}$  representing a censored negative observation.

### The conceptual model

To determine the effect of various explanatory factors on loan approval as well as the extent of determining the loan size upon approval, this study follows from Gustafson [24], Ladue, et. al. [33], Shively [39] [24, 38, 39]. Loan approval decisions are assumed to be based upon the strength of feeling of the  $i^{\text{th}}$  lender to approve the loan. According to Gustafson [24], agricultural officers are assumed to make loan approval decision based upon an objective of utility maximization. If  $j$  represents various sizes of loan where  $j = 1$  for the large amount of loan and  $j = 2$  for the small amount of loan, then the non – observable and unavailable underlying utility function, which ranks the preference of the  $i^{\text{th}}$  lender, is given by  $\mu (M_{ji}, A_{ji})$ . Thus, the utility, derivable from the various sizes of loans approved depends on  $M$ , which is a vector of farm and farmer– specific attributes of the loan beneficiary and  $A$ , which is a vector of attributes associated with the sizes of loan obtained [36]. Although the utility function is unobserved, a linear relationship is postulated between the utility derivable from a  $j^{\text{th}}$  loan size and the vector of observed farm, farmer specific characteristics,  $X_i$  (farm size, age, gender, project type, experience of farmer), and the loan specific characteristic (small or medium, long term), project type specific characteristics (food crops, cash crops), institutional characteristics (extension contact), location specific characteristics (agro ecological zones) and a disturbance term having a zero mean,

$$e_{ji}: \quad \mu_{ji} = \quad iX_i + e_{ji} \quad j = 1,2: i=1, \dots,n \quad (15)$$

$$\text{and} \quad X_i = F_i(M_i, A_i) \quad (16)$$

Agricultural officers are assumed to approve a loan size that gives them the largest utility. Thus, equation 16 does not restrict the function  $F$  to linear, such that as the utilities  $\mu_{ji}$  are random, the  $i^{\text{th}}$  lender will select the alternative

$$j = 1 \text{ if } \mu_{1i} > \mu_{2i} \text{ or if the unobservable (latent) random variable} \\ Y^* = \mu_{1i} - \mu_{2i} > 0 \dots \quad (17)$$

Since the primary aim is to interpret the dependent variable in the model as the probability of making a choice, given information about  $X_i$  there is need to use some notion of probability as the basis of the transformation. This involves translating values of  $X_i$ , which may range over the entire real line, into a probability that ranges in value from 0 to 1. A monotonic transformation is also required since it is desirable that the transformation should maintain the property that increases in  $X_i$  are associated

with increases (or decreases) in the dependent variable for all values of  $X_i$ . The cumulative probability function provides a suitable transformation. This is defined as one having as its value the probability that an observed value of a variable  $X_i$  (for every  $X_i$ ) will be less than or greater than the threshold value. Since all probabilities lie between 0 and 1, the range of the cumulative probability function is the (0, 1) interval [11].

Hence, the standard cumulative normal distribution of  $X_i$  is expressed as:

$$F(X_i\beta) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Y_i} e^{-\frac{s^2}{2}} ds \quad (18)$$

Where,  $s$  = a random variable which is normally distributed with mean zero and unit variance. Thus, the probability that  $Y_i = 1$  (i.e. that the lender approves a loan) is a function of the independent variables:

$$P_i = P_r(Y_i = 1) = P_r(\mu_{1i} > \mu_{2i})$$

$$= P_r(\mu_{1i}X_i + e_{1i} > \mu_{2i}X_i + e_{2i})$$

$$= P_r[e_{1i} - e_{2i} > X_i(\mu_{2i} - \mu_{1i})]$$

$$= P_r(\mu_i > X_i) \quad \text{Therefore,} \quad P_i = P_r(Y_i = 1) = F_i(X_i) \quad (19)$$

Where;

$P_r$  = a probability function

$\mu_i$  = a random disturbance term  $(e_{1i} - e_{2i})$ ;  $\mu_i \sim N(0, \sigma^2)$

$X$  = the  $n \times k$  matrix of the explanatory variables

$\beta$  =  $k \times 1$  vector of parameters to be estimated

$F(X_i)$  = cumulative distribution function for  $\mu_i$  evaluated at

$X_i$ .

Thus, the probability that a lender will approve a certain loan size is a function of the vector of explanatory variables, the unknown parameters and the error term. However, equation (19) cannot be estimated directly without knowing the form of  $F$ . It is the distribution of  $\mu_i$  that determines the distribution of  $F$ . therefore, if  $\mu_i$  is normal,  $F$  will have a cumulative normal distribution [1].

The functional form of  $F$  (which is the decision component of the model) can be specified as a linear combination of observable explanatory variables as:

$$Y_i^* = X_i + \mu_i \quad (20)$$

This can be represented algebraically for the *i*th lender as:

$$Y_i = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \dots + \alpha_N X_{Ni} \dots \dots \dots; i = 1, 2, \dots, N$$

such that

$$Y_i = \begin{cases} 0 & \text{if } Y_i^* \leq T \\ Y_i^* & \text{if } 0 < Y_i^* < T \\ 1 & \text{if } Y_i^* > T \end{cases} \quad (i = 1, 2, \dots, n) \quad (21)$$

where,

- $Y_i$  = observed dependent variable e.g. the size of the loan approved by the *i*th lender.
- $Y_i^*$  = non- observable latent variable representing the continuous dependent variable when decision is made on the loan size. (example loan approved)
- T = non- observable threshold (cut- off) point
- N = number of observations.

Since the disturbance term,  $\mu_i$ , is a function of the independent variables, an attempt to estimate equation (21) using Ordinary Least Square (OLS) will result in biased and inconsistent estimates [7]. If  $Y_i^*$  is assumed to be normally distributed, then consistent estimates can be obtained by performing a Tobit estimation using an iterative Maximum Likelihood Algorithm [40]. The use of maximum likelihood estimation guarantees that the parameter estimates will be asymptotically efficient and the appropriate statistical tests can be performed. This means that all the parameter estimators are asymptotically normal, such that test of significance analogous to the regression t- test can be performed [11]. The likelihood function is of the form:

$$L = \sum_{t=1}^S \log [1 - F(\sigma Y_t - I_t)] + \sum_{t=S+1}^N \log f(\sigma Y_t - I_t) \quad (22)$$

Where  $F_i$  and  $f$  are the cumulative normal distribution function of  $\mu_i$ , and T is the critical (cut-off) value which translates  $Y_i^* > T$ , as lender approves, and  $Y_i^* \leq T$ , as lender rejects the loan application. The Tobit model [37], therefore, measures not only the probability that an applicant will be approved for loan but also the influence of the loan size if approved. Thus, equation 21 is a simultaneous and stochastic decision model. If the non-observed latent variable  $Y_i^*$  is greater than T, the observed qualitative variable  $Y_i$  that indexes approval becomes a continuous function of the explanatory variables and 0 otherwise (no approval).

**Decomposition of loan approval/ loan size**

The single- limit Tobit decomposition framework suggested by Barry and Ellinger [26] was used to assess strategies aimed at enhancing risk- averseness of the lenders in the study area. This was done by examining the effect of changes in variables of specific factors (i.e. farmer’s socio-economic specific, resource, security and institutional) on loan approval and the volume of loan. According to Tobin [31] the expected value of the dependent variable (Y) in the Tobit model is given by:

$$EY = X\beta F(z) + f(z) \quad (23)$$

Where  $z = \frac{X\beta}{\sigma}$  normalized index

$f(z)$  = standard unit normal density function

$F(z)$  = cumulative standard normal distribution function. The expected value of  $Y$  for observations above the limit,  $y^*$ , is  $X\beta$  plus the expected value of the truncated normal error term [42]:

$$\begin{aligned} E y^* &= E(Y|Y>0) \\ &= E(Y|\mu>-X\beta) \\ &= X\beta + f(z)/F(z). \end{aligned} \quad (24)$$

Thus, it was postulated that the basic relationship between the expected value of all observations,  $EY$ , the expected value conditional upon being above the limit,  $Ey^*$ , and the probability of being above the limit  $F(z)$ , is [41; 43]:

$$EY = F(z) \cdot E y^* \quad (25)$$

They employed a useful decomposition of these marginal effects under the single-limit Tobit, which can be extended to the two-limit situation. Thus for a given change in the level of specific characteristics in the loan approval decision model (equation 21), the effects on lenders decision behaviour can be disaggregated into two parts; by differentiating equation (25) with respect to specific factor change:

$$EY / X_i = F(z) (E y^* / X_i) + E y^* (F(z) / X_i) \quad (26)$$

Equation (20) can be converted into elasticity forms by multiplying through by  $X_i/EY$ :

$$(EY / X_i) X_i / EY = F(z) (E y^* / X_i) X_i / EY + E y^* (F(z) / X_i) X_i / EY$$

Rearranging according to equation (10):

$$(EY / X_i) X_i / EY = (E y^* / X_i) X_i / EY + (F(z) / X_i) X_i / F(z) \quad (27)$$

Therefore, the effect of a change in an independent variable,  $X_i$ , on  $E(Y_i/X_i)$  in elasticity form comprises two effects: (i) the change in the elasticity of the probability of approving loan (effects of the probability of being above zero), (ii) the change in the elasticity of determining the loan size, for those farmers whose loan have been approved (effects conditional upon being above zero). The relative magnitudes of these two quantities are an important indicator with substantive economic implications [37]. It should be noted that Tobit beta ( $\beta$ ) coefficients do not measure the correct regression coefficients for observations above the limit as the effect of a change in  $X_i$  on  $Y^*$  is not equal to  $\beta_i$  [41]. The estimated coefficient vector  $\beta$  is simply the marginal effect of the independent variables on the latent variable  $y^*$  (not the observed  $y$ ). This can be shown following from equation (24):

$$E y^* / X_i = \beta_i + (f(z)/F(z)) \frac{f(z)}{X_i} - (f(z)/F(z)^2) F(z) / X_i \quad (28)$$

Thus, the effect of a change in  $X_i$  on  $y^*$  is not equal to  $\beta_i$  (equation 23). This is true only when  $X = \mu$ , in which case  $F(z) = 1$  and  $f(z) = 0$ , which will of course not hold at the mean of the sample or for any individual observation [44].

## METHODS

The study was conducted in Oyo and Ondo states of south-western Nigeria. Agriculture is the main traditional occupation of the people and small-scale traditional farming dominates the scenes. The study was conducted on some selected credit institutions in the chosen states. These are the Commercial banks viz: First Bank of Nigeria Plc and Union Bank of Nigeria Plc. The selected banks were preferred because they are actively partaking in Agricultural Credit Guarantee Scheme (ACGS) coordinated by the Central Bank of Nigeria (CBN) [45]. Multi-stage sampling technique was used to select the respondents. Firstly, Oyo and Ondo States were purposively selected because they had higher number of the banks' branches with high number of agricultural loan applicants. The lists of the applicants were collected from each of the state offices of First Bank of Nigeria and the Union Bank of Nigeria. During the second stage, six branches were purposively chosen for each institution based on the concentration of the applicants. While in the third stage, the lists collected from each bank officials were stratified into two: those whose applications were approved and those whose applications were not approved. Finally, in the fourth stage, having found that the average number of applicants for each branch was 250 during the preliminary survey period, 10 % of the number that is, 25 applicants (consisting of 12 beneficiaries and 13 non - beneficiaries) were randomly selected from each branch of the two banks. Eighteen agricultural officers were interviewed for the purpose of the study. Therefore, 25 multiplied by 12 = 450 made up the sampling size for the applicants while 12 multiplied by 18 = 216 made up the sampling size for loan beneficiaries. The study made use of primary data which were collected between August and November 2008 to accomplish the objectives. The data for this study contained the 2006/2007 production year. The survey was implemented by the author and well trained enumerators. For the year under study, a total of 270, and 280 farmers' applications were received by First Bank of Nigeria and Union Bank of Nigeria, respectively.

### Data Analysis

Data were analysed using descriptive statistics and Tobit regression technique. Descriptions, measurement and expected signs of variables for Tobit regression analysis on loan approval.

Eleven variables were proposed and reasons for their inclusion offered. The expected signs of their coefficients were predicted *a priori* based on past studies, economic theory, and/ or logical reasons.

$$APVL(Y) = \beta_0 + \beta_1 \text{SEX} + \beta_2 \text{EDUC} + \beta_3 \text{FRMEXP} + \beta_4 \text{HHZE} + \beta_5 \text{FRMZSE} \\ + \beta_6 \text{NFI} + \beta_7 \text{PVSLOAN} + \beta_8 \text{COLLA} + \beta_9 \text{SAVGS} \\ + \beta_{10} \text{PSVRISK} + U \dots \quad (29)$$

where

$$APVL(Y) = \begin{cases} \frac{\text{Value Obtained}}{\text{Value of Loan requested}} \times 100 & \text{if } \text{Value Obtained} > 0 \\ 0 & \text{if otherwise} \end{cases}$$

The dependent variable APVL: This is a continuous variable for the  $i^{\text{th}}$  lender. It is the loan approval /non-approval for the applicants. It is a dummy variable with a lender being scored the proportion of loan approval index, if loan is approved, and zero if otherwise. The sizes of loan approved made the variable a continuous one. The time-frame of data to be used for the model is between the production periods of 2006-2007. It is hypothesized that this decision is influenced by the independent variables.

***The farmers’ socio-economic characteristics***

SEX = Gender of farmer. Dummy: Male = 1, Female = 0

EDUC = Educational level (years). The maintained hypothesis is that educational level is positively related to loan approval.

FRMEXP = Farming experience (years). The variable is expected to have positive relationship with the loan approval.

***Resource characteristics***

HHZE = Household size (No). It is difficult to predict this variable *a priori*. The number of persons in the household measures the variable.

FRMZE = Farm size (hectares). The variable is expected to have positive relationship with the loan approval.

NFI = Net farm income (Naira). The variable is expected to have positive relationship with loan approval as the farmer uses the loan to increase net farm income.

PVSLOAN = Previous Loan collected. The variable is expected to have a positive relationship with the loan approval/loan size. It is a dummy variable, with good performance scored 1, otherwise scored zero.

***Institutional specific characteristics***

COLLA= Collateral. Dummy 1=adequate, 0 = if otherwise.

SAVGS =Amount of Savings (Naira). Amount of savings variable has a positive relationship with the loan approval.

***Environmental characteristics***

PSVRISK =Perceived Risk of the Project. Dummy 1= low risk, 0= otherwise.

U = Error Term.

**RESULTS**

A summary of the socio-economic characteristics of the sampled respondents in the study area is shown in Table 1. The respondents’ ages varied between 25 years and 69 years with a mean of 50.5 years for all the respondents. Respondents’ distribution



according to sex showed that about 94.7 % of the respondents were male while the other 5.3 % were female.

It was shown in Table 1 that the average size of land cultivated by the respondents was 5.76. The mean year of schooling was approximately 6.0 and 8.0 years for First Bank of Nigeria and Union Bank of Nigeria applicants, respectively.

The difference between the means of household size of the both institutions is not statistically significant at the 5 % level in the study area. The experience of a farmer shows how exposed he is to various difficulties and problems involved in farming and his ability to gain mastery over them; this could help the farmer in proper loan management or utilization. The difference between the mean years of farm experience was not statistically significant at 5 percent level. The average non-farm income earned by the beneficiaries in the study area was ₦36,697 per annum. This may provide an alternative source of fund for use on their farms. It also shows that farmers in the study area did not depend solely on their farm income to earn a living.

The Tobit regression estimates for the pooled data were shown on Table 2. The significant (positive) coefficients for the pooled data were of the variables FRMZE, COLLA, PVSLOAN and SAVGS. The non-significant coefficient of the variable FRMZE showed negative sign while those of HHZE, EDUC, SEX, NFI and RISK indicated positive signs.

In the model observed in Table 3, the total elasticity value of FRMZE is -1.2485 divided into 0.4258 for the elasticity of loan size and 0.4526 for the probability of loan approval.

## DISCUSSION

The mean age recorded for each category of respondents suggests that middle-aged farmers who are expected to be economically active dominated the sampled population. They should be willing to explore avenues and adopt new methods in order to raise their level of productivity. Most or nearly all-agricultural activities are believed to be tedious and energy draining by most of the surveyed women and therefore left for men that are believed to be able-bodied while women claimed to be weak and fragile [46].

The relatively large farm sizes owned by the applicants indicated that it is one of the major criteria for giving loans to the farmers; hence those with very small farm sizes may not have access to loan from the two institutions. The difference between the average farm cultivated by First Bank of Nigeria and Union Bank of Nigeria applicants in the study area is statistically significant at 5 % with the t value of 2.27. The implication is that those with larger farm size will have better chances of being given the loans.

The educational attainment of a farmer does not only raise productivity but also increases ability to appreciate the essence of credit and also understand and evaluate the information on new techniques and processes disseminated through extension agents.

It was shown that a relatively large number of applicants in the study area were literate. The difference between the mean levels of education between the institutions is statistically significant. This implies that the educational status of the institutions differs.

The high household size in the area suggests a major source of farm labour which is consistent with the fact that household members constitute an important source of labour force required for farm work in a typical rural agrarian population structure in developing counties such as Nigeria and at the same time increases the consumption pressures which may have negative impact on the loan collected, that is, loan divergence for domestic uses.

Findings from the study indicated that the mean net farm income for the beneficiaries was ₦28, 400. The difference between the mean amounts spent by the two institutions beneficiaries was statistically significant at 5% level. This implies that the Union Bank of Nigeria beneficiaries spent more money before obtaining their loan; this may be due to larger amount obtained by Union Bank of Nigeria beneficiaries than those of First Bank of Nigeria counterparts.

Using the Limdep software package, Tobit regression analysis showed that most of the coefficients are consistent with hypothesized relationships, and their tests of significance help to indicate their importance in explaining approval decisions of the institutions. The variables used in the models include the following HHZE; FRMEXP; EDUC; FRMZE; SEX; COLLA; RISK; NFI; PVSLOAN AND SAVGS representing household size, farm experience, education, farm size, sex, collateral, perceived risk, net farm income, previous loan and savings, respectively. Some of the coefficients were significantly different from zero at the 0.1, 0.01 and 0.05 levels of significance while the coefficients of other variables were, however, not significant at these levels but were included based on logical and *a priori* theoretical considerations rather than statistical considerations. The positive coefficient of HHZE indicated that high farm assistance was received from respondents' wife, children and other relations who positively influenced the implications for family labour and cultivation of large area of land and eventually influenced the approval decision. The coefficient of NFI positively influenced the loan approval decision since the farmer can expand his options to acquire more loans and use for profitable ventures since this variable is viewed as a proxy for wealth, thus the beneficiary will have sufficient resources to absorb the cost and risk of failure in their agricultural enterprises. The major significant variable common to the two institutions was the PVSLOAN, which was significant (positive) at 0.01 and 0.05 levels. This indicated that loan beneficiaries of the two institutions have good credit records.

Table 3 implies that an additional increase in the hectares of land for the applicant will increase the probability of been chosen for approval, since additional hectares of land might not necessarily increase the borrowers proceeds. This shows the importance of land in agricultural development. Less than 50 % of the country's cultivable agricultural land is under cultivation. Even then, smallholder and traditional farmers who use rudimentary production techniques, with resultant low yields, cultivate most of this land. They are constrained by poor infrastructure, inadequate access to market, land and environmental degradation. A series of introduced programs such as the farm settlement scheme, the national Agricultural Land Development Authority and the River Basin Development Authority have not been able to unlock this constraint. In fact, population growth has led to a high level of land fragmentation due to fixed nature of land. The land use decree of 1978 has not fully addressed the issue, hence the persistence of the land tenure problem. Added to this is the gender discrimination in respect of land holdings in most communities where women do not have ownership rights over land, although they may have user rights.

The HHZE of the applicant is estimated to increase the total elasticity by 0.05, decomposed into 0.02 for the elasticity of approval probability and 0.03 for the elasticity of expected loan size which means that additional number of children will probably increase the chances of loan approval since additional member increases the availability of labour. The total elasticity of NFI and PVSLOAN are 0.59 and 0.86 decomposed into 0.28 and 0.39 for the elasticity of approval probability and 0.31 and 0.47 for the elasticity of expected loan size respectively. Increase in the net farm income will increase the probability of approval by 28 percent. The total elasticity of the RISK was - 0.79, decomposed into -0.36 for the elasticity of approval probability and - 0.43 for elasticity of loan size. COLLA is an important instrument for all agricultural credit transactions for ensuring credit availability for agricultural purposes and mitigating the chronic problem of loan default. A National Agricultural Insurance Company was established in 1987 to operate and administer the Nigerian Agricultural Scheme. A 10 % increase in the RISK variable will lead to a total elasticity change of about -0.79 percent. This indicates that the elasticity of probability of loan approval will decrease by about 0.36 % elasticity of expected loan size will decrease by 0.43 percent. The result tends to imply risk-averseness of the lenders, as fewer loans are granted. In each of the two institutions, the marginal changes in most of the variables considered increased the probability of loan size influence than it increased the probability of approval.

## CONCLUSIONS

The principal objective of this paper was to examine the agricultural lending process using set of decision variables, the farmer's socio-economic characteristics, resource characteristics, institutional specific characteristics and institution specific characteristics. The study discovered that institutional, environmental and part of the resource variables were important determinant factors of loan approval probabilities. However, demographic and household size variables were not significant in the models, hence evaluation of loan applications should not be based on traditional forms

of bias against gender, age or families with many children. As the results of the analysis indicated these variables however, were totally insignificant. Farm size has a positive significant effect on the probability of approval. This may be because land provides collateral for low-income household.

According to Shively [39], farm size may be proxy for lower risk exposure, fewer liquidity constraints or improved access to resources by borrowers. In a nutshell, the analysis presented in this report supports the overall conclusion that the two credit institutions have been partially handicapped by inadequate financial resources with the result that only a tiny percentage of total loans applied for by farmers have actually been met. Thus, they have limited types of enterprises, regularity and timeliness in providing for the needs of the enterprises. With this study an important insight is provided into the interaction among a more complete set of decision variables for agricultural lending than is normally accorded in agricultural finance literature.

The fact that the study confirmed the significance of loan disbursement lag in reducing repayment ability points to the crucial importance of timeliness in loan negotiation and delivery. When loan delivery misses the critical period of use, there is the tendency that such a loan would be diverted to relatively less productive or utterly unproductive activities. Thus, the study strongly suggests that problems of inadequate skill personnel, bureaucratic procedures, and stringent conditions for fulfilment prior to disbursement and instalment disbursement, which are always sources of delay, must be eliminated to allow the credit market to function effectively. Hence, there should be timely release of capital allocations, bearing in mind that agricultural activities are exceedingly time specific.

In order to reduce the time lag between loan application and the release of funds, it is recommended that power be delegated to Zonal Officers to grant credit to small farmers directly and huge amount (>K 250,000) need be referred to the headquarters. In addition, there is need for the modification of the credit delivery system to include the cooperative and community based organizations as delivery channels to reduce transactions. The results strongly suggest that institution characteristics such as collateral and savings, environmental characteristics such as perceived risk and farm size variables should always be considered in evaluating the determinants of loan approval decision. Such variables will enrich the set of factors conventionally used in decision-making process. The positive significant influence of farm size (which can be used as a proxy for scale of operation) on the probability of approval calls for the government revisitation to the Land Use-Decree and the National Agricultural Land Development Authority (NALDA) as vehicles for land re-distribution to the farmers. It is also necessary for the government to encourage expansion in the scale of operation of the farmers.

**Table 1: Descriptive Statistics of the Sampled Farmers in the Study Area**

Variable	Mean values for overall applicants N=450
Age	50.5
sex	
Male	94.5
Female	5.3
Farm size (FRMZE)	5.76
Education (EDUC)	6.6
Family size (HHZE)	7.8
Farming experience (FRMEXP)	20.7
Farm income (FI)	₦36, 697
Net farm income (NFI)	₦28, 400
Cost of Obtaining loan (COT)	₦ 5,457.08

**Table 2: Tobit Parameter Estimates of Loan Approval Decision for the Applicants**

Variables	Normalized Coefficients	Standard Error	Asymptotic t – ratio
Constant	-0.8597	0.3129	-2.747
HHZE	0.0075	0.0314	0.239
FRMEXP	0.0032	0.0064	-0.500
EDUC	0.0061	0.0085	0.718
FRMZE	-0.1623	0.0191	-8.497*
SEX	0.1325	0.1181	1.122
COLLA	0.8704	0.1212	7.182***
RISK	0.6726	0.0897	0.749
NFI	0.6615	0.9684	0.683
PSVLOAN	0.6840	0.0869	7.365***
SAVGS	0.5211	0.4822	1.081*

\*\*\*Significant at 0.01 levels

\*Significant at 0.10 levels

Log - likelihood Function = -91.44385

The predicted probability of Y > Limit given average var. (i) = 0.5453

The observed frequency of Y > Limit = 0.0143

Mean square error = 39.37334

Standard error of estimate = 15.754

Limit observation = 216

Non- limit observation = 450

COLLA (Collateral)

PSVLOAN (Previous loan)

SAVGS (Savings)

**Table 3: Elasticity of the Expected Loan Approval**

Variable	Elasticity of		
	Probability of Approval	Expected Value of Loan	Total Elasticity
HHZE	0.0149	0.0361	0.0510
FRMEXP	-0.0893	0.0867	0.1760
EDUC	-0.0447	-0.0429	-0.0876
FRMZE	-0.4349	-0.8136	-1.2485*
SEX	0.3170	0.2571	0.5741
COLLA	0.4526	0.4258	0.8784**
RISK	0.3593	0.4310	0.7903**
NFI	0.2793	0.3131	0.5924**
PVSLOAN	0.3921	0.4734	0.8655*

\*\*Significant at 0.01 levels

\* Significant at 0.05 levels

## REFERENCES

1. **Rahji MAY** An analysis of the Determinants of Agricultural Credit Approval/Loan Size by Commercial Banks in Southwestern Nigeria Journal of Nigerian Development Studies 2000; **1**: 6-25.
2. **Plata V and GN Nartea** Credit analysis procedures of rural lenders in Canterbury Paper presented at the 5th Annual Conference of the New Zealand Agricultural and Resource Economics Society (Inc.) 1998.
3. **Khalily MA and R Meyer** The Political Economy of Rural Loan Recovery: Evidence from Bangladesh". Savings and Development 1993; **17(1)**: 23-38.
4. **Oluwasanmi HA and JA Alao** The Role of Credit in the Transformation Traditional Agriculture: The Western Nigerian Experience. Nigerian Journal of Economic and Social Studies 1965; **7(1)**: 31- 50.
5. **Oluwasanmi HA and JA Alao** The Role of Credit in the Transformation of Traditional Agriculture: the Nigerian Experience. Bulletin of Rural Economics and Sociology 1964; **1**: 42-58.
6. **Olomola AS** Dimensions of Institutional and Policy Deficiencies in the Nigerian Agricultural Credit System". Development Policy Review 1989; **7(2)**: 169-181.
7. **Mabawonku AF and AS Olomola** Monetary and Fiscal Policies in Nigeria, 1970-1985: Some Implication for Agricultural Development". Savings and Development Quarterly Review 1988; **12(4)**: 343-362.
8. **Olomola AS** Agricultural Finance. In AO Phillips and S Tunji Titilola (Ed). Nigeria in 2010. NISER, Ibadan. 1997: 51-62.
9. **Central Bank of Nigeria.** Agricultural Credit Guarantee Scheme Fund; Annual Report and Statement of Account, 1989 and 1990, CBN, Lagos, Nigeria.
10. **Armah B and TA Park** Agricultural Bank Efficiency and the Role of Managerial Risk Preference. Paper Presented at the American Agricultural Economics Association Annual Meeting, August 2- 5, Salt Lake City, Utah. 1998:1-16p.
11. **Osuntogun CA** The Impact of Specialized Small Holder Credit Programmes on Farmers Beneficiaries. A case study of First Bank of Nigeria." African Review of Money Finance and Banking 1997; **1**:35-36.
12. **Olomola AS** Credit Control Policies for Improved Agricultural Financing in Nigeria: Panacea, Placebo or Structural Bottleneck?". African Review of Money, Finance and Banking. 1991; **1**: 23-28.



13. **Rao BP** The Economics of Agricultural Credit Use in Brazil”. Unpublished Ph. D Thesis, Ohio State University, Ohio, USA 1970.
14. **Singh WA** The Role of Credit in Agricultural Development: A Case Study of a Backward Indian District, Surendranager (ANVESAK). Journal of the Sardar Patel Institute of Economics and Social Research, 1977; **3(1)**: 15- 32.
15. **David CC and RL Meyer** Measuring the Farm Level Impact of Agricultural Loans In Pischke et. al. (eds.). Rural Financial Market in Developing Countries: Their use and abuse. 1983: 84– 97. New York: Macmillan.
16. **World Bank.** Nigeria in the Midst of Plenty: The Challenge of Growth and Inclusion”. Report N014733 UNI. The World Bank. Washington D.C. 1996; 25-32.
17. **Siles M, Hanson SD and LJ Robison** Socio Economics and the Probability of Loan Approval Review of Agricultural Economics 1994; **16 (2)**: 363-372.
18. **Ladman R and DW Adams** The Rural Poor and the Recent Farm and Operator Characteristics and the Perception of Erosion. Land Economics. 1978; **65**:167-182.
19. **Turvey CG** Credit Scoring for Agricultural Loans: A Review with Applications. Agricultural Finance Review 1991; **51**:43-54.
20. **Osayemeh RKO** Practice of Banking Collins publishers London 1986; **2**: 25-30.
21. **Wu C and XM Wang** A neural network approach for analyzing small business lending decisions Review of Quantitative Finance and Accounting, 2000; **15(3)**: 259-276.
22. **Edwards S** LDC Borrowing and Default Risk: An Empirical Investigation. American Economic Review 1984; **74**:726-734.
23. **McDonald JF and RA Moffit** The Uses of Tobit Analysis. Review of Economics and Statistics 1980; **62**:318- 321.
24. **Gustafson CR, Bayer and DM Saxowsky** Credit Evaluation Investigating the Decision Process of Agricultural Loan Officers.” Agricultural Finance Review, 1991; **51**: 55-63.
25. **Ellinger PN, Splett NS and PJ Barry** Consistency of Credit Evaluations at Agricultural Banks. Agribusiness: An International Journal 1992; **8**:43-56.
26. **Barry PJ and PN Ellinger** Credit Scoring, Loan Pricing, and Farm Business Performance. Western Journal of Agricultural Economics 1989; 14:45-55.

27. **Dunn DJ and TL Frey** Discriminant analysis of loans for cash grain farms. *Agricultural Finance Review* 1976; **36**: 60–66.
28. **Turvey CG and A Weersink** Credit - Risk and the Demand for Agricultural Loans *Canadian Journal of Agricultural Economics* 1997; **4**: 201 – 217.
29. **Altman EI, Glancario M and F Varetto** Corporate distress diagnosis: comparisons using Linear discriminant analysis and neural networks (The Italian experience)", *Journal of Banking and Finance*, 1994; **18**: 505–529.
30. **Barney DK, Graves OF and JD Johnson** The farmers home administration and farm debt failure prediction", *Journal of Accounting and Public Policy*, 1999; **18**:99–139.
31. **Tobin J** Estimation of Relationship for Limited Dependent Variables. *Econometrica*:1958; **26**: 29- 39.
32. **Turvey CG and R Brown** Credit scoring for a federal lending institution: the case of Canada's farm credit corporation", *Agricultural Finance Review* 1990; **50**: 47–57.
33. **LaDue EL, Lee WF, Hanson SD and DM Kohi** Credit Evaluation Procedures at Agricultural Banks in the Northeast and Eastern Cornbelt Development of Agricultural Economics Research Report 92-93 Cornell University1992.
34. **Lee TH and SC Jung** Forecasting creditworthiness: logistic vs. artificial neural net", *Journal of Business Forecasting*, Winter 1999: 28–30.
35. **Featherstone AM, Roessler LM and PJ Barry** Determining the Probability of Default and Risk Rating Class for Loans in the Seventh Farm Credit District Portfolio. *Review of Agricultural Economics* 2006; **28**: 4-23.
36. **Gustafson CR** Credit Evaluation: Monitoring the Financial Health of Agriculture." *American Journal of Agricultural Economics* 1989; **71**:1145-1151.
37. **Splett NS, Barry PJ, Dixon BL and PN Ellinger** A Joint Experience and Statistical Approach to Credit Scoring." *Agricultural Finance Review* 1994; **54**:39-54.
38. **LaDue EL, Lee WF, Hanson SD and DM Kohi** Credit Evaluation Procedures at Agricultural Banks in the Northeast and Eastern Cornbelt Development of Agricultural Economics Research Report Cornell University 1992: 92-93.
39. **Shively GE** Consumption Risk, Farm Characteristics and Soil Conservation Adoption among Low-Income Farmers in the Philippines. *Agricultural Economics* 1997; **17**: 165-177.

40. **Vogel RC** Rural Financial Market Performance: Implication of Low Delinquency Rates". American Journal of Agricultural Economics, 1981; **63(1)**: 58-62.
41. **Maddala GS** Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press, New York. 1983.
42. **Amemiya T** Tobit Models: A Survey. Journal of Econometrics. 1984; **24(1)**: 3-61.
43. **Adesina AA and MM Zinnah** Technology Characteristic, Farmers' Perceptions and Adoption Decisions: A Tobit Model Application in Sierra Leone. Agricultural Economics, Elsevier Science Publishers B. V., Amsterdam. 1993; 297-311.
44. **Judge GG, Griffiths WE, Hill RC, Lutkephol H and TC Lee** Introduction - to the theory and practice of econometrics. 2<sup>nd</sup> ed. New York, Wiley. 1988.
45. **Banking and Finance Digest** Overview of Nigerian Agriculture. Macmillan Ibadan. 2002; **3 (5)**: 106- 107.
46. **Bamire AS** Factors Influencing the Adoption of Fertilizer Technology in Osun State of Nigeria. Unpublished Ph. D. Thesis, Department of Agricultural Economics, O.A.U., Ile Ife. 1999: 17-25.